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IDENTIFYING PRO-POOR IRRIGATION INTERVENTIONS FOR IRRIGATED AGRICULTURE IN ASIA

PRESENTATION DES PROJETS DE LUTTE CONTRE LA PAUVRETE POUR L'AGRICULTURE IRRIGUEE EN ASIE

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ABSTRACT

This paper reports interim results from ongoing research for the ADB funded research project "Pro-Poor Intervention Strategies in Irrigated Agriculture in Asia." This project has the objective of identifying, testing, and promoting potential interventions in irrigated agriculture with the specific intent of alleviating poverty. This undertaking is motivated by the intense efforts of international development agencies and donors to find means to more effectively alleviate poverty. In this regard, research efforts being undertaken seek to maximize participation of the stakeholders, so as develop interventions that are widely acceptable and effective. This effort is additionally guided by the understanding that development within irrigation is going to mainly target improving management as construction of new systems has extremely limited potential. This is despite the existence of persistent poverty in many rural areas. Therefore, it is of the highest importance to develop interventions that recognize the constraint that irrigation faces, are based on proven linkages between irrigation and poverty, thoroughly understand the nature of poverty, and are widely and enthusiastically accepted.

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The paper examines the co-topics of poverty and irrigation. The paper contributes to the growing efforts to devise workable solutions to improve the often poor performance of irrigation systems as one component of the global effort to alleviate poverty. The paper develops a conceptual model of the temporal and spatial patterns of poverty within an irrigation system. The conceptual model serves the analyst in mapping poverty so research (and intervention) can be effectively targeted to the poor. Furthermore, the spatial and temporal model provides criteria against which proposed interventions can be tested. The paper, secondly, develops a conceptual approach to studying the linkages between irrigation and poverty. This framework was developed as a guide for research conducted for the "Pro-Poor Intervention Strategies in Irrigated Agriculture in Asia." However, the conceptual framework provides an additional benefit of allowing researchers, decision makers, and other stakeholder to more easily grasp the complexities of the poverty-irrigation link. This conceptual develop also provides a set of criteria against which proposed interventions can be tested.

The paper outlines current research regarding the institutional, economic, and legal issues related to irrigation and poverty. This activity is one of the core foundation study components for the larger study. By conducting this review of both theory and applied examples, lessons could be drawn regarding the conditions necessary for and the types of interventions that lead to successful improvement of irrigation management. The paper concluded by presenting a set of possible interventions and detailing how they can benefit the poor. Ongoing research will test these interventions for appropriateness and potential effectiveness. Future research under the project will ultimately devise specialized action plans to encourage the adoption of interventions that indicate positive impacts regarding irrigation performance and poverty alleviation.

RESUME ET CONCLUSIONS

Cet article présente les résultats du projet "Pro-Poor Intervention Strategies in Irrigated Agriculture in Asia" financé par la Banque Asiatique de Développement. Les principaux objectifs de ce projet sont l'identification, l'expérimentation et la promotion de méthodes d'agriculture irriguée, dans l'optique de combattre la pauvreté. Cette démarche s'inscrit dans la politique développée par les organismes internationaux de développement et les bailleurs de fond afin de trouver des solutions pour lutter le plus efficacement possible contre la pauvreté. Dans cette optique, les recherches entreprises essayent d'impliquer les populations concernées dans une approche participative acceptable et efficace. De plus, cet effort est basé sur la compréhension qu'une amélioration de la gestion des systèmes d'irrigation est plus efficiente que le développement de nouveaux systèmes. Il est très important d'intervenir en tenant compte, aussi bien des contraintes rencontrées, que des interactions entre l'irrigation et la pauvreté. Pour cela, la compréhension et l'acceptation du degré de pauvreté doivent être appréhender.

Cet article traite donc, à la fois, le problème de la pauvreté et de l'irrigation. Il contribue à la conception de solutions adaptées pour l'amélioration des performances, souvent faibles, des systèmes d'irrigation. Il développe un modèle qui intègre la distribution temporelle et spatiale de la pauvreté aux systèmes d'irrigation. Ce modèle aide les analystes à appréhender la répartition de la pauvreté afin d'orienter la recherche et les projets de développement vers les plus nécessiteux. Qui plus est, il permet d'évaluer et de tester les critères à prendre en compte pour l'application des recommendations. Ce cadre fut établis pour servir de référence à la conduite des recherches entreprises par le projet "Pro-Poor Intervention Strategies in Irrigated Agriculture in Asia". Il permet également aux chercheurs, décideurs et aux personnes concernées de mieux comprendre la complexité des interactions entre la pauvreté et l'irrigation.

