PRODUCTIVITY AND SUSTAINABILITY OF IRRIGATED AGRICULTURE

A COMPREHENSIVE PERFORMANCE ASSESSMENT SYSTEM

METHODOLOGY AND APPLICATION

IN THE CHISHTIAN SUB-DIVISION,

FORDWAH BRANCH CANAL IRRIGATION SYSTEM

PAKISTAN

STATUS REPORT

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PRODUCTIVITY AND SUSTAINABILITY OF IRRIGATED AGRICULTURE A COMPREHENSIVE PERFORMANCE ASSESSMENT SYSTEM

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SUMMARY

During phase one (1994-1995) of IIMI's Program on Assessing and Improving the Performance of Irrigated Agriculture, the main activities are applying and field testing a comprehensive Performance Assessment System in related schemes in various agro-ecological regions. Building on past work done at IIMI on performance assessment frameworks, the proposed system will cover all aspects of an irrigation scheme including productivity, economic efficiency, equity, financial viability and environmental sustainability.

The objective of this collaborative study between IIMI-Headquarters, IIMI-Pakistan and Punjab Irrigation Department (PID) will be to apply a Comprehensive Performance Assessment System in the Chishtian sub-division of the Fordwah Branch Canal in Punjab, Pakistan. A set of performance indicators will be measured from a sample which consists of 500 farmers in 68 watercourses from all 14 distributaries and 7 minors off-taking from the Fordwah Branch Canal. Two field surveys have been carried out to collect agricultural production, socio-economic and environmental data for Rabi 93/94 and Kharif 94 seasons. Water delivery data are being obtained from an MIS database (at the distributary level) already in use. These data will be used to quantify relationship between water delivery performance and agricultural production. It is also proposed that once the performance indicators have been measured, this same assessment system will be used to test the impact of identified management interventions on the performance of the system. The possible management interventions to be evaluated are lining of watercourses, setting up of community tubewells for augmenting canal water supplies etc.

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1. INTRODUCTION

1.1 Study objectives

The objective of this collaborative study is to field test a Comprehensive Performance Assessment System in the Chishtian sub-division of the Fordwah Branch Canal in Punjab, Pakistan. The field testing of this Performance Assessment System will entail two distinct components namely, measurement and assessment. The measurement activity will consist of quantifying (measuring) selected performance indicators thus obtaining actual values. In the assessment activity these values will be measured against norms which are system/agro climatic region specific. These activities will be carried out during 1994 and 1995.

The Performance Assessment System will be used to evaluate the performance impacts of a set of identified management practices and interventions such as rotational water delivery, introduction of decision support systems, investment in drainage and community tubewells for augmentation of canal supplies.

The short-term objective of the study is to measure the different indicators choosing a sample from the Chishtian sub-division which is a part of the Northern region of the Fordwah-Sadiqia Irrigation System. The Watercourse Monitoring And Evaluation Directorate of WAPDA has a data collection program for a sample of 26 watercourses in the Eastern Sadiqia Branch, which is the southern region of the system. Thus, the long-term objective would be to combine both of these activities which would then provide an opportunity to do a comprehensive performance assessment study in which the sample would be much more representative of the entire Fordwah Eastern Sadiqia Irrigation System.

It is envisaged that the data required for quantification of the parameters will be sufficient in order to statistically test the relationship between water delivery and agricultural production. Hence, it is proposed to correlate water delivery and agricultural production data initially at the distributary level. Further, it is also proposed to study water productivity and water profitability at the distributary level.

