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JBICI Research Paper No. 31

Impact Assessment of Irrigation Infrastructure Development on Poverty Alleviation: A Case Study from Pakistan

March 2007

JBIC Institute
Japan Bank for International Cooperation

Joint Research with
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Foreword

In 2005, Japan Bank for International Cooperation (JBIC), the World Bank and the Asian Development Bank together published the report, "Connecting East Asia: A New Framework for Infrastructure." In that report, it was clearly stated that "there is little doubt that infrastructure development—by both the public and private sectors—has contributed to the region's enviable record on growth and poverty reduction."

Since the beginning of Japanese ODA in 1954, we have always emphasized the importance of infrastructure for development, even during periods when other development organizations were turning to social development. Now that the importance of infrastructure is re-acknowledged, the main developmental research question would be how to make infrastructure contribute most effectively and efficiently to economic development and poverty reduction, rather than whether or not infrastructure contributes to economic development and poverty reduction.

This research paper, along with three others, is our preliminary effort in using developmental microeconomics to empirically investigate the mechanisms in which infrastructure impacts poverty reduction. By investigating the detailed path to poverty reduction, we hope to find implication for more effective infrastructure development.

Finally, I would like to thank the International Water Management Institute (IWMI) for their dedicated effort in this research. All four research papers, No.19, 31, 32 and 33 were conducted in collaboration with them.

March 2007

Teruyuki Tanabe
Executive Director
JBIC Institute

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This study has been undertaken under the collaboration of following members (all affiliations are for the time of the completion of the report in March 2003):

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Executive Summary

This study was undertaken with the overall objective of developing an in-depth understanding of income dynamics in relation to access to irrigation water with the aim of assessing the impacts of irrigation infrastructure development on poverty. The sample areas for the study were selected in districts Mandi Bahauddin and Gujrat, based on several criteria including access to irrigation water, cropping patterns and stage of irrigation infrastructure development. The study sites were selected in areas where On-Farm Water Management (OFWM) projects, for improvement of watercourses/channels, were implemented. The study uses primary data collected through household surveys conducted three times during the year 2000-2001, from a sample of 707 households, using a detailed multi-topic questionnaire.

The results of this study provide strong empirical evidence on the role of irrigation infrastructure development on poverty alleviation, particularly on dynamic aspects of poverty. The study provides quantitative estimates of incidence, depth and severity of both transient and chronic poverty. In addition, the study quantifies and compares non-monetary indicators of poverty and shows how access to irrigation infrastructure development contributes to reducing poverty and raise overall welfare standards. Further, the study econometrically estimates expenditure smoothing effects of access to irrigation infrastructure. Finally, the study develops a multivariate econometric model to quantitatively assess the impact of various factors, including household access to irrigation infrastructure, endowment of land resources, land productivity, household human resources, household non-land productive assets and so on and so forth, on household incomes/expenditures. The model provides quantitative estimates of the potential increases in incomes and expenditures through development of infrastructure and improved access to adequate water supplies. In short, the study provides an in-depth understanding of the role of irrigation infrastructure development on poverty alleviation

Summary of Findings

- Irrigated areas have relatively larger households, and larger number of earners compared to the rainfed areas. Number of dependents are fairly similar across all strata. The average years of schooling is higher in rainfed than irrigated while the age of the household head is fairly similar across all strata.
- Nearly 39 percent of households are landless and landlessness is higher in rainfed areas compared to irrigated areas. Average farm size was highest (3.88ha) in the mixed-wheat perennial stratum and lowest (1.41ha) in rainfed areas. Landlessness

is higher in unimproved areas than in improved areas where landholdings are relatively higher indicating that watercourse improvements were undertaken in the areas where landholdings are relatively large. Overall land distribution is highly inequitable (Gini coefficient for land distribution range from 0.53 to 0.66).

- Cropping intensity is higher in irrigated as well as rainfed areas. Landholdings in rainfed areas are smaller and farmers cultivate their fields intensively using family labor. Among irrigated strata cropping intensity is generally higher in perennial systems on farms located on improved watercourses than farms located on unimproved watercourses.
- Productivity of rice and wheat is higher in irrigated areas than in rainfed areas. Within irrigated areas rice and wheat productivity is higher on farms located on improved watercourses than the farms located on unimproved water courses.
- Gross value of product (GVP) per hectare is highest for rice-wheat non-perennial stratum and lowest for rainfed areas. GVP for farms located on improved water courses was higher than those located on unimproved water courses. Though the cost of production is higher for farms located on improved water courses, overall profitability is higher due to higher GVP. In general, cost of production was higher in Kharif (summer) than in Rabi (winter).
- The major problem of agricultural production reported was shortage of irrigation water in all strata, with over 60 percent of the household reporting this problem. Second most commonly reported problem was increasing cost of farm inputs.
- Rice, being the main cash crop in Kharif season, requires more labor contributing to overall higher labor use in Kharif than in Rabi. In both seasons most of the required farm labor was provided by family labor which mostly comprise of male labor.
- Average wage rate in the study area is Rs. 100/day, and there are no significant differences across strata.
- Majority of the households derive their incomes from more than one source. In irrigated areas 66 percent of household derive their income from non-crop sources while it was 98 percent in rainfed areas.
- Average monthly income is highest (Rs. 6,710) in rice-wheat non-perennial stratum and lowest (Rs. 4,995) in rice-wheat perennial stratum. Though the difference is marginal, average monthly incomes are higher in rainfed area compared to irrigated areas. Average monthly incomes are also higher in non-perennial and improved areas than perennial areas and unimproved areas respectively.
- Monthly income fluctuations in the rainfed areas are less than that of irrigated areas. Similarly volatility in monthly incomes of farm households is greater than that of non-farm households. However, monthly income patterns are fairly similar across improved and unimproved areas.