Cet article donne un aperçu des recherches actuelles, tout en prenant en compte le contexte institutionnel, économique et juridique lié à l'irrigation et à la pauvreté. Cette démarche est un des principaux composants nécessaires pour des études plus larges. Par l'approche qui combine le modèle et les exemples d'application, des conclusions peuvent être tirées pour améliorer la gestion des systèmes mis en place.

La conclusion de l'article présente les possibles recommandations et détaillent les avantages pour la population. Les recherches en cours vont permettre de tester ces recommandations et d'évaluer leur degré d'appropriation et d'efficiences par les populations. Les futures recherches mises en place dans le cadre du projet, vont permettre d'établir les directives pour l'amélioration des performances de l'irrigation et de la réduction de la pauvreté.

INTRODUCTION

This paper reports interim results of ongoing research for the "Pro-Poor Intervention Strategies in Irrigated Agriculture in Asia" funded by the Asian Development Bank (ADB). The goal of the study is to promote and catalyze equitable economic growth in rural areas through pro-poor irrigation interventions[4]. The objective of the study is to determine realistic options to improve the returns to poor farmers in the low-productivity irrigated areas within the context of improving the overall performance and sustainability in established irrigation schemes.

This paper presents some of the empirical evidences of the impacts of irrigation on poverty alleviation, including their spatial and temporal dimensions, following a conceptual model developed for the project. Then, the paper illustrates preliminary

4 Participating countries are Developing Member Countries (DMCs) of the ADB and include Bangladesh, China, India, Indonesia, Pakistan, and Vietnam.

findings regarding the available institutional, economic/ financial, and legal/ regulatory measures to improve irrigation management, along with their field performance and implications for poverty alleviation. Finally, a preliminary menu of pro-poor interventions that can ensure enhanced benefits to the poor while improving the irrigation system performance is presented.

BACKGROUND

Agriculture in developing Asia has made tremendous progress over the past three decades when cereal production more than doubled, thanks to increased irrigation coupled with increased availability of yield enhancing inputs, credits and other supporting services. Despite impressive achievements, the productivity of a large part of irrigation systems remains severely constrained by insufficiency of some or all of these inputs. Such low-productivity areas are characterized by persistent rural poverty, often exacerbated by other physical, economic, and socio-cultural constraints.

While the determinants of low productivity are numerous and complex, they are largely associated with poor performance of established irrigation systems[5] (Hussain and Biltonen, 2001). Institutional and managerial weaknesses, poor governance, and lack of funds for maintenance are causing the problems, rather than technical constraints, which could be addressed without large physical interventions but with greater cost-effectiveness benefiting the poor. However, little scientific knowledge exists on how a range of non-technical interventions such as economic, financial, institutional, and governance measures can most effectively contribute to more efficient and sustainable water use while substantially reducing poverty in these low-productivity irrigation systems. The study has been designed to address these questions.

LINKAGES AND DIMENSIONS OF WATER AND POVERTY

Poverty is a multidimensional concept that includes low and unstable levels of income and consumption, hunger and malnutrition, lack of resources to lack of education and poor health, and other social dimensions such as powerlessness, vulnerability, and social exclusion. At its most basic level, poverty can be characterized as the insufficiency of resources to survive. Water is only one of several

5 Examples of low-productivity irrigated areas in Asian developing countries include parts of both upper and lower Indus basin (in Punjab and Sindh Provinces of Pakistan); tail-end areas of large government-managed systems in several Indian states including the states of Bihar, Uttar Pradesh, Andhra Pradesh and Madhya Pradesh; northern and northeastern Bangladesh; northern uplands, north-central and central highland regions in Viet Nam; irrigation systems in Central Java and in some some of the outer islands in Indonesia; and northwestern part of the People's Republic of China including the provinces of Shaanxi, Gansu, Qinghai, Ningxia, and Xingjiang.

natural resources in a complex set of stocks of various resources upon which poor people depend. It would be naive to perceive that all rural poverty problems could be solved through water. However, as a basic necessity and a vital productive resource, access to water has the potential to significantly contribute to poverty alleviation through its direct and indirect linkages with other resources.