1.2 IIMI's Performance Program activities

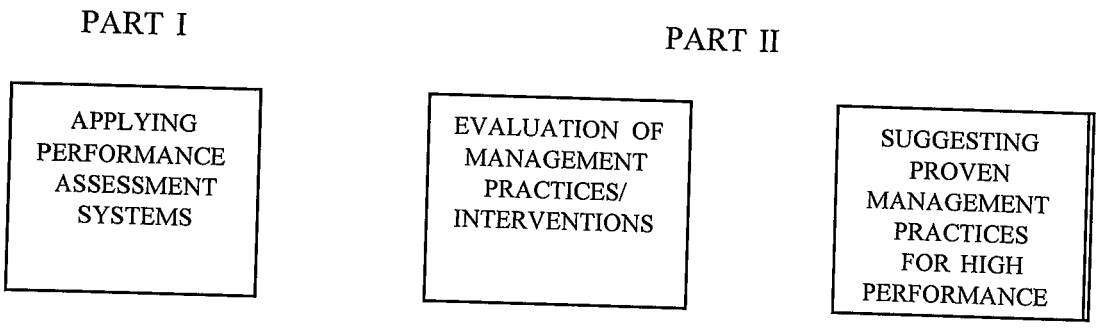
Comprehensive Performance Assessment System

During phase one (1994-1995) of IIMI's Performance Program, the main activity will be applying and field testing a comprehensive Performance Assessment System for Irrigated Agriculture. Building on past work done at IIMI on performance assessment frameworks, the proposed system will cover all aspects of an irrigation scheme including productivity, economic efficiency, equity, financial viability and environmental sustainability.

The proposed activities under this program will integrate and carry forward research presently underway on both performance assessment and decision support packages. Based on the framework developed earlier (Bos et al 1994) and other work (Small and Svendsen 1992, Abernethy 1991, Rao 1993 and Murray-Rust and Snellen 1993), a set of specific indicators will be identified that can be used by policy makers, irrigation managers and researchers. Performance indicators will be grouped into four types: (i) water supply performance; (ii) agricultural performance; (iii) economic and social impacts, and (iv) environmental performance. These performance indicators will be applied and field-tested in selected irrigation schemes as discussed below.

As outlined in Figure 1, the major activities of the Program are divided into two interrelated parts. Part I will focus on developing, applying and refining a comprehensive Performance Assessment System which will provide data regarding an irrigation scheme in terms of productivity, equity, financial viability, environmental sustainability and the degree to which the existing "scheme" meets current and further agricultural requirements. The outputs of these activities would be a package of practical and cost-effective performance indicators which will be used to assist policy makers and irrigation managers to assess and improve the performance of irrigated agriculture.

Figure 1
MAJOR ACTIVITIES OF THE PERFORMANCE PROGRAM



Part II of the program will concentrate on using the performance assessment system to evaluate the performance impacts of a set of management practices and interventions. The empirical studies will evaluate the impact of an existing management practice (e.g. fixed rotational water supply) in selected irrigation schemes or assess the performance improvements achieved as a consequence of a management intervention (e.g. use of a decision support system). The outputs of this part of the Program will be to generate and disseminate knowledge about proven management practices associated with high performance. These evaluations will generate empirical information about the "determinants" of performance-enhancing management practices and institutional changes. Thus, Part I refers to the "Assessment" component of IIMI's Program on Assessing and Improving the Performance of Irrigated Agriculture," where as Part II covers the "Improvement" component. It is expected that, over time, the second component might be integrated with IIMI's other programs, rather than considered a part of IIMI's performance program as such. Proposed activities under the two parts of the Program are described below:

Part I : Developing and Applying a comprehensive Performance Assessment System

As outlined in Figure 2 , the major components of the performance assessment system are:

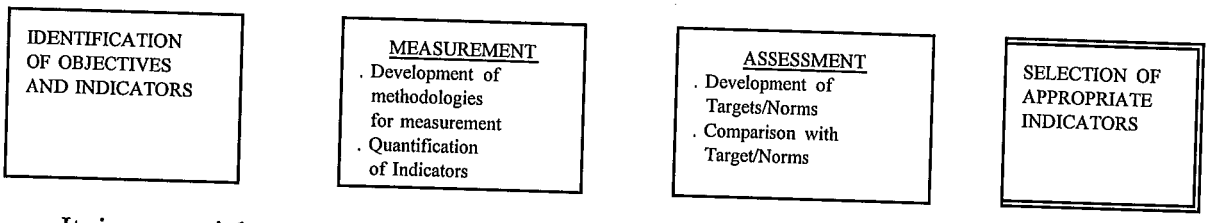
* Identification of objectives and performance indicators;
* Development of practical and cost-effective methodologies for measurement of performance over large irrigation systems;
* Quantification (measurement) of these performance indicators in selected systems;
* Development and specification of targets or assessment norms/standards against which the actual values of performance indicators are to be compared;

