Assesment of Outcomes

Small Scale Community Physical Infrastructure

Irrigation, drinking water and sanitation interventions in Punjab

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Pakistan Poverty Alleviation Fund

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CONTENTS

ACRONYMS

PPAF	Pakistan Poverty Alleviation Fund
CPI	Community Physical Infrastructure
CED	Credit and Enterprise Development
WMC	Water Management Center
HID	Human and Institutional Development
H&E	Health and Education
RnR	Reconstruction and Rehabilitation
AJK	Azad Jammu and Kashmir
FATA	Federally Administered Tribal Area
ICT	Islamabad Capital Territory
DWSS	Drinking Water Supply Schemes
ERD	Evaluation, Research and Development

FOREWORD

Small scale-community based, water and infrastructure interventions are an integral part of PPAF's mandate for poverty reduction and improved quality of life. Such interventions typically are undertaken in roads and communication, drinking water supply, sanitation and irrigation sectors. By June 2010, over 17,000 community physical infrastructure interventions had been deployed in 121 districts of Pakistan.

This study constitutes second phase of PPAF funding by the World Bank, focused on gauging overall effect of these interventions through formalized impact assessment. It seeks to examine outcomes of drinking water supply, drainage/sanitation and irrigation on beneficiary households from 10 districts in the province of Punjab. The methodology adopted (a before-after, with-without approach), incorporated sampling based on 50% of sub projects initiated at the baseline stage, using a range of 15 major and sub indicators.

The study was initiated by Chief Stragegy Officer through Evaluation, Research and Development unit. It was designed and conducted by Muhammad Masood Khalid, while data analysis and report writing was undertaken by Syed Hassan Akbar. Editorial assistance was extended by Anita U. Bakhtiar (CSO Office). The facilitation and support provided by Partner Organizations is gratefully acknowledged.

Qazi Azmat Isa

Chief Executive Officer/Managing Director

EXECUTIVE SUMMARY

Attempts aimed at targeting poverty and enhancing livelihoods of the poor in Pakistan require a sustained and continuous effort to add, upgrade and improve small scale physical infrastructure in poor communities. Organized poor communities have generally shown demand for unpaved roads and bridges, irrigation, infrastructure, drainage and sanitation, safe drinking water, drought prevention and flood protection mechanisms. These “conventional” Community Infrastructure Schemes (CPIs) play a significant role in improving living standards and positively impact livelihood generation in intervention communities. By June 2009, PPAF had provided its PO’s grants to undertake 15,204 CPI interventions across 117 districts of Pakistan. Approximately 36.67% of these were initiated in Punjab and included 320 Drinking Water Supply Schemes (DWSS), 2,810 Irrigation Schemes, 1,591 Drainage and Sanitation Schemes, 795 Roads and Bridges and 3 Flood Protection Works.

This study analyzes the outcomes and impact of conventional infrastructure interventions in Punjab: namely irrigation, drinking water, drainage and sanitation interventions. The study draws on the "with-without" and "before-after" methodology by developing treatment and control groups. Indicators of outcomes and impact have been measured through a baseline survey of expected CPI beneficiaries and control group conducted in 2007 and a follow-up panel impact survey of the same respondents in 2009. Cases were dropped from analysis where respondents from the baseline survey could not be traced during the impact stage. The analysis is based on a final sample of 434 households of which 319 were treatment and 115 control households. While the quality of data was generally good, accurate estimation of household income and expenditure remained a challenge due to the reliance on respondents memory and training of data collection teams. Robust conclusions could not be drawn regarding the impact of drinking water supply and sanitation schemes, as the corresponding sample sizes were relatively small.

Key findings and conclusions of the study, segregated by intervention type, are as follows:

Irrigation Schemes:

It was observed that in 2009, there was a noticeable decrease in the number of times land is irrigated for each major crop and the number of hours required for irrigating land once, for each crop. With the exception of cotton, all major crops reported a decrease (between 1% and 3%) in the frequency with which land was irrigated for each cropping cycle. Nevertheless, irrigation time demonstrated a considerable improvement: indeed, the number of hours required for irrigating land once decreased by 20% on average and consequently, number of working hours in the field also decreased.

In 2009, the average land under cultivation for a household, increased by 5.62% to 9.76 acres. This increase may be attributed to better water management, increased water availability and introduction of innovative techniques such as sprinkler and drip irrigation. Overall, small farmers i.e. households with 12.5 acres or less of farm holding, decreased from 65.43% to 63.55% and while the percentage of households with large farms did not register an increase in 2009, percentage of households reported with medium farm holdings increased appreciably from 6.07% to 7.48%.

Respondents from the project areas reported substantial increase in yields of all major crops: namely wheat, cotton, rice and sugarcane. Sugarcane growers reported the highest increase of almost 75% in yield to 28,022 kg/acre.

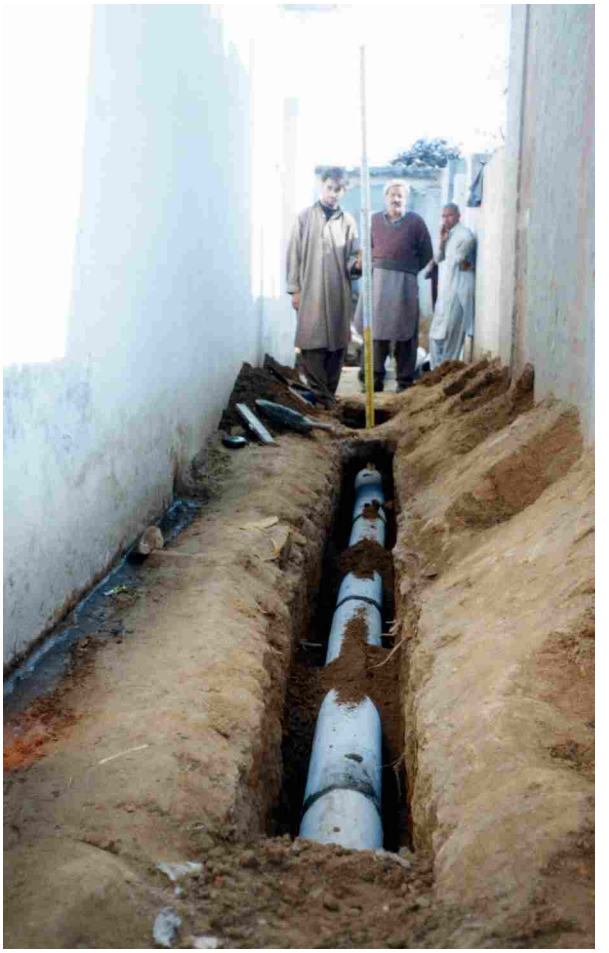
Expectedly, the lowest increase in yield of 37% was reported by growers of wheat, as wheat is not a water-intensive crop. This increase in yield per acrez may, to some extent, be attributed to changes in cropping patterns and increased water availability. However, the change may also have been caused by improved inputs other than water or better technology. Nevertheless, changes in yield of the project areas for irrigation are much larger than the trend increase in yield of wheat (4%) and rice (8%), as reported by the Punjab Agricultural Department over the same period.

About 20% of respondents in the treatment group reported a change in cropping patterns. Reasons cited for the change included increased water availability, access to better quality seeds and time to allow soil regeneration. Overall, a significant change in male and female work hours in the field was also witnessed amongst our sampled households. Indeed, average male work hours saw a decrease of 15.26% to 5.22 hours while average female work hours decreased by 18.88% to 1.56 hours per day in the field. This decrease in work hours may be associated with the introduction of innovative irrigation techniques such as drip and sprinkler irrigation which require considerably less time in the field from farmers.

Drinking Water Supply Schemes:

DWSS beneficiary households reported a greater increase in piped water supply compared to control group households. Percentage of treatment households using piped water accessed through taps increased to 40% in 2009 compared to 12.5% amongst control households. Piped water conveyed through closed underground systems provides the safest method of accessing drinking water with the least chances of contamination: thus this increase positively impacted treatment households. Significantly, drinking water access through open sources such as canals, open wells, streams and ponds decreased from 7.2% households in 2007 to no household in 2009, suggesting a marked improvement in safe drinking water access amongst treatment households.

The prevalence of major diseases such as malaria, typhoid and diarrhea amongst our treatment households saw a decrease in 2009 compared to 2007. The percentage of households reporting malaria decreased from 45% in 2007 to just 7.14% in 2009. Similarly, the percentage of households reporting typhoid decreased from 30% in 2007 to 7.14% in 2009 while simultaneously the percentage of households reporting diarrhea declined from 10% in 2007 to none in 2009. Overall, the prevalence of the major diseases discussed above decreased considerably more amongst our sampled DWSS treatment households than amongst our sampled DWSS control households where no drinking water supply scheme intervention had been initiated.



Drainage and Sanitation CPIs:

The treatment group for drainage and sanitation CPIs reported an increase of 9% in the percentage of households connected with adequate drainage systems. Correspondingly, the control group demonstrated a 15% decrease in the percentage of households connected to adequate drainage. Simultaneously, 93% of our sampled treatment households in 2009 reported using latrines located inside homes while just 60% of our control households reported using latrines located inside the house in 2009. Significantly, the percentage of treatment households using open fields for latrines decreased from 18.2% in 2007 to 5.2% in 2009 while the corresponding percentage of control households accessing open fields for latrines decreased from 60% in 2007 to 40% in 2009. Overall, CPI drainage and sanitation interventions had a noticeable positive influence on drainage and sanitation outcomes amongst our treatment sample compared to our control sample.

Impact indicators, such as household income, expenditure and food security reported a considerably less significant impact in 2009. The following is a summary of assessments under each category:

Household Income and Expenditure:

Overall for our entire sample household incomes decreased in 2009 compared to 2007. Average household income amongst the control group decreased from Rs. 18,777 to Rs. 16,991 in 2009 while average incomes amongst our treatment households decreased from Rs. 20,757 to Rs. 20,322. Importantly, while incomes from agriculture decreased considerably amongst the control group, from Rs. 9,259 to Rs. 6,735 in 2009 the average incomes from agriculture amongst our treatment sample reported an increase from Rs. 9,094 to Rs. 9,492 in 2009. This means that while our sample suffered from recessionary effects settled into the economy overall, the relative improvement in agricultural incomes amongst our treatment households allowed intervention communities to sustain their livelihoods better as compared to non intervention communities. This result is also borne out by the analysis of irrigation sampled households where again agricultural incomes amongst irrigation control households decreased from Rs. 9,736 in 2007 to Rs. 6,598 in 2009 while correspondingly agricultural incomes amongst our treatment households increased from Rs. 9,726 to Rs. 10,794. This implied that irrigation interventions had a positive impact amongst our intervention communities by positively impacting incomes from agriculture.