There are five key dimensions of how access to good irrigation water contributes to socio-economic uplift of rural communities. These are : production, income/ consumption, employment, vulnerability/food (in) security, and overall welfare/well-being.

In general, access to good irrigation water allows poor people to not only increase their production and incomes, but also enhance their opportunities to diversify their income base, and to reduce their vulnerability caused by seasonality of agricultural production and external shocks. It increases employment opportunities not only for landholders but also for the landless. Thus, access to good irrigation has the potential to contribute to poverty reduction, and to moving the poor from ill-being to well-being.

EVIDENCE OF IMPACT OF IRRIGATION ON POVERTY

Recent studies indicate that irrigation water allows poor producers to benefit from increased production and incomes, and poor consumers benefit from reduced prices resulting from overall increases in supplies of agricultural products. Table 1 provides recent evidence on cropping intensities and crop yields in irrigated and rain-fed agriculture in India, Sri Lanka and Vietnam. As is evident, both cropping intensities and crop yields are much higher in irrigated agriculture than in rain-fed systems.

Table 1. Cropping Intensity and Crop Yields in Irrigated and Rain-fed Systems in Selected Asian Countries (Part des terres cultivées et rendements pour les systemes agricoles sous pluies naturelles et les systèmes irrigués)

	Vietnam			India , Chhattisgarh			Sri Lanka		
	Rain-fed	Irri-gated	% diffe-rence	Rain-fed	Irri-gated	% diffe-rence	Rain-fed	Irri-gated	% diffe-rence
Cropping Intensity (%)	63	194	68	102	152	33	95	157	39
Rice Yield (t/ha)	2.78	4.81	42	3	4	25	3.2	4.5	40

Sources : Figures for Vietnam from Ut, Hossain et al, (2000) and India – Chhattisgarh from Janaiah, Bose et al, (2001). For Sri Lanka data based on IWMI survey in Ruhuna basin, 2001.

These factors translate into higher farm incomes contributing to improved livelihoods and reduced incidence of rural poverty in irrigated agriculture. Many studies have shown that irrigation has had significant poverty reduction impacts when properly managed. An example is provided by recent research led by IRRI in India, Philippines, Thailand and Vietnam which suggests that the incidence, depth and severity of income poverty, and level of income inequality are substantially lower in irrigated and agriculturally developed areas compared to rain-fed and less-developed areas, as shown in Table 2 (Thakur, et al., 2000; Janaiah, Bose et al, 2000; Hossain, Gascon et al, 2000; Isvilanonda, Ahmed et al, 2000; and Ut, Hossain et al, 2000).

Table 2. Recent evidence on incidence of income inequality and poverty in irrigated and rain-fed agriculture (Distribution des degrés de pauvreté et de revenus selon le type d'agriculture [irrigué ou non])

Country	Irrigated Agriculture			Rain-fed Agriculture		
	Head Count (%)	Poverty Gap (%)	Gini Con-centration Ratio	Head Count (%)	Poverty Gap (%)	Gini Con-centration Ratio
Vietnam (1996)	17.9	5.7	0.46	60.6	33.4	0.49
Thailand (1998)	20.8	10.8	0.53	55.8	31.8	0.61
Philippines (1997)	30.0	11.0	0.31	39.0	16.0	0.35
India-Bihar (1996)	34.3	10.0	0.29	65.7	33.4	0.40
India-Chhattisgarh (1996)	38.0	5.4	0.30	55.0	13.3	0.34

Source : Various articles from special issues of Economic and Political Weekly, 30 December 2000 including Vietnam - Ut, Hossain et al, (2000), Thailand - Isvilanonda, Ahmed et al, (2000), Philippines - Hossain, Gascon et al, (2000), India-Bihar - Thakur, Bore et al, (2000), and India - Chattisgarh- Janaiah, Bose et al, (2000).

Gini concentration ratio on income indicates concentration or level of skewedness of per capita income among various income groups, greater the value of Gini concentration ratio the greater the level of income inequality.

While the above evidence indicates that availability of irrigation water has substantial positive impacts on agricultural growth and poverty reduction, the actual distribution of benefits between the poor and the non-poor is often at issue in policy debates. In particular, impacts on the poor are generally perceived to be less, where there is unequal distribution of land, although there are certain indirect benefits such as multiplier effects on non-farm activities and increased employment opportunities. The study is also measuring these direct and rarely quantified indirect benefits, thereby identifying further opportunities and gaps to improve the pro-poor impacts of irrigation interventions.