- Variations in the household incomes in improved irrigated areas range between 2.22 to 3.72 and are higher than those for households in unimproved irrigated areas.
- Average monthly expenditure for all strata is Rs. 6,031. Monthly expenditure in rainfed stratum is relatively lower than irrigated strata while it is quite similar in areas within the irrigated areas. Average monthly expenditures are higher in farm households than non-farm households. Either no or little difference in average monthly expenditures across perennial and non-perennial areas and improved and non-improved areas.
- Average monthly expenditure patterns are similar across strata and various categories. Average monthly expenditures are higher in November, December, and March and are similar in all other months.
- On average a household spends Rs. 2,136 per month on food items and it accounts for 40 percent of the total household expenditure. Average monthly food expenditure is higher in irrigated areas than in rainfed area. Monthly food expenditures for non-farmers are lower than that of farmers. There is no significant difference in food expenditure in improved and unimproved areas.
- The estimated average Gini coefficient is 0.51 reflecting high level of inequality in distribution of income in all strata. Income inequality is relatively lower in rainfed areas than in irrigated areas. Inequality is also lower in unimproved areas than in improved areas. However this doesn't mean that improvement in infrastructure has led to such inequality.
- There is also a high level of inequality in land holdings in the study area, with the estimated Gini coefficient ranging from 0.53 to 0.66.
- Headcount index shows that of all the sampled households 26 percent are chronically poor, 67 percent are transient poor and 6 percent are non-poor.
- Rainfed area has the highest incidence of chronic poverty as well as highest level of non-poor.
- The incidence of chronic poverty is higher among non-farm household than farm household while the incidence of transient poverty is higher among farm households than non farm households.
- There is no significant difference in the incidence of poverty between households on improved and unimproved watercourses.
- Chronic poverty gap was higher than transient poverty gap, with higher gap for households in irrigated areas compared to rainfed areas, and significantly higher gap for farm households compared to non-farm households. However, no difference in poverty gap estimates between household on improved and unimproved watercourses. Squared poverty gap estimates shows the same patterns.

- Estimates based on various income categories shows that there is great proportion of households in chronic poverty in irrigated areas than rainfed areas and the chronic poverty is prominent among non-farm households.
- Results show that over 64 percent of the non-farmer sample households were subject to chronic poverty as compared to only 6.5 percent in case of sample farm households.
- Estimated values of poverty indices using expenditure generally correspond to the values estimated using monthly incomes. However, the estimated values of headcount of the chronic poor, proportion of non-poor in rainfed areas, chronic poverty gap and transient poverty gap were less using monthly expenditure.
- Monthly headcount (income), poverty gap and squared poverty gap indices follow the same patterns. The indices are fairly high and similar from January through April and from July through October for all strata and categories. Monthly indices are generally lower for rainfed areas (compared to irrigated areas) and for farmers (than non-farmers). However there is no significant difference between improved and unimproved areas. Indices estimated using monthly expenditure follow the similar pattern.
- There is no significant difference in the incidence of chronic and transient poverty across improved and unimproved areas, with the incidence of chronic poverty only 0.8 percent less in areas with access to improved infrastructure.
- Regression results indicate that monthly variations in consumption expenditures, that is month effects in expenditures, are higher for households in rainfed areas compared to irrigated areas, and higher for households in non-perennial areas compared to perennial areas, higher for households in improved areas compared to unimproved areas, higher for farmers than for non-farmers, higher for non-poor than chronic poor and transient poor. However, the effects of monthly income share in expenditures are only marginal. Overall the results of this study imply that households generally smooth their consumption expenditures, and seasonal variations in expenditures are mainly due to non-income factors (such as preferences and seasonal variations in prices).
- A large majority of farmers in all 3 irrigated strata believed that improvement in the infrastructure had saved water significantly, saved their labor (up to 8.5 days on an average during the year 2000-2001), and increased crop productivity.

The overall conclusions of this study are that (1) access to irrigation infrastructure, regardless of whether it is improved or unimproved, helps keep the incidence of chronic poverty at lower levels; (2) improvements/watercourse lining/upgrading helps in saving water, resulting in higher cropping intensity, higher crop productivity and improved crop incomes (for example per hectare net crop incomes in improved areas of

rice-wheat perennial and rice-wheat non-perennial systems are 18 percent and 15 percent higher, respectively, compared to those in unimproved areas), with impacts on incomes also depending on the types cropping patterns adopted by farmers. However, the overall impact of infrastructure improvements on poverty is only marginal because of several factors including (a) inequity in distribution or resources, particularly land, with those having larger landholdings benefiting more compared to small land holders and landless; and (b) poor governance in water sector (poor infrastructure condition, including the improved infrastructure, resulting from inadequate maintenance, unreliable water supplies resulting from lack of proper planning, water theft), which tends to negate the anti-poverty impacts of improvements in infrastructure. In order to enhance the impacts of hardware/ infrastructure improvements on poverty, improvements in software/management of water coupled with other agricultural productivity enhancing measures (including enhancing availability of non-water production inputs and marketing crop outputs).