According to the povertylines defined in the Economic Survey of Pakistan 2009, about 44% households in the control group fell below the povertyline which was an increase from 2007 when only 40% households had fallen below the povertyline. Correspondingly, 35% households in the treatment group fell below the povertyline in 2009 demonstrating a decrease from 39% in 2007. Therefore, while the percentage of households falling below the povertyline decreased by 4% amongst our treatment households, the corresponding change reported amongst the control group was an increase of 4% in the percentage of households falling below the povertyline.

Average monthly expenditures incurred by households increased drastically between 2007 and 2009. The control group witnessed an increase of almost 53% while the treatment group witnessed a corresponding increase of 79% during the years under review. This increase in overall expenditures can be attributed to food inflation which affected rural households considerably between 2007 and 2009. Due to the continuous rise in food inflation during the baseline and impact surveys, the share of food expenditure in total household expenditure rose to almost 40% in 2009 from 17% in 2007 for the control group.

Similarly, the treatment group too witnessed a sharp rise in the share of food expenses from 23% in 2007 to 47% in 2009.

Food Security:

The average weekly consumption of wheat and rice, by far the greatest sources of nutrition, increased in treatment households by 17.47% and 6.18% respectively between 2007 and 2009. This demonstrated an improvement in food security as treatment households were able to access more key food items in 2009 than in 2007. Correspondingly, wheat consumption amongst control households decreased to 21.35 kg per week and even though rice consumption recorded an increase to 2.56 kg per week, this increase was nominal at 3.23%. Sugar, which forms an important source of energy for poor households, also demonstrated an increase amongst our treatment sample. From 4.02 kg per week, sugar consumption increased to 4.19 kg per week. However, sugar consumption in our control sample decreased by 9.25% to 3.53 kg per week demonstrating a decrease in sources of energy for an average household.

1. INTRODUCTION

1.1 Reasons for Conducting the Study:

With the culmination of the second phase of PPAF funding under the World Bank, the organization started a process of impact assessment to gauge overall effect of PPAF interventions across all spheres of poverty alleviation during 2005 and 2009. As part of this process of self assessment and in order to improve on key learnings from the period to provide necessary changes where required, this study focuses on the overall impact of conventional physical infrastructure interventions of the CPI unit in Punjab.

The study seeks to examine outcomes and impact of conventional CPI schemes specifically, DWSS, drainage, sanitation and irrigation by collecting a sample of beneficiary households from within Punjab. The study introduces, briefly, the key demographic profile of sampled households and then attempts to examine the impact of conventional schemes on household income and expenditures. Realizing the diverse objectives of the sub-categories of CPI conventional schemes the study provides an indepth analysis on health and disease prevalence so as to focus on outcomes from DWSS and sanitation schemes. It also provides analysis on the agricultural economy by highlighting production, water consumption and land utilization within sampled households for a clearer understanding of the outcomes of irrigation specific projects.

1.2 Background:

Pakistan Poverty Alleviation Fund (PPAF) is an apex autonomous organization registered under section 42 of Companies Act 1984. The organization, established under Government of Pakistan and funded through the World Bank, commenced its operations in April 2000 adopting a strategy of poverty alleviation involving interventions in infrastructure, micro-credit, human and institutional development, health and education and aimed at enhancing livelihoods and reducing the incidence of poverty in rural and urban Pakistan. These interventions were implemented through PPAF's POs operating in 124 districts across the country, making it the single largest provider of funds and technical assistance to private sector development organizations.

As of June 2009, PPAF had disbursed funds worth Rs. 61.16 billion through its 6 core units namely Water Management Center (WMC), Community Physical Infrastructure (CPI), Health and Education (H&E), Credit and Enterprise Development (CED), Human and Institutional Development (HID) and Reconstruction and Rehabilitation Programme (RnR). “These funds have financed over 700,000 loans, 1,500 infrastructure schemes, 22 health and education facilities and over 1,520 trainings for participating community members and staff of partner organizations”.[1]

PPAF's CPI unit up to June 2009 had initiated 15,204 projects through 48 partner organizations in 117 districts of Pakistan, AJK, FATA and ICT. These 15,204 projects directly impacted 1,093,799 beneficiary households with a total beneficiary population of 7,749,103. Punjab accounted for the majority of projects undertaken through the CPI unit with 36.67% of total projects implemented in the country totaling 5,574. The vast majority of projects undertaken by CPI unit in Punjab came under the category of conventional physical infrastructure which includes 320 DWSS, 2,810 Irrigation, 1,591 Drainage and Sanitation, 795 Roads and Bridges, and 3 Flood Protection Works.[2] Figure 1.2.1 highlights the share of each sub-category within conventional infrastructure interventions.

1. PPAF Annual Report 2008-2009. page 2.
2. Ibid. page 17.

Figure 1.2.1 Percentage Share of Each Sub-Category under Conventional CPI

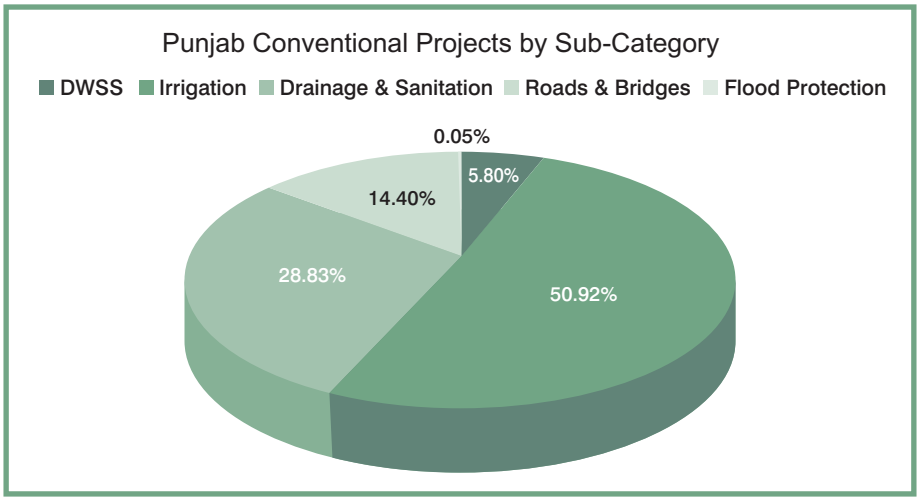


Table 1.2.1 below shows the share of each province with Punjab accounting for 5,574 projects, NWFP for 3,044 projects, Sindh with 2,930 projects, Balochistan with 2,354 projects and lastly 'others', inclusive of FATA, AJK, Northern Areas and ICT, accounting for 1,302 projects. Punjab accounts for the vast majority of CPI schemes, keeping in view its historical and geographical ascendance in agriculture. Indeed, a closer look at the composition of infrastructure interventions within Punjab shows that almost 51% of interventions in Punjab were related to irrigation schemes/sub-projects (see table 1.2.2). Similarly, out of the total irrigation interventions initiated by PPAF between 2000 and 2009, almost 60% were located in Punjab. Thus, the importance of agriculture in Punjab's rural economy coupled with the need of upgrading and maintaining its critical irrigation network has meant that PPAF has intervened considerable more in Punjab.

Table 1.2.1 Provincial Share in CPI Infrastructure Schemes FY 2000 to FY 2009

	Projects*	Beneficiary Households	Beneficiary Population
Punjab	5,574	476,735	3,117,174
NWFP	3,044	270,035	2,018,656
Sindh	2,930	149,961	1,078,660
Balochistan	2,354	105,821	820,129
Others	1,302	91,247	714,484
Grand Total	15,204	1,093,799	7,749,103

* These projects do not include the 83 schemes initiated under the Pilot DMPP Project of PPAF- I.
Source: PPAF CPI MIS for June 2009.

Table 1.2.2 Conventional CPI under PPAF II by Intervention Category

Category	PPAF-II
Drainage and Sanitation	1,983
DWSS	2,332
Flood Protection Works	120
Irrigation	2,642
Roads and Bridges	1,066
Conventional Total	8,143

Source: PPAF Annual Report 2008, 2009.

Keeping a focus on conventional interventions undertaken by CPI unit, table 1.2.2 provides a breakdown of the sub-categories under conventional CPI during 2005 to 2009. This period i.e. 2005 to 2009 corresponds with PPAF-II which refers to the second tranche of World Bank funding for PPAF. During this period a total of 8,143 conventional schemes/projects were initiated by the CPI unit across Pakistan. Of these 8,143 schemes/projects 1,983 were under drainage and sanitation, 2,332 were under drinking water supply schemes (DWSS), 120 interventions were Flood Protection Works, 2,642 were under Irrigation representing the majority and lastly 1,066 were under Roads and Bridges.

1.3 CPI Intervention Types:

The following section briefly introduces each sub-category of intervention undertaken by the CPI unit under conventional physical infrastructure:

1.3.1 Drinking Water Supply Schemes:

Drinking Water Supply Schemes (DWSS) include sub-projects initiated in intervention localities in order to ensure the supply, quality and sustainability of clean and hygienic sources of drinking water. Sub-projects under DWSS include hand-pumps, dug wells, water storage dams, tap/piped water supply, desalination plants and water tanks. etc. Project type and scope depends on the community's location and access to existing water supply.

1.3.2 Drainage and Sanitation:

Proper systems for sanitation and sewerage disposal are an integral part of environmental sustainability within communities. CPI unit sub-projects under this category seek to improve and upgrade the provision of drainage and sanitation facilities within communities so as to decrease the prevalence of disease. Sub-projects under this category include community latrines, upgrading and cleaning sewers and drains, garbage disposal pits etc.

1.3.3 Flood Protection Works:

The incidence of flooding in Pakistan's river fed agricultural lands provides a significant threat to rural livelihoods as flooding destroys not only existing crop but also degrades the quality of soil, leaving it unusable for many cropping cycles. Flood Protection Works include sub-projects such as causeways/diversions, protection walls and earthen embankments.

1.3.4 Irrigation Schemes:

Agriculture, directly or indirectly, accounts for the vast majority of rural livelihoods in Pakistan. With a vast irrigation network feeding agricultural land across the country, the maintenance and upgrade of this network is vital to continuing attempts at poverty alleviation in rural households. As such CPI's irrigation schemes with sub-projects such as water course lining, pumping systems, karez[3] maintenance, tube-wells and storage reservoirs attempt to provide technical and financial assistance required in rural areas of the country to supplement livelihoods and improve water conservation.

1.3.5 Roads and Bridges:

PPAF through the operations of its CPI unit supports the building of small scale wooden or paved roads and bridges within intervention communities. These projects play a key role in providing access, improving transportation and allowing market linkages in remote, inaccessible areas of the country. This category includes sub-projects such as link roads and bridges, which play a key part in enhancing the access of the poor to publicly provided social services and facilities.