SPATIAL AND TEMPORAL DIMENSIONS OF IRRIGATION AND POVERTY : MAPPING POVERTY

Identifying the poor, their locations, and temporal patterns in rural poverty is important for targeted interventions for effective poverty reduction. Most past work on irrigation and poverty has focused on static concepts, which can conceal spatial and temporal aspects of poverty. To overcome this shortfall, a conceptual model was developed that couples the spatial and temporal dimensions of poverty and irrigation and is presented in Figure 1. The horizontal axis represents the irrigation system with the arrow illustrating the flow of water from the head down to the tail reach. The rain-fed area relies on rain as its primary source of water. The vertical axis represents the time dimension and is characterized as either the wet or dry season. Based on the location and season timing each area is classified by the relative security of access to adequate irrigation water supplies.

Assumptions:

1. There is no good groundwater at tail reaches
2. There is no market town at tail reaches

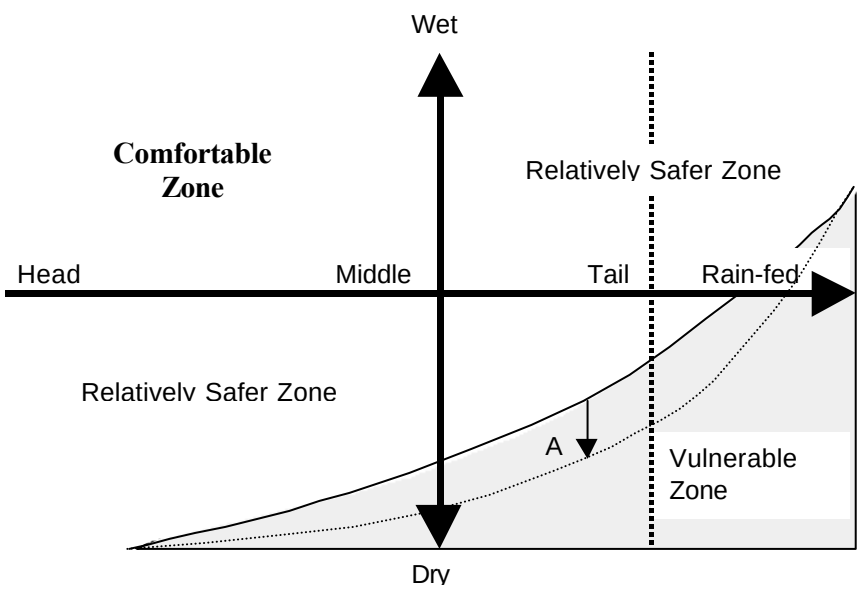

Figure 1. Spatial and Temporal Dimensions of Poverty and Irrigation (Visualisation spatiale et temporelle de la pauvreté et de l'irrigation)

Near the head of the irrigation system during the rainy season, a farmer is most likely to be guaranteed an adequate supply of water. This is because during the wet season surface water flows will be at their highest and because head-end farmers will

have first opportunity to take water. Farms located further down the irrigation system will experience diminished relative security of their access to irrigation water. The diagram presented illustrates that there are seasonal vulnerability patterns for access to irrigation water, as well as distinct spatial patterns. Policy interventions to alleviate the vulnerability, would attempt to reduce the vulnerability zone both in time and location, illustrated by the lower dashed curve.

TAIL END DEPRIVATIONS – CASE STUDIES FROM INDIA AND PAKISTAN

IWMI undertook detailed case studies in India and Pakistan to analyze canal water distribution across head, middle and tail reaches of canal systems and impacts on crop productivity. The study found significant inequity in distribution of canal water in both India and Pakistan, with tail reaches receiving less canal water than head and middle reaches (shown in Table 3). Except for one head watercourse in India, Gini coefficients for tail-end watercourses are higher than their respective head-end reaches indicating greater inequity. Additionally, wheat yields were higher in the head reaches, decreasing towards tail reaches for almost all watercourses (Table 4). Yield differences across watercourses are much higher than those within watercourses.

Results suggest that improvements in water management practices at the system level can contribute to increased yields and the overall profitability of wheat production. Most of the gains from reallocation will be achieved in tail-end reaches. Canal water reallocation of this type is, therefore, both productivity enhancing and pro-poor[6].