Part 1

Chapter I Study Background

1.1 Introduction

Over the last decade the focus of major development lending and aid agencies has gradually shifted towards the alleviation of poverty in developing countries. Poverty alleviation has now become one of the most important goals of development assistance. The perception of poverty, too, has changed in recent years, from the popular static concept of poverty to a dynamic one such as chronic and stochastic or transient poverty. Recent studies show that transient poverty accounts for a major part of overall poverty in developing countries. Since the poor are vulnerable and susceptible to exogenous negative shocks due to natural disasters such as drought, flood, typhoon, etc, providing households with coping strategies against the emergence of such temporary poverty becomes an important policy target.It is generally believed that irrigation infrastructure development provides large benefits to the production activities in agriculture. The development of irrigation infrastructure contributes to increased productivity, and raises long-term production and income levels. It is generally recognized that irrigation infrastructure, by providing access to irrigation water, enables small and poor households to better manage risks and reduce income fluctuations caused by drought or other seasonal climatic fluctuations. This income stabilization and smoothing effect of infrastructure is assumed to contribute to transient poverty reduction by helping consumption smoothing. There is a large body of research showing that irrigation infrastructure contributes to socio-economic uplift and overall economic development. However, as Lipton and Ravallion (1995) and Jimenez (1995) indicate that research clearly analyzing the direct influence of infrastructure development on poverty alleviation is very limited. A recent review, by Sawada (2000), on the role of infrastructure in reducing chronic and transient poverty clearly indicates the need for empirical research in understanding the dynamics of poverty in irrigated agriculture and the role of infrastructure development in reducing chronic and transient poverty. Irrigated agriculture provides the bulk of food and food security in the Asian region. At present, 40 percent of the cropland in Asia is irrigated and accounts for 70 percent of total cereal production. The population of Asia, already the most populous region in the world, is expected to grow to over 4.2 billion by 2025. Poor people are the most vulnerable to variability in the supply and quality of water available for agricultural uses. Irrigation sector interventions, therefore, must consider programs that contribute most effectively to poverty reduction. This requires a proper analysis of the various dimensions of poverty in diverse socioeconomic conditions, and a better understanding of the dynamics of poverty in irrigated

agriculture and the role played by irrigation infrastructure development in poverty alleviation.

1.2 Goal and Objectives

The goal of the study is to evaluate the efficacy of using irrigation infrastructure development as a policy instrument for poverty alleviation in developing countries. The objective of this study is to make an objective assessment of infrastructure development by using the concept of transient and chronic poverty, taking irrigation projects as a case study. The study aims to fill a major gap in the literature on the role of irrigation infrastructure in poverty reduction. This study formally investigates the dynamic poverty reduction effect of irrigation infrastructure development by integrating field observations, economic theory, and econometric analysis. By using the quantitative evaluation results, the study also derives in a rigorous manner the policy implications for future infrastructure development.

Specific objectives of the study are:

1. To assess the impacts of irrigation infrastructure development on poverty alleviation taking JBIC financed irrigation projects as case studies.
2. To develop a set of indicators and an analytical method by which to measure the impact of irrigation infrastructure development on poverty alleviation.
3. To establish a panel database for impact assessment and to understand the dynamics of poverty in the selected study areas.

1.3 Scope and coverage

The scope and coverage of this study is quite extensive in the sense that it attempts to evaluate both the static as well as the dynamic aspects of poverty in relation to irrigation infrastructure development. The scope and coverage of the study include the following:

1. Undertake assessments of impacts of irrigation infrastructure development on poverty taking selected JBIC funded projects in areas in districts Mandi Bahauddin and Gujrat in Pakistan (Upper Jehlum Canal) as case studies.
2. Establish a detailed methodology including all inputs, outputs and data requirements for the study. Develop an analytical framework, including indicators of poverty, to analyze inter-temporal changes in income and consumption.
3. Develop a sampling framework for the study based on several criteria including access to irrigation water, cropping patterns and stage of development of irrigation infrastructure and select representative sample areas. Identify specific locations

within the selected areas, which represent various states of irrigation infrastructure development: well established/developed/improved, partially developed/improved, unimproved and with no infrastructure.

4. Carryout household level surveys three times over a period of 10 months beginning May 2001, of a representative sample of over 850 households in order to establish the panel database.
5. Evaluate the impact of irrigation infrastructure on poverty reduction using a "with and without" approach, comparing sample areas of varying degrees of irrigation infrastructure development: improved, unimproved, no infrastructure and without irrigation to construct the optimal mix of irrigation accessibility in each of the selected areas.
6. Compare the inter-temporal movements of income and consumption (e.g., variance and means) of household income and consumption in the surveyed areas. Through this quantitative evaluation, assess the impact of the irrigation infrastructure on dynamics of poverty in selected locations, assuming that other conditions such as climate, soil, and access to the market is more or less similar across the selected areas and locations in order to control those external factors in the analysis.
7. Carry out econometric analysis of household level panel data to investigate the dynamic poverty reduction impacts of irrigation infrastructure development.

1.4 Organization of the Report

This report is organized into three parts consisting of 11 chapters. Part 1 (chapters 1 to 3) provides background material for the study. Chapter 2 provides a brief review of literature on the impact of irrigation infrastructure development on poverty. Chapter 3 gives an overview of key developments and trends in Pakistan economy, its agricultural sector, and poverty situation and trends in the country. Part 2 (chapters 4 to 6) provides details on study methodology. Overall study design, approach and sampling framework are discussed in chapter 4, with details on household level survey administration and data collection procedures in chapter 5. Chapter 6 develops an analytical framework of the study. Part 3 (chapters 7 to 11) reports results of the study. Basic socio-economic profile of sample households is given in chapter 7, followed by analyses of household income and expenditures and distribution patterns in chapter 8. Chapter 9 provides detailed estimates of chronic and transient poverty. Econometric analysis of seasonality in incomes and expenditures, and quantitative estimates of impact of infrastructure development on poverty are provided in chapter 10. Summary of study findings, conclusions and policy implications are provided in the final chapter. Other information, including detailed descriptive statistics are given in the appendix of the report.

