Production and income benefits from improved irrigation efficiency: What is the potential?

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Abstract. The benefits of improved irrigation efficiency on production and income in rice-based irrigation systems is analyzed using a combination of simulation and structural model estimation techniques for five diversion irrigation systems in the Philippines. The results show that increased efficiencies generate substantial production and income benefits. With the limitations on new system development, designing and enforcing appropriate real-time water resource management policies to capture high potential benefits of improved irrigation efficiency should be an increasingly high priority for policy-makers.

I. Introduction

Irrigation has played a crucial role in enhancing productivity in the rice-growing areas of Asia. The rapid rise in irrigation investment in the 1970s was facilitated by the Green Revolution as well as by the sharp rise in world rice prices in 1973–74. But with the increase in food grain supplies, there has been a steady decline in world rice prices in the 1980s with a subsequent slackening of investment in Asian irrigation and agriculture in general. Other factors that have resulted in the decline in irrigation investment include the large debt load carried by most of the agriculturally-based economies in the region, the decline in the availability of land and/or water resources to accommodate new projects, rising per-hectare costs, and the strengthening of environmental interests and those negatively affected by irrigation development (Rosegrant and Svendsen 1993). With continued expansion of irrigation into new areas likely to be slow, future increases in food production must come increasingly from improvement in the productivity of the existing irrigated land base. This implies the need to increase the overall irrigation efficiency in existing irrigation systems. What are the potential benefits from improving irrigation efficiency?

Low existing irrigation efficiencies suggest that the benefits might be sub-
stantial. Though individual project performances vary considerably, overall irrigation efficiencies (IE hereafter) or project efficiency \( \eta \) in irrigation projects in developing countries are low, ranging from 25–40% for Philippines, Thailand, India, Pakistan and Mexico to 40–45% in Malaysia and Morocco. This is contrast to Taiwan, Israel, Japan where irrigation efficiencies range from 50–60 percent. For the U.S. efficiency estimates range from 35 percent to 50–60 percent.²

It has been suggested that in the predominantly rice-growing regions of Asia, efforts to improve IE could result in significant production benefits with a concomitant increase in rural incomes. In four case studies of irrigation projects in Pakistan, India, Indonesia and Taiwan, Bottrall (1981) concluded that there are “immense opportunities” to improve overall irrigation efficiency through better water distribution which would provide major production and income benefits, and improved system maintenance as a result of farmers’ willingness to pay higher water charges. However, the empirical evidence of the success of interventions to improve production by increasing IE through rehabilitation and management improvement shows a wide variation in success.³ Attempts to improve the performance of existing systems through rehabilitation of system facilities on the one hand, and expansion of farmer participation through water user associations or other cooperative groups on the other, have often produced results that fall far short of expectations (Rosegrant and Svendsen 1993). What is the actual potential for raising production and incomes through improved irrigation efficiency? This paper examines the impact of overall irrigation efficiency on production and income using a combination of simulation and econometric techniques for diversion irrigation systems in the Philippines. The paper is organized as follows: the next section outlines the methodology used, providing a brief description of the simulation model, and describing the use of the simulation model to generate pseudo-data under alternative water management rules. Specification and estimation of the structural econometric model is then described, and results showing the impact of overall irrigation efficiency on production and income are discussed in Section VI. The concluding section summarizes the findings and provides some policy implications.

II. Methodology

The impact of overall irrigation efficiency on farm production and income is usually difficult to isolate from the effect of agroclimatic and other variables. Cross-sectional and time-series variation in the crop/water environment makes it difficult to measure and control for important physical and environmental variables in case study analyses. Simulation modeling provides control over a