* Comparison of "actual values" of performance indicators with targets and assessment norms to derive conclusions regarding the "performance level" of the scheme/sub-scheme (or a group of schemes) for a given year and/or changes over time.

* Selection of "appropriate" indicators for a given scheme.

Figure 2

STEPS IN PERFORMANCE ASSESSMENT



It is essential to use performance indicators which are optimally appropriate for the objectives of the user. For example, the objectives of the policy maker may be one or more of the following : maximizing irrigated area from given supplies of water; maximization of productivity per unit of land/water/labour; meeting targets of food self-sufficiency, employment; providing benefits to small farmers, and for livelihoods of rural people including women; enhancing farmers' profitability and ensuring environmental and financial sustainability. The performance indicators will have to be so selected as to reflect such concerns. Table 7 on page 17 illustrates some of the linkages between various objectives and corresponding performance indicators. The selection of "relevant" performance parameters will depend on the interest of the policy maker in assessing the contributions made and to be made by irrigated agriculture.

In contrast to the policy maker, the concerns of the irrigation manager, would relate to more specific aspects of system management e.g. adequacy and predictability of water supply to the farmers; equitable distribution of water supplies between head and tail-enders; and the effectiveness of infrastructure. On the other hand, the farmers' concern will be the effect of water supply on his productivity and net profitability. The indicators for these concerns are given in Table 1.

It may be emphasized that an irrigation manager or a policy maker will require a small number of performance indicators for which data can be collected in a timely and cost-effective manner. This "preferred" set of indicators will vary depending upon agro-ecological conditions, methods of water delivery and allocation and the size of the system. However, to enable an irrigation manager and policy maker to select an appropriate set of indicators, there is a need to carry out field research to quantify the cost of measuring various indicators. In view of the fact that methodologies for practical measurement of performance in terms of

various indicators over large systems do not yet exist, the design of such field research will be a challenge.

Currently, as part of the main activity in Phase 1 (1994-1995), this Assessment System is being applied and field tested in two major irrigation schemes in Malaysia and Pakistan.

In Malaysia, work has already commenced in the MADA Irrigation System where the study will focus on the application of the Performance Assessment System with a view to quantifying water delivery, productivity and sustainability indicators. The study, which commenced at the beginning of 1994, is a collaborative effort between IIMI and Muda Agricultural Development Agency (MADA). In this study, quantitative linkages between performance indicators and management interventions are currently being analyzed for the following management interventions:

* Development of tertiary canals, drains, and roads in 38 out of 110 irrigation blocks,

* Reducing irrigation supply period in the first season, in response to dry sowing (from 197 days for 1984-86 to 152 days for 1990-93),

* Decision support system, and

* Establishment of farmer organizations (Kelompoks and Mini-Estates)

The study will assess the contribution made by each of the above mentioned interventions on the performance of irrigation performance with the help of two types of indices: Impact indices which measure the immediate impacts of the interventions and determinant indices which measure the extent to which the intervention is implemented.