Chapter II A Brief Review of Literature on Irrigation Infrastructure Development and Poverty

Poverty is usually defined as a state in which a household or individual's living standard is below the poverty line. If a household's living standard is always below the poverty line, that household is considered to be in a state of chronic poverty. If the household's living standard is usually above the poverty line, but falls below it at times, or has the potential to fall below the poverty line, such a state is defined as transient poverty or short-term or temporary poverty. Much effort has been made in the past to study the various aspects of poverty, including its measurement, causes and impacts. The role of infrastructure in alleviating poverty is an area of study that is currently receiving much attention. It has been argued that most of the poor are concentrated in rural areas and depend heavily on agriculture. Therefore rural infrastructure development, and irrigation development, in particular, is believed to increase returns from agriculture, thereby reducing poverty.

Results of the studies undertaken on the impact of infrastructure on poverty suggest that infrastructure development can have a beneficial impact on the poor. There is some evidence to suggest that infrastructure does play an important role in reducing both chronic as well as transient poverty. Raising the productivity of the poor requires a sustained investment in infrastructure development, particularly rural infrastructure, which raises agricultural production and thus permanent incomes of the poor, which reduces chronic poverty in the long-run (Lipton and Ravallion, 1995). A study on infrastructure and poverty in Vietnam (de Walle, 1996) simulated the benefits from irrigation, using certain assumptions on how the benefits would be distributed. The study showed that the gains to the poor from irrigation infrastructure development would be higher than the gains to the non-poor, and therefore the benefits would be re-distributive in nature. The greatest gains to the poor would be from the expansion of irrigation to households with small landholdings. The rate of return from irrigation would be in the region of 20 percent. However, constraints other than those due to lack of irrigation would equally reduce the benefits of irrigation to both the poor and non-poor. One should keep in mind that Vietnam is a country with high levels of income poverty, and where every type of infrastructure is in poor shape. Under the circumstances, benefits from expanding a particular infrastructure would be reduced. Net marginal benefits from irrigation increases with education, therefore, the gains to the poor who are usually less educated, would be less than the gains to more educated non-poor (de Walle, 2000).

A recent review of the literature on the role of infrastructure by Sawada (2000) highlights the importance of the dynamic aspects of poverty, specifically chronic and transient poverty aspects, in relation to the role of infrastructure in poverty reduction

and the associated policy interventions. Conventional static indicators such as the Foster-Greer-Thorbecke (FGT) indicators are useful in determining poverty targets, particularly in determining public allocation between regions at different poverty levels according to the index. However, Sawada argues that conventional static indicators of poverty are unable to capture the differences between transient and chronic poverty effectively. These indicators use static information on average income and consumption levels, and social indicators over a period or a particular point in time and therefore cannot grasp the problem of dynamic poverty or changes in the state of poverty over time. This could result in advocacy of inappropriate measures/policies for poverty alleviation.

Recent research by Jalan and Ravallion (2001) raises an important question: Are the determinants of chronic and transient poverty different? Do policies that reduce transient poverty also reduce chronic poverty? Their studies in China suggest that some of the factors determining transient poverty do not matter to chronic poverty. They found that while a household's average wealth holding is an important determinant for both transient and chronic poverty, household demographics (such as education levels and health status), while important for chronic poverty, are not significant determinants of transient poverty. Results of their studies suggest that different types of policies will be needed to address the two types of poverty. They conclude that while China's poor area development program may well be an appropriate policy response to reduce chronic poverty, it is unlikely to reduce consumption variability and transient poverty. Additionally, policy instruments such as seasonal public works, credit schemes and insurance options for the poor may be needed to smooth consumption and to reduce transient poverty.

Transient poverty is most common in agriculture. Since agricultural production involves high risk and is seasonal by nature, the income of farmers tends to vary according to the season, while net income changes according to the level and use of inputs and variability of output. Farmers face a variety of risks, including output and input price fluctuations, that tend to have a negative influence on the household welfare. Tropical diseases can cause a severe reduction in household income. The basic problem faced by a developing country household is how to reconcile variable income flow with a stable consumption pattern. Farmers manage agricultural production risks through various means, including, crop diversification, use of low risk technologies, business relationship through kinship and ethnicity, and other traditional ways. Studies using Pakistani household data (Kurosaki, 1998) show that reduction of risks resulted in a 20 percent drop in the welfare of the small farmers. Risk coping strategies for avoiding temporary poverty (as summarized by Sawada), include, "self insurance" or consumption smoothing to adjust their resources inter-temporarily and "mutual insurance" or informal risk sharing arrangements among family members, relatives, neighbors and friends. Sawada describes five strategies for self-insurance. The first

strategy for consumption smoothing adopted by the poor is to lower the quality of consumption (substitution of cheaper food with the same nutritional value, e.g. soybean instead of meat or fish) and reduce expenditures on health, education and other 'luxury' goods. Other strategies for self-insurance include, borrowing, selling of own physical assets or drawing on savings; greater use of own human assets like joining the labor market, and obtaining gifts/money from relations and friends.

Mutual insurance or risk sharing refers to the informal reciprocal transfers that take place among family members, relatives, friends, and neighbors in times of need. This coping strategy has evolved through years of developing relationships based on trust, reciprocity and mutual assistance within rural communities in developing countries, arising from the need to find alternatives to the less accessible commercial insurance and credit markets. Studies done by several researchers (Townsend 1994, 1995, Deaton 1997, Jalan and Ravallion 1996, Gillani 1996, Kurosaki and Sawada 1999) showed that, although a perfect risk sharing hypothesis was rejected statistically, about 60 to 70 percent of income fluctuations were absorbed by some form of risk sharing or mutual insurance. When an entire village is affected by a flood or drought, transfers from family members living elsewhere serve as insurance for smoothing the household's consumption. Paxson (1993), using data from Thailand, investigated whether seasonal variation in incomes, as opposed to variation in preferences or prices, determines seasonal consumption pattern. It is generally assumed that the consumption patterns of poor rural households, with restricted access to credit, follow the pattern of seasonal incomes, implying that these households are unable to smooth consumption levels across seasons. However, Paxson suggests that there may be reasons, apart from borrowing constraints that may cause this seasonality in consumption. First, taste variations due to festivals, holidays and weather patterns may be an important determinant of seasonal consumption. Second, seasonal price variation may also cause fluctuation in consumption. The results of her study suggest that seasonal variations in consumption are not clearly or consistently related to the timing of income receipts. Her findings also suggest that seasonal consumption patterns are due to the seasonal variation in prices or preferences, common to all households and not due to an inability of the household to dis-save or use savings to smooth consumption.