[3]Karez refers to the local irrigation system under use in Balochistan which is based on underground water conveyance tunnels to reduce precipitation.

1.4 Financing and Implementation Arrangements for CPI Sub-Projects:

1.4.1 Pakistan Poverty Alleviation Fund:

PPAF's core operating unit Community Physical Infrastructure (CPI) provides financial support, in the form of loans and grants, as well as technical support to PO's for the implementation of approved small scale physical infrastructure interventions like drinking water supply schemes (DWSS), irrigation infrastructure projects, water canal lining, flood protection, drainage and sanitation schemes, unpaved roads and bridges and small scale alternate energy systems. CPI unit's interventions are demand driven and incorporate a community led approach whereby mutual consultation amongst community members, PO's and PPAF technical staff highlight areas of intervention. All interventions are designed to incorporate minimum community participation in kind or cash, so as to build project ownership amongst communities for long term sustainability. Since PPAF operates on a public-private partnership system, it signs individual implementation agreements with its PO's and provides financial and technical assistance for project implementation.

1.4.2 Partner Organizations:

As of June 2009, PPAF had 48 PO's implementing CPI projects countrywide. These PO's included large scale rural support programs such as, National Rural Support Programme (NRSP) and Punjab Rural Support Programme (PRSP), as well as smaller, more focused partners like Soon Valley Development Programme (SVDP). Once an implementation agreement is finalized between the partner organization and PPAF, the PO is responsible for creating community organizations through social mobilization and implementing proposed projects.

Of the 48 PO's working with CPI unit across Pakistan, 18 PO's implemented projects in 35 districts of Punjab. Of these 18 partner organizations our study aims to assess the impact of conventional projects implemented by the following 7 PO's namely: Ghazi Barotha Taraqiati Idara (GBTI), National Rural Support Programme (NRSP), Rural Community Development Society (RCDS), South Asia Partnership Pakistan (SAP-PK), SOS Children's Villages, (SHER) and Women Social Organization (WSO). Conventional projects within the sub-categories of DWSS, drainage & sanitation and irrigation undertaken by these 7 PO's in Attock, Khushab, Kasur, Nankana, Muzaffargarh, Sheikhupura, Lodhran, Rahimyar Khan and Mianwali districts of Punjab have been randomly selected for this study.

2. STUDY DESIGN, ENUMERATION AND ANALYSIS

2.1 Strategic Issues:

All impact assessment studies focus on providing a scientific method for examining the results of poverty alleviation interventions. While study design and methodology differ according to the type of intervention being assessed, a key focus remains on providing results which are unbiased and contain minimum sampling errors. An important issue in assessing physical interventions is that unlike credit or advocacy interventions, physical infrastructure interventions contain sub projects that affect the whole community. Therefore, samples drawn for such study involve the creation of treatment and control groups based on communities rather than individual beneficiaries. Indeed, pinpointing all beneficiaries of a drainage line or a water course lining project is fraught with difficulties. However, the selection of control groups, i.e. communities located close to the intervention area and reflecting the same socio-economic background allows researchers to separate the intervention's impact on the treatment community. However, due to the nature of the projects being studied, the complete elimination of selection bias is impossible. Indeed, the same characteristics which convince a program manager to provide infrastructure interventions in one community rather than another are a direct reason for the inherent selection bias in all infrastructure impact assessments. Although, randomization is an ideal rigorous method for evaluating impact, the practical implementation of randomization in the selection of intervention communities is both technically and socially difficult.

Another key consideration in such impact assessments is the contamination of the control community. When selecting a control community at the baseline, great care is taken in ensuring that no similar interventions have been undertaken in the locality. However, since modes of financing for rural infrastructure programs include NGO's, international donors and local governments, PPAF cannot ensure complete non-contamination of control villages over the two years of the study. Nevertheless, as PPAF and its partners constitute the greatest source of financing and implementation for rural infrastructure projects, control villages in our sample have largely remained uncontaminated over the course of the study.

2.2 Sample Design:

2.2.1 Sample Size:

Table 1.2.1 demonstrates that the population for our study is 476,735 beneficiary households in Punjab where CPI conventional interventions were undertaken by PPAF till June 2009. Using simple random sampling the operational sample size rule can be expressed as follows[4]:

$$n \geq \left(\frac{1.96}{\varepsilon}\right)^2 \times p(1-p)$$

Where n = Sample Size
ε = Error Margin
p = Confidence Level

Therefore, with a 95% confidence level and 5% error margin the minimum required sample size for adequate representation is 384 households. Our actual sample for the study is as follows:

Table 2.2.1.1 Baseline and Impact Sample

	Baseline Survey Conducted in Sep 2007 (Households)	Impact Survey Conducted in May 2009 (Households)
Irrigation	484	352
Drainage & Sanitation	149	60
DWSS	29	22
Total	662	434

Table 2.2.1.1 provides the actual sample of households collected for the study during the baseline and impact surveys in 2007 and 2009 respectively. Since the study is designed as a panel study where households interviewed in the baseline survey are re-enumerated for the impact survey the overall functional sample for the study decreased to 434 households as 662 households either migrated, were unavailable, could not be traced or refused to cooperate during the impact survey. All households in the baseline survey, which were not enumerated in the impact stage, were dropped from the sample when conducting analysis of field data.

[4] Battese, George. 2007. "Note on Sample Selection". Survey on Domestic Commerce. Ministry of Commerce, Government of Pakistan. (Dr. George Battese is Adjunct Associate Professor School of Business, Economics & Public Policy. University of New England, Australia)

2.2.2 Sample Selection:

Once our sample size has been finalized the second important step is sample selection. As mentioned previously we have adopted a simple random sample design for the study. Accordingly, a three stage random sample methodology was followed so as to ensure minimization of bias. At the first stage, 7 PO's out of the 18 CPI PO's operating in Punjab were selected randomly. At the second stage, 9 districts out of Punjab's 35 districts with CPI conventional interventions till June 2009 were selected randomly so as to provide a provincially representative sample. Lastly, beneficiary communities were randomly identified from the 7 PO's within the 9 selected districts. Table 2.2.2.1 below highlights the distribution of the selected partner organizations across the 9 selected districts in Punjab.

Table 2.2.2.1 Sampled Districts and Associated Partner Organizations

District	Partner Organization	Sub – Category
Attock	GBTI, NRSP	Drainage & Sanitation
Kasur	RCDS, SOS	Irrigation
Khushab	SHER	Drainage & Sanitation
Lodhran	SAP-PK	Irrigation
Nankana	RCDS	Irrigation
Sheikhupura	RCDS	Irrigation
Mianwali	NRSP, SAP-PK	DWSS, Irrigation
Muzaffargarh	WSO	Irrigation
Rahimyar Khan	NRSP	Irrigation

Of the selected sample, Attock and Khushab provided sample households covering drainage & sanitation interventions while Kasur, Lodhran, Nankana, Sheikhupura, Mianwali, Muzaffargarh and Rahimyar Khan provided sample households for irrigation while Mianwali also accounted for data on DWSS. A closer look at the sampled districts also demonstrated the spread of selection. This was a result of conducting simple random sampling at the district level through stratification of the province along geographical lines namely; Western Punjab, Northern Punjab, Southern Punjab, and Central Punjab. Therefore, the final sample contained representation from each stratum increased the representativeness of the overall sample.

Within each sampled district, along with the treatment households (those households which were direct beneficiaries of PPAF interventions) a sample of control households(those households where similar infrastructure interventions were not undertaken by PPAF) were also selected. This was done in order to utilize the experimental research design with a with-without approach examining the change across time in treatment households and comparing that with change across time in control households.

2.3 Questionnaire Design:

The Household Questionnaire or study instrument was designed by core staff of the Evaluation, Research and Development (ERD) unit of the PPAF. Due to selection of numerous districts across the province for sampling purposes, the questionnaire was designed specifically to capture all important socio-economic variables which would be common across Punjab. The instrument included questions on family details, education, employment status of household head, housing infrastructure, health, household income, household expenditure, household food consumption and household assets. The impact questionnaire for the 2009 survey included an addendum on agricultural practices and included questions on yields, water consumption, irrigation time and cropping patterns. This addendum was administered only for the irrigation treatment households and provided key inputs in examining the impact of CPI interventions on agricultural production patterns in sampled households.

2.4 Field Work:

For both baseline and impact surveys, two day comprehensive training was conducted for enumerators under the supervision of trained Evaluation, Research and Development (ERD) unit staff and field work was carried out simultaneously for a total of three weeks each. Survey teams were successful in creating a friendly environment in sampled communities and faced very few problems. It is also important to note that respondents within communities were selected randomly and included poor households, middle income households, as along with relatively well-to-do households. Survey monitoring was conducted by ERD staff which conducted random spot checks on field teams in each district. ERD staff also conducted random validation checks of filled questionnaires.

Data entry for both 2007 and 2009 surveys was conducted centrally at the ERD unit in PPAF. A specialized data entry module was developed for the field instrument and trained data entry staff was hired to conduct data entry.

Once all data was entered, data cleaning was undertaken by ERD staff including random validation of entered data with filled in questionnaires.

2.5 Analysis Methodology:

Analysis methodology adopted for the study utilizes a with-without approach by developing a treatment group and control group. Changes in variables of interest are tracked over the study period: in this case 2007 as baseline year and 2009 as impact survey year. Differences in changes over time between the control group and treatment group demonstrate the impact of our intervention on the treatment group. An advantage of this study design is that macro-economic variables affecting a community such as inflation, drought conditions and unemployment are cancelled out when comparing differences between the two study groups as macro-economic conditions are equally likely to affect one group as they are likely to affect the other group. However, we must also note that this study design is unable to completely remove the effects of selection bias which is an inevitable result of social service delivery. Indeed, the factors that resulted in the selection of particular community for infrastructure intervention instead of another community are likely to still affect our results. It is also important to note that when analyzing agricultural economy for irrigation schemes we depart from the with-without approach and instead utilize a before-after approach. The reason for this deviation is that the addendum to our field instrument carrying questions on agriculture was added subsequently in 2009 and carries data on before-after based on respondent memory and perception.

3. CHANGES IN SOCIO-ECONOMIC PROFILE OF BENEFICIARIES

3.1 Demographics:

Our sampled households for baseline and impact surveys in 2007 and 2009 respectively were 434. Of these, 319 were treatment houses while 115 were control households. The total population represented by the households surveyed was 3,429 in 2007 and 3,542 in 2009. Table 3.1.1 highlights that 45.1% of treatment population sampled in 2007 was female and that this percentage remained approximately the same in 2009 at 45.7%. However in 2009 the proportion of female population increased considerably from 2007 with 47.7% of the control population being female. Additionally, the average household size increased by almost the same in both treatment and control groups.