INTERVENTIONS FOR IMPROVING IRRIGATION SYSTEM PERFORMANCE AND THEIR PRO-POOR IMPLICATIONS

Over the last two decades, a variety of interventions have been proposed to improve management performance of irrigation. These may be classified as (i) institutional interventions; (ii) economic and financial interventions; and (iii) legal and regulatory interventions. This section reviews the conceptual framework of these interventions, their performance where applied, and implications in improving the pro-poor benefits.

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6 IWMI is undertaking a detailed study on spatial and temporal aspects of irrigation and poverty. Initial results suggest that canal command reaches with poorer quality groundwater and receiving less canal water are relatively poorer than those with good quality groundwater and/or receiving adequate amounts of canal water.

Table 3. Canal water use, Gini-coefficients and head-tail equity ratios across head, middle and tail reaches of four distributaries in India and Pakistan (2001) (Utilisation des eaux d'irrigation selon le coefficient de Gini et l'équité des ratios de répartition le long de 4 cours d'eau en Inde et au Pakistan)

Outlet / Distributary / Minor	Amount of canal water applied (m^3)	Gini Coefficient	Head-Tail equity Ratio
India			
Batta-Head	849	0.55	2.07
Batta-Middle	897	0.10	1.34
Batta-Tail	700	0.29	1.11
Rohera- Head	584	0.63	3.41
Rohera-Middle	148	0.78	11.46
Rohera-Tail	109	0.80	-
Batta – all	816	0.36	1.21
Rohera-all	282	0.75	4.64
Across all watercourses	550	0.29	1.72
Pakistan			
Lalian – Head	1500	0.29	1.47
Lalian – Middle	2745	0.20	0.67
Lalian – Tail	345	0.60	3.61
Khadir – Head	606	0.71	1.00
Khadir – Middle	600	0.62	1.17
Khadir – Tail	187	0.89	14.23
Lalian- all	1458	0.44	4.35
Khadir – all	465	0.74	3.24
Across all watercourses	980	0.42	3.90

Source: Hussain, Sakthivadivel et al, (forthcoming)

Note : All figures are based on actual field-level water measurements, 2000-2001

Table 4. Average wheat yields (t/ha) across distributaries and watercourses in India and Pakistan, 2000-2001 (Rendements moyens de blé selon la position des champs irrigués le long des cours d'eau en Inde et au Pakistan.)

India						
Location (Distributary/watercourse)	Batta			Rohera		
	Head	Middle	Tail	Head	Middle	Tail
Head	4.81	4.73	4.42	4.92	4.83	4.28
Middle	4.56	4.42	4.22	4.89	4.79	3.98
Tail	4.35	4.31	3.72	4.91	4.67	3.55
Average	4.57	4.49	4.12	4.91	4.76	4.04
Pakistan						
	Lalian			Khadir		
Head	5.18	4.02	2.96	4.56	3.00	4.51
Middle	4.92	3.31	3.01	3.32	3.51	4.57
Tail	4.79	4.5	3.59	4.22	3.62	4.69
Average	4.95	3.92	3.19	4.03	3.37	4.59

Source: Hussain, Sakthivadivel et al, (forthcoming)

Note : Yield data are based on crop cutting experiment 2000-2001

Institutional interventions

Participatory irrigation management (PIM)/irrigation management transfer (IMT) programs have been widely promoted. Management transfer programs assume that involving irrigators in decision making will lead to higher cost recovery, efficient operation and maintenance, and equitable allocation of limited irrigation water resulting in an improvement in system performance and also higher productivity of water (Vermillion, 1997). However, the success and benefits of PIM/IMT, other than the immediate relief to the public resources, are not always obvious. The following are some evidences gathered from recent studies concerning the impacts of institutional reforms.

(i) **Irrigation management reforms in Andhra Pradesh (AP), India** : AP has undertaken comprehensive institutional reforms comprising (i) establishment of water user associations (WUAs) with necessary legal framework; (ii) irrigation management transfer with massive rehabilitation campaign; (iii) rationalization of irrigation service fees; and (iv) capacity development of sector institutions. A recent study by Raju (2001) shows some of the key benefits such as increased irrigated areas, increased crop yields of 20-30 percent, and increased irrigated area in the tail ends by 10-20 percent. Additional benefits include drastically reduced irrigation-related complaints, increased access and flow of information, and empowerment of farmers and users.