Canning (1999) estimated production functions using human assets and physical infrastructure as factors of production, with data covering 57 countries. Empirical results from this study suggests that the development of physical infrastructure will raise long-term production and income levels by externalities, thus making a large contribution to the reduction of chronic poverty. Jimenez (1995) demonstrated that improvement to irrigation, paved roads, or an increase in the density of regional roads, had a direct impact on poverty reduction by generating an increase in agricultural productivity, the highest impact coming from irrigation development. Lipton and

Ravallion (1995) suggested that infrastructure development increases the mobility of information, goods and services and employment, thereby indirectly helping to reduce chronic poverty. Sen (1981) suggests that improved access to infrastructure increases access to markets, including non-farm labor markets; reduces the cost of exchange or sale of goods and services; and raises farm and non-farm incomes. Thus, infrastructure development, both directly and indirectly, raises the welfare standards of the poor and reduces chronic poverty by increasing agricultural production, raising non-farm incomes, bringing smooth transition to the market economy, and reducing the transaction costs of accessing education and medical services. Infrastructure development also helps to reduce transient poverty through preventing or reducing the risks of natural disasters. It also reduces transaction costs of marketing goods and services, and increasing non-farm employment opportunities, thereby, reducing transient poverty. Risk sharing and mutual insurance strategies adopted by the transient poor could be complemented by the development of infrastructure that aims to integrate markets by increasing the mobility of goods, services and information, and promote consumption smoothing. A study by International Food Policy Research Institute (IFPRI) (Fan, Hazell and Thorat, 1999) analyzes the linkages between government spending, growth and poverty in rural India, using state level data from 1970 to 1993. The results of the study show that government spending on productivity enhancing investments, such as irrigation, research and development in agriculture, rural infrastructure (including roads and electricity), and rural development and welfare programs which target the rural poor directly have all contributed to reductions in rural poverty. Most of these investments have also contributed to growth in agricultural productivity, but their impacts on poverty and productivity show large variations. For example, expenditure on roads has the largest impact on both poverty reduction and productivity growth. Targeted spending on welfare for scheduled castes, tribes and other backward classes has been very effective and has had a large impact on rural poverty reduction, but it has had a negligible impact on productivity. On the other hand, expenditure on health reduced rural poverty significantly, but had little impact on productivity. Government spending on agricultural research and extension has had the largest impact on agricultural productivity growth, and it has also led to large benefits for the rural poor. Additional investments in irrigation had the third largest impact on growth in agricultural productivity, but a smaller impact on rural poverty (it should be noted here that the impact is determined based on marginal returns of each additional unit of investment, over and above the past investment in irrigation development), while the study acknowledges that irrigation development played a large role in production growth during the Green Revolution. The study appears to have some methodological problems in quantifying the impacts of various investments.

In Pakistan, several studies have attempted to evaluate the impact of watercourse improvements/upgrading/lining (under On-farm Water Management Program). These include Renfro et al. (1983), WAPDA (1984); Sarwar et al. (1985); and Saleem, Amin and Ul-Haq (1993); and other related paper as compiled by Inayatullah (1994) in proceedings of a conference held in Islamabad on "An Assessment of the On-Farm Water Management Program". In all these studies, emphasis has been on evaluation of conveyance efficiency and agricultural productivity through 'before and after' or 'with or without' comparisons. The key impact indicators used included conveyance efficacy, cropping patterns, cropping intensity, productivity of major crops and gross value of production/farm income. The study by Saleem, Amin and Ul-Haq (1993), which received significant attention in the conference, compared improved watercourses with unimproved watercourses. The key findings of the study included (a) land use intensity and cropping intensity was 2 percent and 4 percent higher on improved watercourses compared to that on unimproved watercourses; (b) there was no significant difference in labor use per cultivated acre and per cropped acre on improved and unimproved watercourses; (c) the delivery efficiency estimated at 68 percent and 61 percent on improved and unimproved watercourses respectively, an increase of 7 percent with improvement in watercourses; (d) average yields of wheat, cotton, rice, sugarcane and maize on improved watercourses was higher by 11.2 percent, 7.4 percent, 16.8 percent, 31.8 percent, 23.1 percent and 18.9 percent respectively; (e) the average net farm income per cultivated acre was Rs. 2,162 on improved watercourse and Rs. 1,700 on unimproved watercourses; and (f) overall annual manual labor saved for irrigation was reported to be 29.2 man-days i.e. 45 percent after watercourse improvement. None of the above studies evaluated the impact of watercourse improvements on poverty alleviation. The conference in Islamabad concluded that it is difficult to determine the impact of on-farm water management program on poverty alleviation from the information presented and that more research is needed to answer poverty related questions.

More recently, Halcrow (1999) evaluated the impact of the On-Farm Water Management (OFWM) Project in Pakistan. The study is based on the data collected from the OFWM-III project sites, and evaluation focused on conveyance efficiency and cropping intensities before and after the project in the selected areas. The study concluded that conveyance efficiencies increased by 13 and 18 percent in Rabi and Kharif seasons respectively. The overall cropping intensity in the project area increased by 11 percent; and area under vegetables increased by 93 percent in Rabi and 34 percent in Kharif season. The productivities of rice and wheat were reported to be increased by 8 and 11 percent respectively. The report concluded that there was increase in real annual income by 34 percent in the project area. It was also mentioned in the report that greater benefits could be obtained with the participatory and improved irrigation management system.