Table 3.1.1 Demographic Details of Sampled Households

Description	Treatment		Control	
	2007	2009	2007	2009
Households	319	319	115	115
Population	2546	2651	865	891
- Male	54.9%	54.3%	53.5%	52.3%
- Female	45.1%	45.7%	46.5%	47.7%
Household Size	7.985	8.30	7.52	7.74
Literacy	51.06%	54.09%	50.40%	51.63%
Dependency Ratio	74.98%	71.47%	68.95%	71.02%

A significant difference was witnessed between literacy rates in the control households and treatment households. While literacy in the treatment group increased by 3.03 percentage points between baseline year and impact survey year, the corresponding increase in literacy amongst control group households was just 1.23 percentage points. Interestingly, while the dependency ratio decreased amongst treatment group households suggesting an increase in labor force, the control group witnessed an increase in dependency ratio. This meant that on average, household income earners in the treatment group were less burdened in 2009 than in 2007 while on average household income earners in the control group were more burdened in 2009 than in 2007.

Figure 3.1.1 Household Members by Age Group

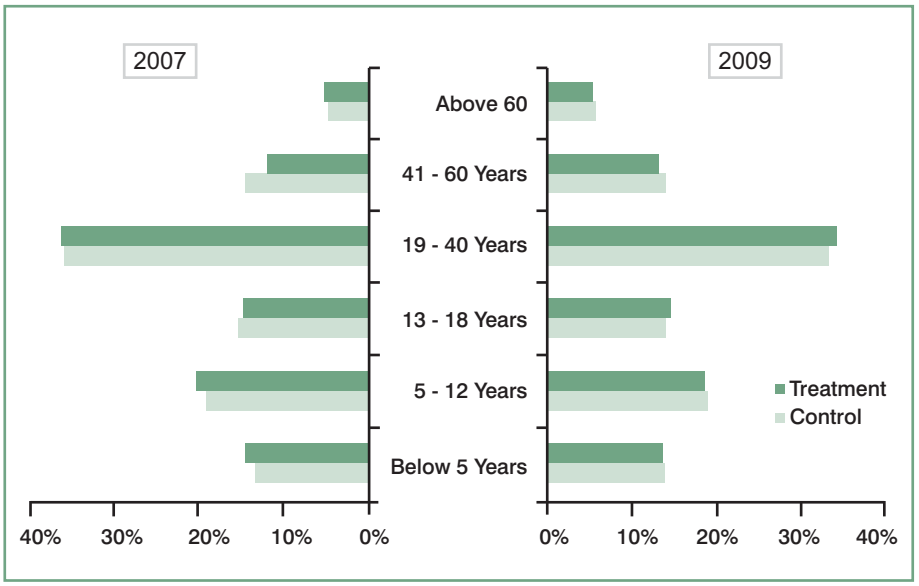


Figure 3.1.1 above provides the distribution of treatment and control household members by age group. In 2009, the control group demonstrated an increase in 12 years and below members by reporting a greater percentage of members in that category. On average, working class group of 19-60 years showed the largest concentration of population in treatment and control groups.

3.2 Food Security:

Food security, i.e. availability, access and consumption of key nutrient providing food items is an important aspect of examining poverty in study communities. Table 3.2.1 provides the average weekly consumption numbers for a household in 2007 and 2009. The data is collected for major food items such as wheat, rice, milk, sugar and pulses. Overall, our treatment households witnessed an increase in the consumption of major food items between 2007 and 2009. A slight decrease (6.67%) was witnessed in the consumption of pulses by treatment households in 2009 however, the corresponding change in consumption of pulses amongst the control group was a percentage decrease of almost 19% in 2009.

Table 3.2.1 Weekly Household Consumption of Key Food Items

Food Item	Treatment		Change	Control		Change
	2007	2009		2007	2009	
Wheat (kg)	18.77	22.05	17.47%	21.71	21.35	-1.66%
Rice (kg)	2.75	2.92	6.18%	2.48	2.56	3.23%
Pulses (kg)	1.95	1.82	-6.67%	1.96	1.57	-19.09%
Eggs (No.)	6.56	7.79	18.75%	5.23	6.48	23.90%
Milk (Liter)	14.53	15.79	8.67%	12.43	13.56	9.09%
Sugar (Kg)	4.02	4.19	4.23%	3.89	3.53	-9.25%

Average weekly consumption of wheat and rice, by far the greatest sources of nutrition, increased in treatment households by 17.47% and 6.18% respectively between 2007 and 2009. This demonstrated an improvement in food security as treatment households were able to access more key food items in 2009 than in 2007. Correspondingly, wheat consumption amongst control households decreased to 21.35 kg and even though rice consumption recorded an increase to 2.56 kg per week: this increase was nominal at 3.23%. Sugar, which forms an important source of energy for poor households, also demonstrated an increase amongst our treatment sample. From 4.02 kg per week, sugar consumption increased to 4.19 kg per week. However, sugar consumption in our control sample decreased by 9.25% to 3.53 kg per week demonstrating a decrease in sources of energy for an average household.

Overall, food security in the treatment group was positively impacted in 2009 compared to 2007. Indeed, the relative improvement in food security amongst treatment households, compared to control households, was a reflection of differences in household income and expenditure. A look at section 3.6 reveals that household incomes deteriorated more amongst the control group than amongst the treatment group between 2007 and 2009. Overall, 44% of control group households fell below the povertyline while only 35% of treatment group households fell below in 2009. Combined, this data reveals that the control group from 2007 to 2009, became worse off in food security cumulatively than the treatment group.

3.3 Housing Infrastructure:

In 2009, 27.27% of our sampled households in the control group had Katcha housing structures. This percentage demonstrated a decrease from 2007, when almost 29% houses sampled were Katcha. However, the treatment group in both 2007 and 2009, showed 15.89% households were living in Katcha structures. This meant that the treatment group, unlike the control group, demonstrated no improvement in quality of housing structures between 2007 and 2009 for the poorest segment of the sampled population. Similarly, the control group demonstrated a greater improvement in both percentage of households with Pucca and Pucca & Katcha housing structures between 2007 and 2009. While in 2007, the percentage of households with Pucca housing were 48.29% compared to 43.64% in control group, in 2009 the control group reported an improvement over treatment group with 59.09% households reported living under Pucca housing structure.

Table 3.3.1 reports that in 2009, 16.01% more households in the treatment group had a latrine inside the house, compared to the control group which only had 65.22% households with a latrine inside. Indeed, the percentage point decrease in open field and outside latrine[5] use was greatest in the treatment group between 2007 and 2009. This greater decrease, compared to the control group, was also reflected in the greater increase in "inside" house latrine use amongst treatment households.

[5] Outside Latrine refers to constructed latrines which are within the boundary walls of the house but are accessible from the outside of the house.

Table 3.3.1 Percentage of Households Reporting on Housing Infrastructure

		Treatment		Control	
		2007	2009	2007	2009
House	Katcha	15.89%	15.89%	29.09%	27.27%
	Pucca	48.29%	58.88%	43.64%	59.09%
	Pucca & Katcha	35.83%	25.23%	27.27%	13.64%
Latrine	Inside	63.32%	82.13%	57.39%	65.22%
	Open Field	31.66%	16.93%	37.39%	26.96%
	Outside	5.02%	2.51%	5.22%	3.48%
Fuel	Wood	81.37%	84.18%	88.10%	87.29%
	Gas	3.56%	7.34%	3.17%	4.24%
	Other	15.07%	8.47%	8.73%	8.47%
Electricity	Connected	89.69%	93.13%	97.27%	94.55%

Similarly, percentage of households using gas as fuel increased to 7.34% amongst the treatment households compared to 4.24% in control households. The increase in gas fuel consumption between 2007 and 2009 was greater in treatment group as compared to the control group. While electricity access was greater amongst the control group in 2009 with 94.55% households reporting electricity connections, the increase in percentage point between 2007 and 2009 was greater for the treatment group which demonstrated an increase in electricity connections from 89.69% in 2007 to 93.13% in 2009.

3.4 Employment:

Self farming, service/job and non-farm labor constituted a major source of employment in our sampled households. A key aspect of examining the impact of PPAF's conventional infrastructure interventions in Punjab is the analysis of employment trends. Significantly, unemployment increased in both control and treatment groups over the study period: a trend that reflects the economy's overall recessionary mode. Table 3.4.1 and Table 3.4.2 report disaggregated data on employment for DWSS Drainage & Sanitation as well as irrigation households.

Table 3.4.1 Employment by Sector in DWSS and Drainage & Sanitation Sampled Households

	2007			2009		
	Control	Treatment	Total	Control	Treatment	Total
Not Working	35.11%	43.82%	42.48%	40.54%	44.15%	42.35%
Household Work	29.79%	23.94%	24.84%	27.93%	29.14%	28.54%
Self Farming	15.96%	9.85%	10.78%	14.41%	7.33%	10.87%
Farm Labor	0.00%	1.16%	0.98%	0.00%	1.57%	0.79%
Non-Farm Labor	7.45%	7.34%	7.35%	8.11%	6.11%	7.11%
Service/Job	8.51%	5.60%	6.05%	5.41%	7.33%	6.37%
Business	1.06%	2.90%	2.61%	1.80%	2.62%	2.21%
Other	2.13%	5.41%	4.90%	1.80%	1.75%	1.77%

Table 3.4.2 Employment by Sector in Irrigation Sampled Households

	2007			2009		
	Control	Treatment	Total	Control	Treatment	Total
Not Working	38.91%	44.38%	42.87%	49.87%	46.97%	47.76%
Household Work	27.50%	21.65%	23.26%	22.44%	24.16%	23.69%
Self Farming	11.41%	15.29%	14.22%	9.10%	11.79%	11.06%
Farm Labor	1.95%	2.12%	2.07%	2.31%	2.79%	2.66%
Non-Farm Labor	8.43%	6.16%	6.79%	8.46%	6.88%	7.31%
Service/Job	3.37%	4.14%	3.93%	3.85%	4.48%	4.30%
Business	1.69%	1.28%	1.39%	2.05%	2.26%	2.20%
Other	6.74%	4.98%	5.47%	1.92%	0.67%	1.01%

3.5 Education:

As discussed earlier, overall literacy levels amongst sampled households during the study period remained at 50% for treatment and control groups. This section examines data on education status in greater detail by analyzing school attendance and highest degree for sampled households. The percentage of household members who had never attended school decreased between 2007 and 2009 for both groups. While this decrease was 3

percentage points amongst treatment group, the control group demonstrated a corresponding decrease of 2 percentage points. Table 3.5.1 lists the percentage of household members who had never attended school, had previously attended school and who were currently attending school. The most visible difference between treatment and control groups was seen in the percentage of household members who were presently attending school. We can see that while the percentage of household members presently attending school remained constant for the control group, the treatment group actually demonstrated an increase of 2 percentage points to 24%. This meant that present enrollment increased in the treatment group while it remained constant for the control group over the study duration.

