

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

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Executive Summary

This study was undertaken with the overall objective of developing 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 provides 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 than in Rabi.
- 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 – 3.72 and are higher than those for households in un-improved 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.
- Head count 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. Poverty gap squared 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 head count of the chronic poor, proportion of non-poor in rainfed areas, chronic poverty gap and transient poverty gap were less using monthly expenditure.
- Monthly head count (income), poverty gap and poverty gap squared indices follow 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 are no significant differences 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 un-improved 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 rain-fed 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 un-improved 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 is 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), increased crop productivity.

The overall conclusions of this study are that (1) access to irrigation infrastructure, regardless of whether it is improved or un-improved, 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 un-improved 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 of resources, particularly land, with those have larger landholdings benefiting more compared to small land holders and landless; and (b) poor governance in water sector (poor infrastructure condition, including of the improved infrastructure, resulting from inadequate maintenance, un-reliable 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).