Chapter III Economy, Agriculture and Poverty in Pakistan – An Overview of Key Developments and Trends

3.1 Characteristics of Pakistani Economy

Pakistan is predominantly an agricultural country. Agriculture accounts for 25 percent of Gross Domestic Product (GDP) and employs 44 percent of the rural labor force (GoP, 2001). Agriculture also has important linkages with other sectors of the economy. It is the source of raw material for major domestic industries, particularly those producing cotton-based products that account for 80 percent of the overall value of exports. The sector is also important because it provides an important source of livelihood for the rural poor.

The Pakistan's economy has gone through different phases of development. During the first decade of independence, the economy of Pakistan grew at an average rate of 3.1 percent. At that time, the share of agriculture in GDP was 53.2 percent and the agriculture sector registered a growth rate of 2.1 percent and employed 66.4 percent of the labor force. During the 1960s, the overall GDP growth rate amounted to 6.8 percent, whereas the share of agriculture towards GDP decreased to 45.8 percent. On the contrary, the shares of manufacturing, mining and services sector increased to 12.0, 0.42 and 41.8 percent respectively. In the same period, agriculture sector provided employment to 60.8 percent of the total labor force as compared to 66.4 percent during the 1950s.

In the 1970s and the 1980s, the agricultural growth rate declined, mainly due to insect/pest attack and low harvest of the crops. The sector wise distribution of the employed labor force showed that agriculture's share diminished to 58.0 percent and 55.4 percent, respectively during the 1970s and the 1980s. During the 1980s the average growth rate of the economy was 6.5 percent, which was the second highest following the growth rate of 6.8 percent in the 1960s. The analysis of the sectoral share in GDP showed that the share of agriculture further declined and reached 30.6 percent during the 1980s.

During the 1990s, the overall GDP growth rate remained constant at 4.6 percent. The sectoral share in GDP showed that agriculture contributed to 24.6 percent, which retained a declining trend since the country's independence. The growth rates of the sectors including agriculture, manufacturing and services remained at 4.4 percent 4.8 percent and 4.6 percent, respectively. The sectoral distribution of the employed labor showed that agriculture and manufacturing employed 47.5 percent and 12.4 percent of the labor force, respectively.

Throughout the 1990s, Pakistan's exports concentrated on few items/groups, namely, cotton, fish, leather, rice, synthetic textile, wool, carpet and sports goods. These seven

categories of exports, on average, accounted for 88 percent of the total exports during the 1990s. Among these categories, cotton items alone contributed, on average, 60.3 percent of the total exports during this period followed by leather (7.9 percent), synthetic textiles (6.5 percent) and rice (5.7 percent) (GoP 2001). The Pakistan's overall economic performance in 2000-01 had suffered from the unprecedented drought conditions, which caused serious damage to agriculture sector and to overall economic growth in the country. The value added in agriculture had registered a negative growth of 2.5 percent and resulted in the decline of the overall GDP growth. Due to relatively lower GDP growth, the growth in real per capita income remained more or less stagnant and just increased marginally from Rs. 4,718 to Rs. 4,724 (0.1 percent) during this period.

3.2 Characteristics of Agriculture in Pakistan

In Pakistan, agriculture is the business of about 5 million farms, which cultivate about 22 million hectares (Mha) of land. Among these farms 69 percent, 12 percent and 19 percent of farms are categorized as owner cultivators, owner-cum-tenants and tenants, respectively. In Punjab, there are 2.9 million farms, which cultivate about 11 Mha of land. Irrigation facility from canals, tube wells and various other sources of irrigation have been provided to almost 18.9 Mha of the cultivated land in Pakistan (Table 3.1). The average cropping intensity is reported to be 137 percent for Pakistan. The agricultural calendar in Pakistan is divided into two distinct growing seasons, namely Kharif (summer) and Rabi (winter). The Kharif season is from May to September and Rabi season is from October to April. There are four main crops grown in Pakistan i.e. wheat, rice, cotton and sugarcane. Rice and cotton are grown during

Table 3.1 Total Land Use and Cultivated Area under Major Crops in Pakistan (Mha)

Land use category	Area (Mha)	Percentage of total Area
Total area	79.61	100.00
Area not available for cultivation	24.50	30.78
Cultivated area	21.99	27.62
Irrigated Area	18.99	22.72
Wheat	8.14	10.22
Rice	2.38	2.99
Cotton	2.93	3.68
Sugarcane	0.96	1.21
Maize	0.97	1.21
Forest area	3.66	4.60

Source: GoP 2001; Economic Survey of Pakistan 2000-01.

the Kharif Season. Wheat is grown during Rabi season and sugarcane cultivation spans over both seasons. Sugarcane is sown during February and is harvested in December-January.

Wheat is the staple food of people in Pakistan. During 1999-2000, it was grown on an area of 8.14 Mha, which was 10.2 percent of the total land area. Out of these 8.14 Mha, the irrigated wheat was grown on 7.21 Mha area, while the rest of the wheat was grown under the rainfed (non-irrigated) conditions. Rice was grown on an area of 2.38 Mha (about 3 percent of the total area). Rice is considered as a major export crop in Pakistan. Its contribution to GDP is 1.6 percent. Cotton is one of the major cash crops. It is used as raw material in local textile industries; similarly lint cotton is used for foreign exchange earnings. Cotton is sown on an area of 2.9 Mha (3.7 percent of the total area). It accounts for 11.5 percent of agriculture value added and 2.8 percent of the GDP. Sugarcane was grown on 0.96 Mha, contributing to GDP by 1.5 percent and value adding to agriculture by 6.4 percent. Maize accounts for 1.2 percent of total land area or about 0.97 Mha (GoP 2001).