Table 3.5.1 School Attendance for Sampled Households in 2007 and 2009

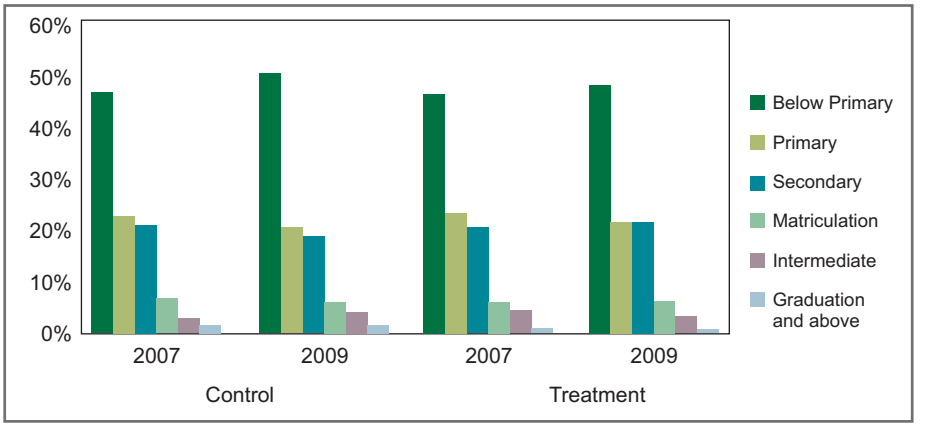
School Attendance	2007						2009					
	Control		Treatment		Total		Control		Treatment		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
Never Attended School	429	50%	1245	49%	1674	49%	425	48%	1217	46%	1642	46%
Previously Attended School	233	27%	734	29%	967	28%	263	30%	806	30%	1069	30%
Presently Attending School	203	23%	567	22%	770	23%	203	23%	628	24%	831	23%

Table 3.5.2 provides frequencies and percentages of household members by education level achieved. Both treatment and control groups saw an increase in percentage of household members currently enrolled in below primary classes (this essentially refers to katchi classes which are below formal primary level). Similarly, percentage of household members enrolled in primary classes also decreased for both treatment and control groups. However, the treatment group saw a one percentage point increase in members with secondary schooling while the control group saw a one percentage point decrease in secondary schooling. Conversely, the control group reported an increase of one percentage point for members with intermediate education, while treatment group's percentage of members with intermediate education remained the same.

Table 3.5.2 Education Levels of Sampled Households by Year and Group

Schooling Levels	2007						2009					
	Control		Treatment		Total		Control		Treatment		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
Below Primary	188	46%	561	45%	749	45%	221	49%	651	47%	872	48%
Primary	92	22%	284	23%	376	23%	91	20%	293	21%	384	21%
Secondary	85	21%	250	20%	335	20%	83	18%	294	21%	377	21%
Matriculation	28	7%	75	6%	103	6%	27	6%	87	6%	114	6%
Intermediate	12	3%	54	4%	66	4%	19	4%	47	3%	66	4%
Graduation and above	7	2%	12	1%	19	1%	8	2%	11	1%	19	1%
Total	412		1236		1648		449		1383		1832	

Figure 3.5.1 Sampled Households by Education Level



3.6 Overall Changes in Income and Expenditure:

Agriculture consistently formed the bulk of average monthly household income accounting for 40% or more of share of total income. This is shown in table 3.6.1 which presents data on sources of monthly income for 2007 and 2009. This data represents a holistic picture with sampled households for Irrigation, DWSS, and Drainage & Sanitation combined. Interestingly, average monthly incomes fell between 2007 and 2009 for both treatment and control groups. Neverthless, drop in average monthly incomes was higher for the control group, as average income fell by almost 9.5% than for treatment group as average monthly income fell by 2.1%. As a result a dramatic shift in the

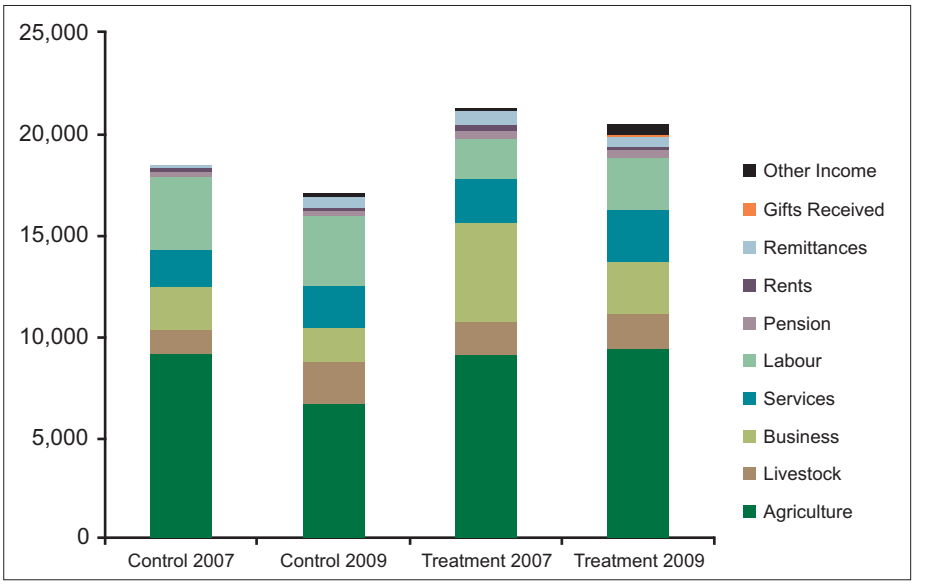
composition of average monthly income occurred in the control group with agriculture decreasing as a source of livelihood by 9% and livestock increasing as a source of livelihood by 6%.

Table 3.6.1 Average Monthly Household Income by Source

Source	Control Group				Treatment Group			
	2007		2009		2007		2009	
(Amounts in Rs.)	Avg Actual	Share %	Avg Actual	Share %	Avg Actual	Share %	Avg Actual	Share %
Agriculture	9,259	49%	6,735	40%	9,094	44%	9,492	47%
Livestock	1,257	7%	2,167	13%	1,655	8%	1,776	9%
Business	2,488	13%	1,772	10%	4,903	24%	2,750	14%
Services	1,774	9%	2,197	13%	2,135	10%	2,521	12%
Labour	3,678	20%	3,446	20%	1,994	10%	2,583	13%
Pension	166	1%	215	1%	252	1%	294	1%
Rents	142	1%	26	0%	161	1%	132	1%
Remittances	9	0%	303	2%	520	3%	341	2%
Gifts Received	4	0%	0	0%	7	0%	26	0%
Other Income	0	0%	130	1%	35	0%	406	2%
Average Household Income	18,777	100%	16,991	100%	20,757	100%	20,322	100%
Per Capita Income	2,477	-	2,201	-	2,601	-	2,448	-

Figure 3.6.1 graphically demonstrates that decrease in average monthly incomes in 2009 was considerably less in the treatment group than in the control group. As a result, agricultural incomes within the control group increased and allowed households in the treatment group to largely maintain a constant source of income as in 2007. However, in order to understand the exact reasons for differences in agricultural and total average monthly incomes between treatment and control groups we would have to undertake detailed analysis by type of intervention, so as to examine whether irrigation interventions in the treatment communities had a positive effect on incomes or not.

Figure 3.6.1 Household Income by Source and Group



Pakistan's official poverty categories classify individuals and households into extremely poor, ultra poor, poor, vulnerable, quasi-non poor and non poor categories. Table 3.6.2 lists latest available poverty groups from the Economic Survey of Pakistan 2007 2008. Due to data unavailability for 2007-2009 poverty groups we use the compounded annual CPI inflation rate of 7.8%, 12.0% and 20.8% respectively for 2006 2007, 2007 2008, and 2008 - 2009[6] to extrapolate poverty groups for 2006 2007 and 2008 2009. Households are then classified into each poverty category based on their per capita income levels. For baseline households the poverty categories used are 2006 2007 ones while impact survey households are classified according to the 2008 2009 poverty categories.

Table 3.6.2 Poverty Groups for Pakistan

	Income per Individual 2005 - 2006	Income per Individual 2006 -2007[7]	Income per Individual 2008 - 2009
Extremely Poor	Less than Rs. 472.23	Less than Rs. 509.06	Less than Rs. 688.74
Ultra Poor	Rs. 708.35	Rs. 763.60	Rs. 1,033.12
Poor	Rs. 944.47	Rs. 1,018.14	Rs. 1,377.50
Vulnerable	Rs. 1,180.59	Rs. 1,272.78	Rs. 1,721.88
Quasi-Non Poor	Rs. 1,888.94	Rs. 2,036.28	Rs. 2,755.00
Non Poor	Over Rs. 1,888.94	Over Rs. 2,036.28	Over Rs. 2,755

Source: Economic Survey of Pakistan 2007 2008. "Poverty Chapter". Ministry of Finance.

[6] Trends in Inflation. Economic Data. State Bank of Pakistan. url<www.sbp.org.pk>

[7] Income per household in 2006-2007 was calculated by adjusting the poverty categories for 2005-2006 with annual inflation rate in 2006-2007.

Once we have calculated poverty groups for 2006 2007 and 2008 2009 fiscal year we then go on to classify our households within each poverty group in order to analyze any changes in poverty classification of households between 2007 and 2009.