(ii) **Irrigation management policy reforms in Progo Sub-basin, Java, Indonesia** : In Indonesia, IMT/PIM in medium to large scale irrigation systems was initiated in Kalibawang irrigation systems (in Yogyakarta province) in Progo Sub-basin. Papah irrigation scheme and Penjalin Irrigation scheme were handed over to farmer management in 1998. WUAs in these schemes are responsible for irrigation management at the secondary level, while also contributing funds for minor repairs at primary levels. The overall productivity in these schemes is reported to have increased, by as much as 1 t/ha, after the reforms. Fee collection rate is 100 percent, and the management transfer reform is generally considered a success.

(iii) **Development of participatory irrigation management in China** : In China's Hubei Province, management was transferred to farmer water user groups, who were responsible for local irrigation distribution networks. Water deliveries are charged by volume, so farmers in the WUAs have an incentive to use water more efficiently and less wastefully. Although, WUAs appear to have led to a reduction in water costs to farmers, only limited investigation has been undertaken of this area[7]. The introduction of WUAs seems to indicate improved frameworks for poverty reduction. A field study of WUAs in Longhui County, Southwest Hunan by Taylor (2001) suggests that the creation of WUAs has been important in ensuring a regular, guaranteed supply of water to farmers, who then allocate water equitably through the user associations. Furthermore, the operation of WUAs has been important in building capacity for increased farmer participation in decision-making.

These measures, mainly comprising management transfer of irrigation facilities to WUAs and installment of financial autonomy and accountability mechanisms within WUAs and external service delivery institutions, have increasingly been applied. However, their impacts on irrigation water use efficiency, equitability in distribution, and sustainability have not yet been well captured as yet. Recent IWMI research, which reexamined irrigation management transfer programs that were previously seen as successful, found the cases where they actually favor large farmers over small farmers (Van Koppen et al, 2001). Thus, the establishment of WUAs may simply serve to consolidate and formalize the influence and control of the irrigation system by a small number of large farmers (Shah, Hussain and Rehman, 2000). IWMI is currently undertaking in-depth studies on socio-economic impacts of reforms in the above and other schemes.

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7 For example, in WUAs visited in four counties in Hunan by a WB Mission in July, 2000, the cost of water to farmers had fallen on average from 40 to 32 *yuan* per *mu* since the setting up of the WUAs in 1996 (compared with no reductions in non-project villages).

Economic instruments

Economic instruments for managing water resources water charging/ pricing, which may be categorized into non-volumetric pricing (acreage pricing, input taxes, and output taxes) and volumetric pricing.

(i) **Acreage-based pricing** : Under acreage pricing, farmers are charged per unit of irrigated. While this is most widely applied, there are some drawbacks which prevent this instrument from promoting efficient and equitable distribution of water. First, the farmer does not get any incentive to economize the use of water in each plot. Second, in water scarce systems, farmers may not receive their allocated share in irrigation supplies, and, third, variations in water delivered to farm gate may result in significant yield variations and even crop failures. In these cases water distribution may not be efficient or equitable, and the farmer would be required to pay a charge, which might be unfair and highly inequitable. To cope with these drawbacks, fees may be adjusted to reflect the actual services provided, such as adjustments depending upon the type of crops, number of irrigation received, irrigation season of the year, and irrigation methods. Additional mechanisms would be required to secure stable benefits to the poor farmers who have limited access to land and water. However, these require effective monitoring and control mechanisms for water distribution, which are often lacking in many schemes.

(ii) **Input/output pricing** : Input pricing methods charge irrigators by imposing a tax on agricultural inputs. Here, irrigation charges are implicitly incorporated into the price of farm inputs. Input based irrigation charges may penalize the poor in instances of crop failure, although they will be less damaged if they use fewer inputs for subsistence farming. Output pricing methods charge irrigators a fixed fee per unit of output produced in lieu of irrigation charges. Output taxation may penalize poor farmers by taxing subsistence production, or reduce incentive to grow highly profitable, and taxable, cash crops: crop-switching may result in welfare loss.