3.3 Irrigation System in Pakistan

The Indus irrigation system is the largest contiguous irrigation system in the world which provides irrigation water to about 14 Mha of Culturable Command Area (CCA) in Pakistan. The system is comprised of the Indus River and its major tributaries, 3 major storage reservoirs, 19 barrages/head-works, 12 link canals and 43 canal commands. The total length of the canal system is about 58,500 km, while the watercourses, from channel and field ditches, are running another 1.6 million km in length.

History of irrigation in Pakistan goes back to the Indus civilization (5000 BC). The history tells us that the inhabitants of the fertile valleys of Mohenjodaro and Harrrapa used to irrigate their lands through river spills during the floods in the rivers. Later, between 8th and 19th century AD, various emperors built a large number of inundation canals. The Mughal emperors also constructed a number of canals. During the 1870s, the British initiated the canal construction program. They developed the irrigation system on a massive scale and converted the inundation canals to the properly regulated perennial canals by constructing the barrages on the rivers. The development of irrigation system improved the condition of rural masses in Punjab, and the uninhabitable lands started producing rich harvests.

During the 1960s, a number of works took place with the signing of the Indus Basin Water Treaty. First of all, Mangla dam with a storage capacity of 5.34 Million Acre Feet (MAF) was constructed on river Jehlum in 1967. Then, Terbela dam was with the storage capacity of 9.4 MAF was constructed on Indus River in 1975. A number of barrages were also constructed after the 1960 treaty. These included barrages at

Balloki, Trimmu, Mailsi siphon, Sidhnai, Qadirabad, Marala, Rasul and Chasma. New major link canals were Sidhnai-Mailsi-Bahawal, Trimmu-Sidhnai Link, Balluki-Sulemanki Link, Qadirabad-Balloki Link, Rasul-Qadirabad Link, Taunsa–Panjnad Link, and Chasma-Jehlum Link. In 1949, total canal water withdrawals were 67 MAF, which increased to 108 MAF after the construction of this irrigation network. This network of irrigation infrastructure helped to reduce rural poverty by increasing the productivity of agricultural lands and by providing more employment opportunities to the rural non-farm households.

3.4 Labor Force in Agriculture

In Pakistan, labor on agricultural farms constitutes about 18 million people who are mainly comprised of family labor, permanent labor, and casual labor. Family labor consists of household members of 10 years and above who perform any kind of agricultural work on their holdings. Family labor is classified into two categories i.e. permanent and part-time labor (depending upon the time they devote to farm work on agricultural holdings). Part-time family labor consists of households who, in addition to agricultural work on their farms, also render services to other sectors, such as service or business, etc. During the peak season of harvest, the farmers hire casual labor on a daily or weekly basis to deal with specific needs like transplanting and harvesting of crops. The casual labors get their wages in cash, either on a daily or weekly basis. In the cultivation system prevalent in most parts of Pakistan, the men spend most of their time on agricultural farms while the women have traditionally performed most of the household work and also help in agricultural activities during the peak seasons. Women hired as casual labor are often employed for specific tasks such as transplanting of rice/vegetables, cotton picking or weeding, or harvesting and threshing activities. Most often they are paid in kind.

Pakistan's agriculture has undergone several structural changes since the 1960s. In the process of economic growth, the share of rural dwellers in the total population has gradually decreased from 75 percent in 1972 to 65 percent in 1996-97 (GoP 2001). Within the rural sector, although the evidence suggests that the agricultural labor force has increased from 10.58 million in 1970-71 to 28.01 million in 2000, the share of economically active population has decreased from 61 percent in 1961 to 47 percent in the year 2000 (GoP, 2001). The employment scene in the rural areas of Pakistan is dominated by the non-wage sector, where employment is mainly composed of the self-employed and unpaid family members. Currently, agriculture continues to provide employment for the country's labor force. It is pertinent to note that the female participation rate in the labor force is generally lower than that of the male population.

The increase in value added per worker in agriculture has been smaller, for example, between 1963-64 and 1988-89 it was 50 percent compared with more than 200 percent

in manufacturing sector (Mahmood and Walter, 1990). The bleak side of the labor picture in rural areas shows that these areas lack even elementary education and skill development. The lack of basic skills only compounds and enhances the difficulties of the rural labor force and contributes to augment poverty in the rural areas.

3.5 Poverty Trends in Pakistan

Poverty is easier to define than to measure. Few studies in the past tried to derive the poverty line in Pakistan on the basis of income, which could provide daily intake of 2,250 calories per person (2,450 calories per adult in rural areas and 2,150 in urban areas). Researchers had analyzed poverty in various ways. The analysis of poverty on the basis of the occupation of the household heads shows that the highest poverty rate was found in the households headed by the laborers in transport and construction. Similar was the case for the household heads involved in agriculture as workers. These two groups constitute 60 percent of the poor population in Pakistan. Secondly, when the poverty is viewed in terms of employment status of household head, this classification showed that about 70 percent of all of the poor households were headed by the self-employed persons. Thirdly, if seen in the context of the household size, it showed that in larger households, the poverty level was high. In the same way, poverty showed a decreasing trend with the increase in number of earners. Fourthly, the province wise analysis of poverty showed that, Punjab, the largest province, has the highest poverty rate (34.4 percent), while the poverty rate was found lowest in Baluchistan (21.7 percent) (Zaidi and De Vos, 1993).