Figure 3.6.2 Percentage of Households by Poverty Group - Control

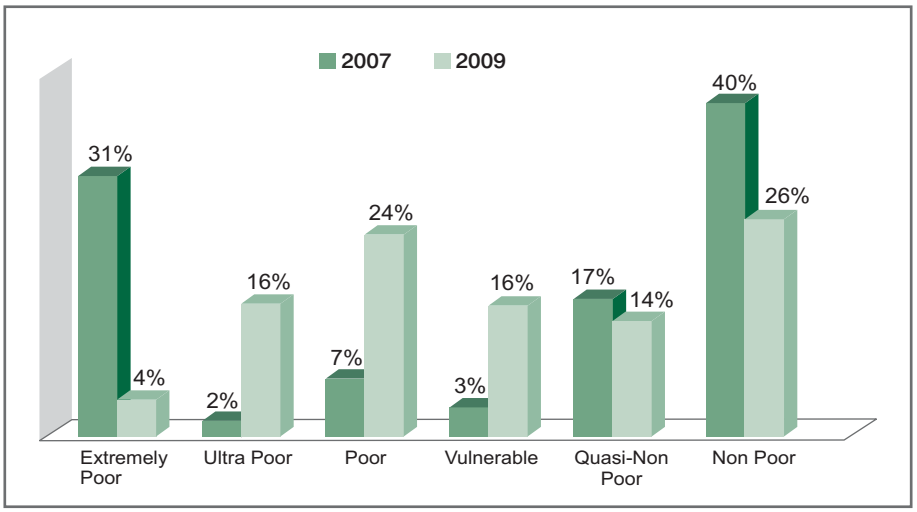


Figure 3.6.3 Percentage of Households by Poverty Group - Treatment

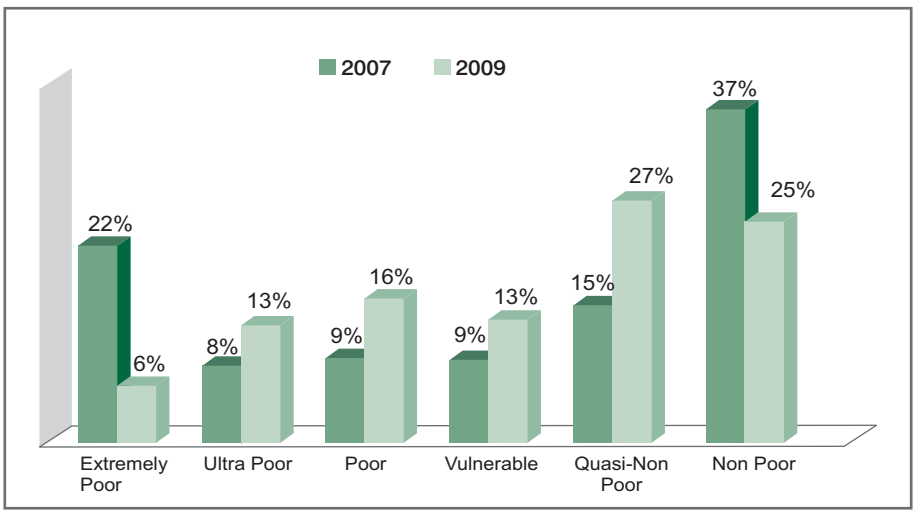


Figure 3.6.2 highlights the percentage of control group households falling within each poverty category while figure 3.6.3 presents the percentage of treatment group households within each poverty category. In 2007, almost 31% of households in control group were falling in the extremely poor category, while 22% households in treatment group fell into the extremely poor category. These figures changed considerably in 2009 with just 4% households in the control group falling in extreme poverty and 6% in the treatment group falling in extreme poverty category. Overall, about 44% control group households in 2009 fell below the povertyline while 35% treatment group households fell below the povertyline in 2009.

This result is borne out by the analysis of average household incomes in 2007 and 2009 respectively. Indeed, average incomes in 2009 amongst treatment group demonstrated a more stable outlook than average incomes amongst the control group. As average incomes fell in the control group more households were pushed below the povertyline: 44% compared to 40% in 2007. While many of the extremely poor households graduated into ultra poor and poor categories, many quasi-non poor households graduated into the vulnerable and poor categories. These results can be attributed directly to falling average monthly incomes and increasing food prices over the study years.

Conversely, households under the treatment category fared better than their control counterparts as more poor households transitioned positively into vulnerable and quasi-non poor categories. Incidentally, percentage of households below the povertyline in 2009 decreased to 35% from 39% in 2007 demonstrating a visible positive difference between treatment households and control households. Indeed, sample households where PPAF undertook CPI conventional interventions were less adversely affected by worsening economic conditions during the years under study than sampled households where PPAF had not provided such schemes and projects.

Household expenditure is a significant variable when examining the overall impact of interventions aimed at poverty reduction. Therefore, an analysis of household expenditures in conjunction with household income provides a more indepth view of the status of sampled households. Table 3.6.3 provides the details of the average household expenditure along with percentage share of each source in total expenditure.

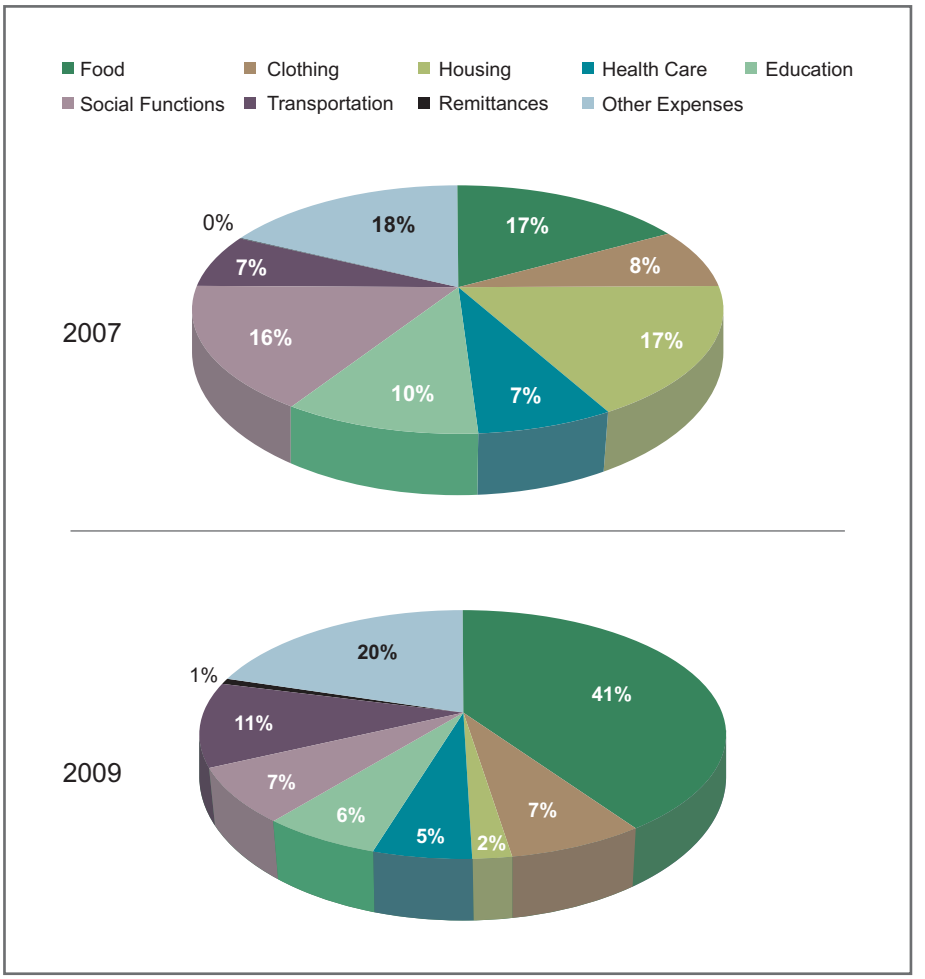
Table 3.6.3 Average Monthly Household Expenditures by Source

Source	Control Group				Treatment Group			
	2007		2009		2007		2009	
(Expense in Rs.)	Avg Actual	Share	Avg Actual	Share	Avg Actual	Share	Avg Actual	Share
Food	1,330	17%	4,815	40%	1,537	23%	5,539	47%
Clothing	648	8%	867	7%	655	10%	1,091	9%
Housing	1,346	17%	212	2%	1,273	19%	259	2%
Health Care	588	7%	632	5%	539	8%	638	5%
Education	762	10%	784	6%	557	8%	1,090	9%
Social Functions	1,256	16%	844	7%	460	7%	704	6%
Transportation	545	7%	1274	11%	488	7%	830	7%
Remittances	34	0%	139	1%	95	1%	326	3%
Other Expenses	1,397	18%	2,411	20%	1,214	18%	1,314	11%
Average Household Expenditure	7,906		12,106		6,587		11,800	

Overall, average monthly expenditures incurred by households increased drastically between 2007 and 2009. The control group witnessed an increase of almost 53% while the treatment group witnessed a corresponding increase of 79% during years under review. This increase in overall expenditures can be attributed to food inflation which affected rural households considerably between 2007 and 2009. CPI food inflation during the years under study was 10.3% in fiscal year 2007, 17.6% in fiscal year 2008 and 23.7% in fiscal year 2009[8]. Due to the continuous rise in food inflation the share of food expenditure in total household expenditure rose to almost 40% in 2009 from 17% in 2007 for the control group. Similarly, the treatment group too witnessed a sharp rise in its share of food expenses from 23% in 2007 to 47% in 2009.

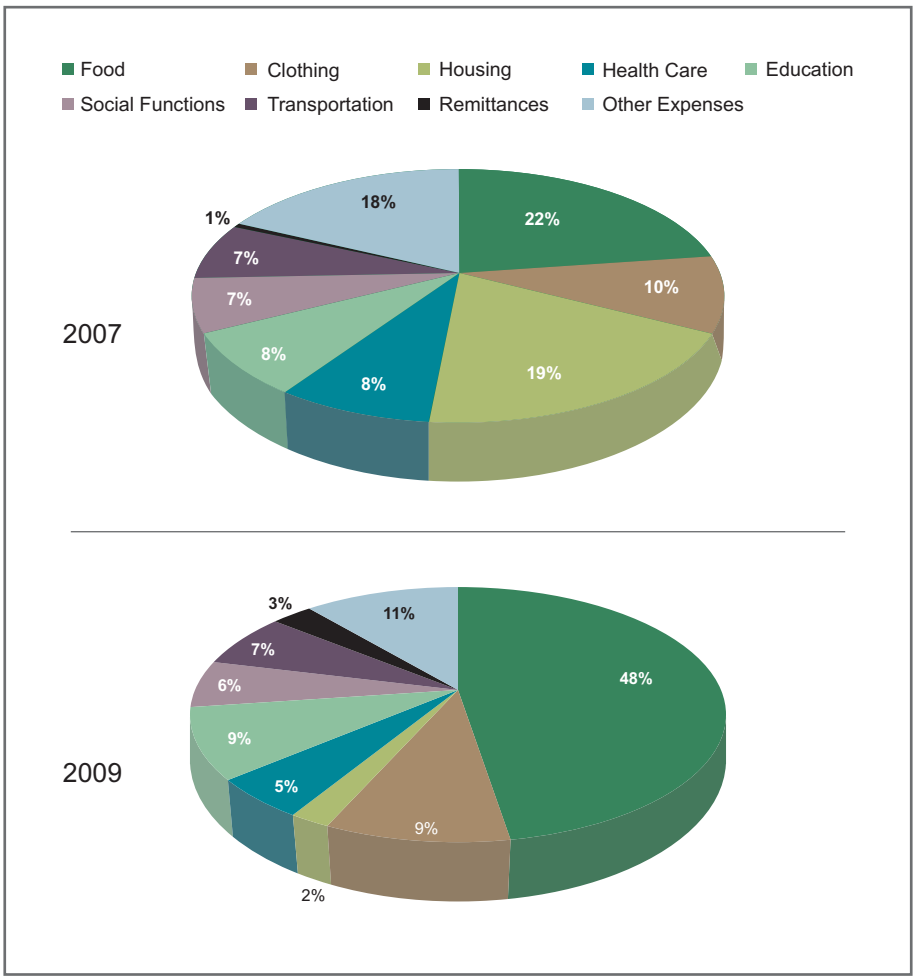
[8] Trends in Inflation. Economic Data. State Bank of Pakistan. url<www.sbp.org.pk>.