Another five year collaborative effort - Research Program on Irrigation Performance (RPIP) - is also currently being carried out between IIMI, the International Institute for Land Reclamation and Improvement (ILRI) and the International Institute for Infrastructural, Hydraulic and Environmental Engineering (IHE) in four irrigation systems in India (Mahi-Kadana), Sudan (Rahad), Morocco (Moulouya) and Argentina (Rio Tunuyan). The program is funded by the Dutch government. Here too, the scope of the research program is to test the relative utility of a variety of performance indicators for irrigation water management, and to test the impact of identified operational interventions. Many national institutes of the respective countries will play an important role in carrying out the research namely, Water and Land Management Institute (WALMI) of Gujarat, India, the Office Regional de Mise en Valeur Agricole de la Moulouya (ORMVAM) in Morocco, Rahad Agricultural Corporation in Sudan and the National Institute for Water Science and Technology (INCYTH) in Argentina.

IIMI will coordinate all four programs with a view to adopting a common methodology so that the performance parameters will be comparable across all four systems. The wide spectrum of agro-ecological as well as irrigation characteristics of these four countries will

ultimately result in a wealth of data which would facilitate the comparison of the performance of irrigated agriculture across many different countries.

1.3 Previous work done by IIMI in Fordwah Sadiqia

Irrigation and Agricultural Performance was studied in the Fordwah Branch command area at main canal, distributary and water course level (Irrigation Management In The Fordwah Branch Command Area South East Punjab, Pakistan, by M. Kuper and J. Kijne, 1992, and The Appropriateness Of Canal Water Supplies: The Responses Of The Farmers, by M. Kuper and P. Strosser, 1992). The objective of the study was to research possible improvements in irrigation management to prevent further land degradation and to mitigate the effects of salinity on crop production. Performance indicators in terms of adequacy and dependability of supply and equity in distribution were measured and quantified with respect to canal operations.

In the first study, performance indicators were quantified in terms of adequacy and dependability of supply and equity in distribution. The sample for water delivery data consisted of eight water courses from Fordwah and Azim distributaries (Chishtian sub-division consists of 14 distributaries). In the analysis, the performance of Fordwah Branch Canal was compared with that of canals of previous IIMI research locations. Much of this research work was carried out in the command area of Upper and Lower Gugera Branch of Lower Chenab Circle East, Mananwala and Lagar distributary in the upper reach and Khikhi and Pir Mahal in the lower reach of the system.

The performance of the sub-division was measured by comparing three sections of the branch canal - head to tail reaches. The calculated values in Table 1 show a marked difference in performance between the three sections. Pa, an indicator for the total volume of water delivered is rapidly decreasing towards the tail of the Fordwah Branch from a level of 0.79 to 0.45 in the tail reach. However, the variation in the discharge (Pd value) does not change towards the tail. The distribution (Pe value) of water between the distributaries, however, appears to be worse in the tail section than the two upstream sections.

Table 1. Performance of sections of Chishtian sub-division in kharif 1992

Section	Equity (Pe)	Dependability (Pd)	Adequacy (Pa)
Takhat Mal	0.52	0.26	0.79
Chak Abdullah	0.46	0.26	0.57
Chishtian	0.65	0.25	0.45

When adequacy and dependability values were compared for the Azim and Fordwah distributaries, it was found that the delivery of water to the secondary canals differ substantially in terms of adequacy and dependability, with Fordwah performing better than Azim distributary (see Table 2). The table also provides a comparison of these values against the average for the sub-division.

Table 2. Water delivery to Fordwah and Azim distributaries during Kharif 1992

Distributary	Dependability (Pd)	Adequacy (Pa)
Azim	0.66	0.39
Fordwah	0.37	0.57
Average Chishtian sd	0.41	0.76

The measurements of water supply to sample watercourses, expressed as mm of water supplied to the service areas of the watercourses are presented in Table 3. The same table provides values of water supplied through tubewell water and rainfall. It is clear from the values that tubewell water is an important source of water.

Table 3. Sources of irrigation water and Relative Water Supply (RWS) for sample watercourses in Kharif 1992

Watercourse	Canal (mm)	Tubewell (mm)	Rainfall (mm)	RWS
Azim 63	256	248	135	0.91
Azim 11	120	671	88	1.05
Fordwah 62	413	78	121	0.74
Fordwah 130	482	165	127	0.93