Historical trends in income inequality reveal that the Gini coefficient decreased during the 1960s, while it went up during the 1970s, declining again in the 1980s and finally took an upward turn in the 1990s. The lowest 20 percent of the rural households had higher share of the rural income than that of the lowest 20 percent of the urban households. Contrary to that, the highest 20 percent of the urban households had higher share of urban income than similar group in rural areas. This up and down behavior was the result of major difference in resources and the policies adopted by the government of the relevant era. During the 1970s, the drop in inequality has been due to after effects of Green Revolution. Inequality of the income once again increased during the 1980s due to the ineffective land reforms. These land reforms were so destructive in their nature that they adversely changed the agriculture structure of the country. In the same way, the inequality and poverty increased during the 1990s especially in the rural areas. The underneath causes for this increase was the Social Action Program, which removed the subsidies and increased the exchange rates. In urban areas, the major reason of inequality was the migration trends from rural to urban areas. Decade-wise, analysis of income distribution showed that the Gini Coefficient decreased from 0.39 during the 1960s to

0.33 in 1970-71, helping in reducing poverty levels. The reduction in poverty was mainly due to foreign remittances. During the 1990s, economic growth continued to decelerate and similarly workers' remittances slowed down. This worsened the income distribution and caused poverty to rise in Pakistan (Ali and Tahir, 1999).

Table 3.2 provides estimates of poverty indices from 1992-93 through to 1998-99. Poverty has been higher in rural areas than in urban areas. The incidence of rural poverty was 28.8 percent in 1992-93, which increased to 34.7 percent in 1993-94, and then decreased to 30.7 percent in 1996-97 and then again increased to 36.3 percent in 1998-99. The depth of poverty showed similar zigzag pattern, increasing from 4.8 percent in 1992-93 to 6.5 percent in 1993-94, and decreasing to 5.3 percent in 1996-97 and again increasing to 7.8 percent in 1998-99. Indices estimated for the country as a whole followed the similar trends.

Table 3.2 provides estimates of poverty indices from 1992-93 to 1998-99 for the Punjab province. In rural Punjab, the incidence of poverty was 23.8 percent in 1992-93, which increased to 33.9 percent in 1993-94 and then decreased to 26.8 percent in 1996-97. In 1998-99, the incidence of poverty increased to 34.5 percent. The depth and severity of poverty have followed similar trends.

Table 3.2 Estimates of Poverty in Pakistan

	1992-93			1993-94			1996-97			1998-99		
	IoP	DoP	SoP	IoP	DoP	SoP	IoP	DoP	SoP	IoP	DoP	SoP
Urban	20.7	3.6	0.9	16.3	2.9	0.7	16.1	2.4	0.6	22.4	4.4	1.3
Rural	28.8	4.8	1.2	34.7	6.5	1.8	30.7	5.3	1.4	36.3	7.8	2.5
Pakistan	26.5	4.5	1.1	29.2	5.5	1.5	26.2	4.5	1.1	32.2	6.8	2.1

Source: Pakistan Integrated Household Survey 2001.
Note: IoP=Incidence of poverty (Headcount), DoP = Depth of Poverty (Poverty Gap), SoP = Severity of Poverty (Poverty Gap Squared)

Table 3.3 Estimates of Poverty in Punjab

	1992-93			1993-94			1996-97			1998-99		
	IoP	DoP	SoP	IoP	DoP	SoP	IoP	DoP	SoP	IoP	DoP	SoP
Urban	21.1	3.7	0.9	17.0	3.1	0.8	16.9	2.6	0.6	24.2	4.9	1.5
Rural	23.8	4.3	1.1	33.9	7.0	2.2	26.8	4.5	1.2	34.5	7.1	2.2
Overall	23.1	4.1	1.09	27.8	5.6	1.7	24.1	4.0	1.0	31.4	6.5	2.0

Source: Pakistan Integrated Household Survey 2001.
Note: IoP=Incidence of poverty (Headcount), DoP = Depth of Poverty (Poverty Gap), SoP = Severity of Poverty (Poverty Gap Squared)

The findings of 1998-99 Household Income and Expenditure Surveys (HIES) showed that the poor households lack basic human assets such as education and physical

assets such as land, and had a larger number of children. Above all, these households were found to be mainly employed in elementary jobs especially as daily laborers in agriculture, construction, trade and transportation. Average size of poor household (8.4 persons) was larger compared to non-poor household (6.2 persons). One of the reasons for this difference is that 71.2 percent of women from poor households get married at the age between 15-19, compared to 61.2 percent of women of the same age group from non-poor households. Education was also one of the key determinants of poverty. Literacy rate of members of poor household (27.2 percent) was half that of non-poor households (51.5).The Government of Pakistan has been striving hard to improve the conditions of the poor in the country, through various welfare programs. These programs include Khushaal Pakistan Program, Food Support Program, Zakat Rehabilitation Grant, Micro-Credit Bank and Social Sector Funding. In the Khushaal Pakistan Program, the Government has allocated Rs. 20 billion for the period of two years (2001-2002). This program is aimed at increasing employment level and providing infrastructure such as roads, water supply, schools and drainage system in the rural areas. The Food Support Program is reported to be targeted towards the poorest of the poor, with a cash grant of Rs. 2,000 per annum to each poor household. Under Zakat rehabilitation Grant, which is also meant for the poorest of the poor and charity organizations, it is reported that out of 0.5 million registered poor, about 0.2 million are receiving Zakat on regular basis. Micro-credit banking program was initiated by the Government of Pakistan to provide easy access of credit to the poor households on personal guarantee basis. The program is being planned to be operated through involvement of the private sector including NGOs. Another major program is the social sector spending especially in development of human capital for primary education and basic health, with attention to water supply, sanitation, and women and child labor.

In short, poverty situation in Pakistan is worsening. This is basically a consequence of long neglect of fundamentals of socio-economic development of the country. While various programs have been initiated, efforts will have to go long way to bring any dent in the poverty situation.