Figure 3.6.4 Sources of Expenditure by Percentage Share - Control Group



Another important source of expenditure in 2007 for both treatment and control groups that saw a change in its proportionate share in total average household expenditures was housing. Housing declined as a major source of expenditure in 2009 due largely to the decrease in real estate prices across Pakistan between 2007 and 2009. Another key reason for this decline in overall share was the proportionately larger increase in food expenditures during the period under review. Similarly, 'other' expenses which included utility bills covering electricity, gas and water consumption also rose in 2009 compared to 2007. For the treatment group 'other' expenses increased in average value to Rs. 1,314 from Rs. 1,214 in 2007. Similarly, for the control group 'other' expenses increased to Rs. 2,411 from Rs. 1,397 in 2007. This increase in 'other' expenses can be directly associated with the rising prices of utilities across Pakistan.

Figure 3.6.5 Sources of Expenditure by Percentage Share - Treatment Group



Consequently, an increase in overall average household expenditures coupled with a decrease in average household incomes meant that households were worse off in 2009 than in 2007. Interestingly, PPAF interventions in the treatment communities and their resulting impact on livelihoods meant that households sampled in the treatment group were better placed to adjust to rising food and non-food inflation for the period studied. Therefore, greater increase in expenditure by treatment households compared to control households was a result of increased capacity of treatment households to absorb rising inflation without compromising on consumption.

4. IRRIGATION INTERVENTIONS

4.1 Introduction:

Irrigation projects, by far, formed the major part of CPI initiated conventional physical interventions in Punjab accounting for almost 50% of all projects. These 2,810 schemes and projects were aimed at directly impacting livelihoods of intervention communities by providing water management techniques, decreasing water conveyance losses, improving availability of water for irrigation and introducing innovative sprinkler and drip irrigation techniques for increased yields and decreased costs.

Punjab alone accounted for almost 60% of all irrigation schemes and projects initiated by PPAF across the country. Table 4.1.1 provides a breakup of irrigation projects by province. Of the 4,696 projects initiated by PPAF under irrigation 2,810 were located in Punjab, while Balochistan accounted for the second largest concentration of irrigation projects with 1,118. With almost 56% of Pakistan's population residing in Punjab and 68.73% of that population

residing in Punjab rural areas, agricultural forms a primary source of earning livelihoods. Indeed, any attempts to target poverty in Pakistan must directly address the deteriorating agricultural infrastructure in Punjab. Table 4.1.2, providing latest employment statistics for Punjab from the Labor Force Survey of 2005-2006, demonstrates that 42.32% of rural Punjab's working population is employed directly in the agricultural sector. Therefore, interventions which directly improve the infrastructure of agriculture in Punjab are likely to have a measurable impact on almost 23% of the country's population.

Table 4.1.1 Geographical Distribution of Irrigation Projects

Province/Region	No. of Irrigation Projects Initiated	Percentage of Irrigation Projects Initiated
Balochistan	1,118	23.80%
NWFP	390	8.30%
Punjab	2,810	59.83%
Sindh	255	5.44%
Northern Areas	112	2.38%
Azad Jammu & Kashmir	6	0.13%
FATA & ICT	5	0.12%
Total	4,696	

Table 4.1.2 Employment by Industry in Punjab

Sr.	Major Industry Division	PUNJAB		
		Total	Rural	Urban
1.	Agriculture, Forestry, Hunting and Fishing	44.35	42.32	2.03
2.	Mining and Quarrying	0.08	0.07	0.01
3.	Manufacturing	15.4	8.08	7.32
4.	Electricity, Gas and Water	0.51	0.27	0.24
5.	Construction	5.55	4.04	7.45
6.	Wholesale, Retail Trade, Restaurant & Hotels	14.08	6.62	8.23
7.	Transport, Storage and Communication	5.3	3.02	2.28
8.	Financing, Insurance, Real Estate & Business Services	0.98	0.28	0.7
9.	Community, Social and Personal Services	13.72	7.01	6.72
10.	Activities Not Adequately Defined	0.04	0.03	0.01

Source : Labour Force Survey, 2005-2006, Federal Bureau of Statistics

The following analysis seeks to examine the impact of CPI initiated irrigation interventions on direct agricultural outcomes in Punjab such as land under cultivation, yield per acre for major crops, cropping patterns and water consumption. As mentioned earlier in the study design chapter, this segment of our analysis draws on the before after methodology whereby sampled households where PPAF implemented irrigation projects were asked to report agricultural production before and after the intervention.

4.2 Land under Cultivation:

Table 4.2.1 shows the average land under cultivation in our intervention communities. Before PPAF's infrastructure interventions the average land under cultivation was 9.24 acres: however, this average land holding size increased by 5.62% to 9.76 acres per household after the irrigation intervention. Indeed, the greater availability of water and better water management of existing sources allowed households to expand their irrigated land in intervention communities.

Table 4.2.1 Average Land Holding of Sampled Households

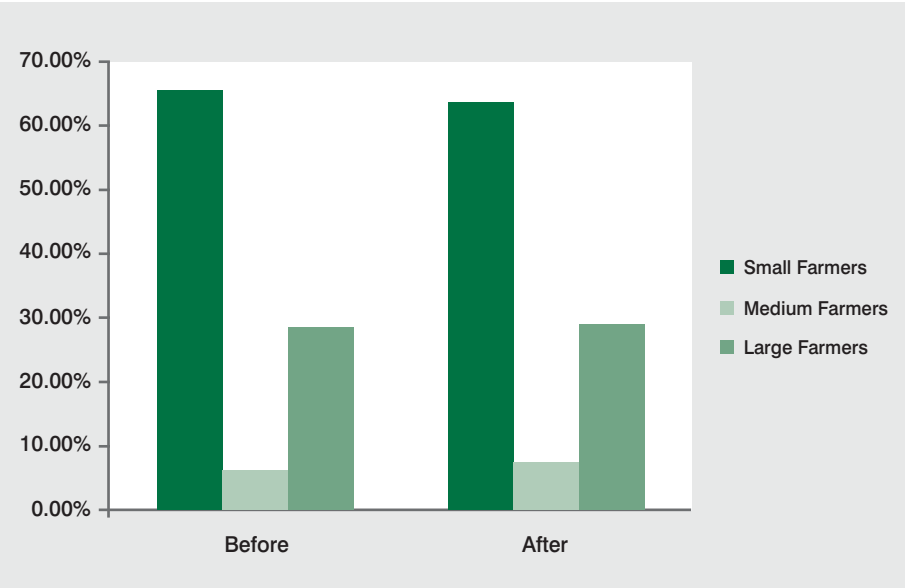
(In Acres)	Before	After	Percentage Change
Cultivated Land	9.24	9.76	5.62%

Similarly, table 4.2.2 categorizes household by size of farm. After irrigation interventions the percentage of households falling in the small farmer category decreased to 63.55% while medium farm households increased to 7.48% of the sampled households. A closer examination of the data reveals that 6 households increased their land holding after the intervention. 4 households migrated into the medium farmer category while 2 households transitioned from medium farmers to large farmers. This transition shows that during the study period households in our intervention communities demonstrated mobility and were able to increase their cultivatable land.

Table 4.2.2 Households Categorized by Size of Farm

Category[9]	Percentage of Households Before	Percentage of Households After
Small Farmers (Less than 12.5 acres)	65.43%	63.55%
Medium Farmers (12.5 to 25 acres)	6.07%	7.48%
Large Farmers (Above 25 acres)	28.50%	28.97%

Figure 4.2.1 Percentage Households by Size of Farm



4.3 Yield per Acre for Major Crops:

Overall, the average yield per acre reported increased for all major crops after implementation of irrigation projects for the sampled households.. Table 4.3.1 shows that a greater percentage increase in yield per acre was witnessed in sugarcane, which requires large amounts of water for production, as it grew by almost 75% after the intervention period.

[9] Farmer categories are defined for Pakistan by the Agricultural Census, 2000. For greater detail refer to Khan, Rao Abdul Rauf. "Some Operational Issues and Institutional Constrains in Lending to Small Farmers". Pakistan Development Review. Winter 1991.

Table 4.3.1 Yield per Acre of Major Crops

Major Crops	Yield in kg/acre		Percentage Change
	Before	After	
Wheat	1083.83	1487.69	37.26%
Cotton	688.96	1105.17	60.41%
Rice	1138.24	1757.06	54.36%
Sugarcane	15948.57	28022.86	75.70%

Similarly, the average yield for wheat increased from 1,083.83 kg/acre to 1,487.69 kg/acre in 2009. Rice too demonstrated an increase in yield per acre by nearly 54% increasing to 1,757.06 kg/acre. The smallest increase was witnessed in cotton which increased to 1,105.17 kg/acre from 688.96 kg/acre.

4.4 Cropping Pattern and Work Hours in the Field:

A significant number of households sampled for irrigation projects reported a change in cropping pattern after implementation of conventional irrigation interventions. Table 4.4.1 highlights that almost 20% of these households reported a change in cropping patterns with most households suggesting that the reason for change was either an increase in water availability, improved seed availability or soil regeneration. Three respondents reported a change in cropping pattern due to effective resolution of water supply problem in their area.

Table 4.4.1 Households Reporting change in Cropping Pattern

	Percentage of Households
Cropping Pattern Changed	20.09%

An analysis of average work hours in the field disaggregated by gender revealed that average time required per day for tending crops in the field decreased by 15.26% for males and 18.88% for females. This decrease in time can be associated with an improvement in water conveyance and the introduction of innovative irrigation methods such as drip and sprinkler irrigation.