(iii) **Volumetric pricing** : Volumetric pricing methods charge irrigators according to the actual volume of water supplied or diverted to the field. It achieves higher efficiency and cost recovery than other pricing options, but some practical issues and equity concerns arise. Practical issues of concern for operating this pricing method include installation of water meters, current water delivery systems, and valuing water. Seasonal variation of water availability may also affect its viability as in the case of acreage pricing, when temporal water scarcity would result in significant yield variations within the irrigation schemes, which may not be well-captured by measuring total volumes of water used during the irrigation season.

It is widely held that the price of water should reflect three cost components : supply costs, externality costs, and scarcity rents. The conventional approach advocates that water should be priced equal to its (long-run) marginal supply cost and is called marginal cost pricing. Marginal cost pricing would achieve high efficiency, and cost recovery provided transaction costs could be minimized, though equity may be negatively affected. When all costs, including external, are taken into account, then marginal cost pricing becomes opportunity cost pricing. The opportunity cost of water refers to the total economic value of the last unit of water to the society or the economic value foregone by the society by diverting additional cubic meter of water to irrigation from its next best use. Opportunity cost pricing would achieve first-best water allocations and system-wide efficiency. However, the amount of information required to estimate opportunity cost of water, and its equity implications, limits its practical implementation.

Financial instruments – Financial autonomy

Within the context of promoting efficient and sustainable water management, financial autonomy has been advocated by many as a pro-market intervention. User fees or irrigation charges can be used for raising revenue for covering capital and/or recurring cost of irrigation systems. Irrigation charges may restrict overuse of irrigation water and thereby enhance demand side efficiency. Supply side efficiency can be attributed to quality and quantity improvements arising out of greater accountability on part of the irrigation agency. The revenue raised by fees and charges will help to (i) ensure sustainability through sufficient O&M of the irrigation system; and (ii) contribute to improving the welfare throgh new undertakings to benefit heretofore non-irrigated areas and poor communities and thus help to reduce poverty and improve equity.

Svendsen (1993) analyzed the impact of financial autonomy on the performance of National Irrigation Systems (NIS), Philippines. The study showed that financial autonomy for the irrigation agency resulted in reduced operating expenses, harmonization of revenues and costs, and elimination of the recurrent cost burden on the national government. It also helped to improve timeliness and equity in distribution of water. However, Bruns (1993) argues that NIS need to do more to ensure user participation if full benefits of financial autonomy are to be realized. Komives (1999) emphasizes the need for elimination of policy and market distortions and provision of financial incentives to supply agencies to be able to serve the poor.

Regulatory and legal instruments

For an efficient and equitable allocation of water resources, the management efforts should be facilitated by appropriate legal and institutional mechanism. Especially, mechanisms should be geared towards achieving efficiency while ensuring sufficient pro-poor benefits and equity. Most of the existing water rights and

water laws are generally neither pro-market nor pro-poor; hence, they are in need of comprehensive reform.

(i) **Water rights** : In most developing countries, the existing water rights are based on riparian water rights, prior appropriation, and public allocation (Sampath, 1992; Holden and Thobani; 1996). Under the riparian system, the ownership of adjacent or overlying land determines the ownership and right to use water resources. Prior appropriation is based on actual water use over time ("first in time, first in right"). Under public allocation system, the government may allocate water resources among competing users through regulation and control.

Public allocation of water resources is accomplished through either optimal allocation or proportional allocation. Under optimal allocation, water is not priced rather it is allocated free among the farmers in a way so as to maximize total agricultural output. This mechanism results in efficiency loss and may even promote income inequality. Under proportional allocation, water allocation is proportional to the ownership of cultivated area within the command area (e.g., warabandi system). The proportional allocation system may not be fair to the poor because the poor may lack access (ownership) to the land, or may own fragmented plots. Rosegrant and Binswagner (1994) argue that tradable water rights are important for improving efficiency, equity and sustainability of irrigation resources.

(ii) **Water laws** : Ensuring efficiency, equitability and sustainability of water resources requires that national water laws be instituted to allocate water among the competing uses both inter-sectorally and inter-temporally. Water rights of the existing users must be protected against both the variations in quantity of water and deterioration in its quality in a local, regional, national, and global arena. In particular, rights to the poor deserves particular attention because they are much more dependant on water and other natural resources for their survival than non-poor: any change in water entitlements or its quality may result in loss of livelihood for the poor. Hence, modern water rights and water laws have to evolve to a level of maturity where they are pro-market, so as to allocate scarce water resources most efficiently among competing uses, while being sufficiently pro-poor so as to be able to protect the water rights of vulnerable people both quantitatively and qualitatively.

MENU OF INTERVENTIONS TO INCREASE BENEFITS OF WATER TO THE POOR IN SURFACE IRRIGATION SYSTEMS

Based on the previous discussions and conceptual models developed, a preliminary version of a menu of pro-poor interventions in irrigation sector is presented. These need to be promoted with national level policies and plans that

recognizes the need and importance of pro-poor interventions to ensure efficient, equitable and sustainable irrigation water management. Detailed analyses of these and other related interventions are being carried out in the regional study.

(i) **Pro-poor institutional arrangements** : These include: (a) involving the poor in WUA water management decisions through due representation of the smallholders and the poor, along with their capacity development through information and training programs; (b) establishing separate WUAs of tail enders in situations where there are significant head-tail inequities in distribution of water, (c) establishing stringent monitoring and control mechanisms within service delivery institutions to ensure appropriate water distribution;

(ii) **Water allocation rules** : These include (a) canal water reallocation to command areas/reaches where groundwater is of poorer quality, mostly tail ends where poverty is highly concentrated; (b) allocating more canal water per unit of area for small holders as compared to large farmers; (c) promoting conjunctive use of surface and groundwater where applicable; (d) introducing specific area ceilings for seasonal irrigation per farm households or per distributary canals depending on total water availability; (e) prioritized protection of minimum water flow for smallholders in drought and scarcity conditions to ensure household food security;

(iii) **Water pricing** : Including differential pricing for (a) larger areas beyond specified ceiling per farm household; (b) commercial crops consuming more water and produced by large farm households (against subsistence crops); and (c) irrigation timing, where higher charges may be levied in water scarcity months;

(iv) **Water rights** : Including (a) establishment of clear water rights and water entitlements in the systems, by introduction of legal and third party enforceable service contracts, with flexible provision for seasonal water use in the system; and (b) separation of water and land right where water rights are more equally distributed among farmers;

(v) **Benefit re-distribution** : This include, for example, collection of farmer contribution for capital cost recovery (on top of O&M cost recovery) for productivity improvement of the landless, marginal and other poor farmers;

(vi) **Employment opportunities** : This could be promoted through involvement of the poor in O&M activities, water fee collection and other monitoring and supervisory measures.

(vii) **Targeting approaches** : These include (a) increasing productivity and value of water in ways that favor the poor i.e. promoting crop diversification on

smallholder farms by providing necessary incentives, information and support measures; (b)Targeting technological support, such as providing high quality seeds, fertilizers, credit, agricultural equipments for land leveling for the poor communities in canal commands; (c) providing monetary and technical support for installation of pumps/water lifting devices for communities in command areas/canal reaches which are relatively poorer but have good quality groundwater; and (d) prioritizing command areas/reaches with relatively greater incidence of poverty for infrastructure rehabilitation and upgrading, and for new infrastructure for storage and distribution of water.

CONCLUSIONS

This paper has examined the topic of how best the poverty reduction issues are addressed within the context of improving the poor performance and sustainability of irrigation systems. The paper started with presentation of empirical evidences regarding the linkages between irrigation and poverty, where significant poverty reduction impacts of irrigation have been observed. However, more rigorous assessment is required to analyze the scope for further improving the poverty reduction impacts through improved distribution of benefits in favor of the poor against the non-poor. The paper then presented a conceptual model to depict the temporal and spatial patterns of poverty within an irrigation system. This model serves the analyst in mapping poverty so research (and intervention) can be effectively targeted to the poor. It also provides criteria against which proposed interventions can be tested.

The paper outlined the institutional, economic/ financial, and legal/ regulatory instruments to improve the performance and sustainability of irrigation systems, along with their implications to poverty reduction. On the basis of this, a set of possible interventions to specifically ensure the benefits to the poor was presented. These activities are a part of the core foundation study components for the ongoing ADB-financed study. By conducting the review of both theory and applied example and analyzing their appropriateness and effectiveness, lessons could be drawn regarding the conditions necessary for and the types of interventions that lead to successful improvement of irrigation management while ensuring benefits to the poor. Further research under the project will ultimately devise specialized action plans to encourage the adoption of interventions that indicate positive impacts regarding irrigation performance and poverty alleviation.

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