Table 4.4.2 Average Work Hours in the Field

Average Work Hours	Before	After	Percentage Change
Male	6.16	5.22	15.26%
Female	1.93	1.56	18.88%

4.5 Water Frequency and Irrigation Time:

Another key aspect of conventional irrigation interventions is the effect of improved water availability and conveyance on irrigation time and frequency required for each crop. Table 4.5.1 shows the number of times each major crop needed to be irrigated in one production cycle. As demonstrated in the table all major crops except cotton saw a decrease in irrigation frequency required before the intervention. The highest decrease was witnessed in sugarcane, which requires the most irrigation frequency followed by rice which fell by almost 2%. Incidentally, cotton was the only crop that showed an increased water frequency after the intervention period. Nevertheless, we must also account for the fact that frequency of irrigation for each major crop in one production cycle usually remains the same around the average. Indeed, the results in table 4.5.1 also suggest that changes in the number of times land is irrigated are very moderate and are likely to represent an insignificant change in water frequency.

Table 4.5.1 Number of Times Land is Irrigated for each Major Crop

Major Crop	Before	After	Percentage Change
Cotton	7.28	7.40	+ 1.65%
Wheat	5.09	5.00	- 1.76%
Rice	24.47	23.98	- 2.00%
Sugarcane	26.88	26.08	- 2.98%

Table 4.5.2 Number of Hours Required for Irrigating one Acre for each Major Crop

Major Crop	Before	After	Percentage Change
Cotton	4.30	2.98	- 30.69%
Wheat	4.28	3.13	- 26.86%
Rice	5.40	4.57	- 15.37%
Sugarcane	4.76	3.91	- 17.86%

However, comparing results in table 4.5.1 with table 4.5.2 (which presents the number of hours required for irrigation one acre of land by crop) we can note that the average number of hours required to irrigate one acre of land for each crop decreased substantially between the intervention period. This suggests that PPAF's conventional irrigation interventions were able to reduce hours of irrigation by introducing simultaneous watering techniques and increasing water flows.

4.6 Household Income Analysis for Irrigation CPI's:

In keeping with the general trend witnessed earlier, household income of irrigation sampled households too fell between 2007 and 2009. However, like earlier, the percentage decrease in control households (11.5%) was greater than the percentage decrease (4.3%) in treatment households. This trend, sustained in our irrigation sample, strengthened the analysis that PPAF irrigation interventions helped treatment households cope better with economic recession compared to control households. Indeed, a closer examination of average monthly household incomes by source reveals that while incomes from agriculture fell for our control households from Rs. 9,736 to Rs. 6,598, treatment households witnessed an increase from Rs. 9,726 to Rs. 10,794. Overall, the greatest decrease in average incomes amongst irrigation households was witnessed in business incomes, which fell from Rs. 6,120 to Rs. 2,437. If the decrease in business incomes is discounted, average monthly household's incomes would have demonstrated an increase in 2009 from 2007. This sharp decline in business incomes can be directly associated with the economic recession in the country.

Table 4.6.1 Average Monthly Income by Major Sources for Irrigation Schemes

Source	Control Group		Treatment Group	
	2007	2009	2007	2009
(Amounts in Rs.)	Average Actual	Average Actual	Average Actual	Average Actual
Agriculture	9,736	6,598	9,726	10,794
Livestock	1,267	2,388	1,542	2,039
Business	2,556	1,891	6,120	2,437
Services	1,589	2,086	2,114	2,516
Labour	3,729	3,404	2,043	2,597
Total Income	19,200	17,000	22,547	21,584

Significantly, if agricultural incomes had not increased in irrigation treatment households during 2009 the overall effect on average household incomes would have been even greater, thus affecting livelihoods in a far more negative way. Importantly, CPI irrigation interventions in treatment communities helped prevent the decrease in agricultural incomes in 2009 providing a much needed cushion to livelihood earners in our treatment sample.

5. DRINKING WATER SUPPLY SCHEMES

5.1 Introduction:

> "The safety and accessibility of drinking-water are major concerns throughout the world. Health risks may arise from consumption of water contaminated with infectious agents, toxic chemicals, and radiological hazards. Improving access to safe drinking-water can result in tangible improvements to health"(World Health Organization,[10] 2010).

Unavailability of safe drinking water constitutes a major constraint on the social development of rural and semi-urban households in Pakistan. Its direct consequences on disease prevalence and mortality are great concerns which require urgent and sustained mitigation efforts. PPAF, in its attempts to improve the livelihoods and standards of living in the country, seeks to leverage its outreach and resources by introducing sustainable interventions under Drinking Water Supply Schemes (DWSS) by upgrading and enhancing drinking water infrastructure across Pakistan. The following sections examine both access to drinking water, its role as a major constraint and its health effects for DWSS interventions undertaken by the CPI unit in **Punjab**.

[10] World Health Organization. Health Topics: Drinking Water. An Introduction. URL: << http://www.who.int/topics/drinking_water/en/>>

5.2 Access to Drinking Water:

Table 5.2.1 reports the percentage of households in our DWSS sample according to sources of drinking water. Piped source includes drinking water conveyed into the community through closed pipes and accessed through either taps in the street or inside the home. This source of drinking water is considered the safest due to the lower probability of contamination. Secondly tubewells as a source of drinking water include all motorized/electrical water drawing mechanisms which access underground water. Hand-pumps also access underground water but require considerably more effort and therefore provide some constraints for drinking water access amongst the disabled, women and children. Nevertheless, since both tubewells and hand-pumps access underground water, their safety is similarly dependent on the purity of underground water. These two sources for drinking water represent three main constraints namely; the quality underground water may be contaminated, fixed points in the community where hand-pumps and tubewells are installed may be at a considerable distance resulting in accessibility problems and once water is drawn through this source its transport and storage to the home may pose challenges for households. Lastly, the category open source refers to drinking water access through wells, canals, streams or ponds. All these sources are open and therefore represent the highest risk category for drinking water supply.

Table 5.2.1 Sources of Drinking Water for DWSS Households

Source	Control		Treatment	
	2007	2009	2007	2009
Piped*	0%	12.5%	0%	40%
Tubewells**	25%	12.5%	21.40%	0%
Hand Pump	75%	75%	71.40%	60%
Open Source***	0%	0%	7.20%	0%

*Piped: Water supplied through closed pipes and accessible through tap, either in the house or in the street.
**Tubewells: Includes all motor/turbine run water sources including Tube Wells.
***Open Source: Water available in open canals, ponds or wells.

Overall, access to drinking water through safer sources improved more amongst our sampled treatment households than amongst the control households. No household (in either treatment or control groups) reported access to drinking water through piped supply in 2007. However in 2009, 40% percent of the households in the treatment group reported access to drinking

water through pipe based supply. Similarly, 12.5% of the control households reported access to drinking water through pipe based supply. Significantly, while 7.2% of households in our treatment sample reported accessing drinking water through open sources, in 2009 no household in the treatment group was accessing drinking water through open sources. This represented a major improvement in both risk and access of drinking water amongst our DWSS treatment households.

5.3 Health Effects:

When analyzing health effects of DWSS interventions in treatment communities we focus on examining the prevalence of four major water borne diseases namely; hepatitis, malaria, typhoid, and diarrhea. These diseases have a high rate of prevalence in Pakistan and result in serious health consequences for affected persons. Indeed, children represent the most vulnerable group amongst affected persons and if these diseases are left un-treated they can result in high mortality.

Table 5.3.1 Prevalence of Major Diseases by Percentage of DWSS Households

Source	Control		Treatment	
	2007	2009	2007	2009
Hepatitis	10%	0%	-	-
Malaria	40%	12%	45%	7.14%
Typhoid	-	12%	30%	7.14%
Diarrhea	-	-	10%	0%

Table 5.3.1 above reports the percentage of households within the DWSS sample which reported the prevalence of hepatitis, malaria, typhoid and diarrhea during baseline and impact surveys. Hepatitis was reported by 10% households amongst the control group during 2007 while no household in the treatment group reported the prevalence of hepatitis in 2007. However, during the 2009 impact survey no household, either in the control or treatment group, reported the prevalence of hepatitis. Malaria, on the other hand, was reported in both treatment (45%) and control (40%) households, in 2009 the percentage of households reporting prevalence of malaria decreased in both control and treatment groups. However, the decrease in the treatment group (7.14% from 45%) was considerably higher than amongst the control group (which decreased from 40% to 12.5%).

Another interesting result was the prevalence of typhoid. While 30% of households in the treatment group reported the prevalence of typhoid in 2007, no household had reported the occurrence of typhoid amongst the control group during 2007. However, subsequently, at the time of the impact survey 12.5% control households reported the prevalence of typhoid while in the treatment group the prevalence of typhoid fell to 7.14%. Indeed, the prevalence of diarrhea too was not reported amongst treatment households in 2009 compared to the earlier prevalence rate of 10% in 2007. Overall, we can conclude that the prevalence of the major diseases discussed above decreased considerably more amongst our sampled DWSS treatment households than amongst our sampled DWSS control households where no drinking water supply scheme intervention had been initiated.

6. DRAINAGE AND SANITATION INTERVENTIONS

6.1 Introduction:

> "Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and feces. Inadequate sanitation is a major cause of disease world-wide and improving sanitation is known to have a significant beneficial impact on health both in households and across communities. The word 'sanitation' also refers to the maintenance of hygienic conditions, through services such as garbage collection and wastewater disposal" (World Health Organization,[11] 2010).

In Pakistan inadequate drainage and sanitation poses a serious threat to health, hygiene and standards of living amongst poor and vulnerable households. Sanitation facilities in the country are available to only 45% of the total population including 65% in urban areas and 30% in rural communities. Nearly 45% of all households have no access to latrines and 51% households are without proper drainage facilities[12]. Indeed, most urban poor dwell in shanty towns called "Katchi Abadis" which are haphazard slums devoid of any drainage and sanitation. The compounded effect of the inadequacy of drainage and sanitation impacts poor households in multiple ways; it exposes the poor to high risk diseases, increases mortality (especially amongst children), increases health costs and adds a multiplier effect on poverty indicators. Therefore, PPAF, through its CPI unit strives to positively impact the lives of the poor across Pakistan by enhancing basic access drainage, sanitation and waste disposal mechanisms. The following sections examine the impact of drainage and sanitation interventions under taken by the CPI unit between 2005 and 2009 across Punjab.

6.2 Access to Drainage and Sanitation:

Under housing infrastructure, we analyzed the prevalence of latrines for all of our sampled households. However a closer look at the type of latrine facilities used by our drainage and sanitation sample households reveals that amongst our treatment group 93% households were using inside latrines in 2009

[11] World Health Organization. Health Topics: Sanitation. An Introduction. URL: << http://www.who.int/topics/sanitation/en/>>
[12] National Sanitation Policy. Ministry of Environment. Government of Pakistan. URL:<< http://www.environment.gov.pk/NEP/SanitationPolicy.pdf>>

compared to 80% in 2007. Similarly, the percentage of households using open fields as latrines decreased to 5.2% in 2009 compared to 18.2% in 2007. Overall, our sanitation treatment group demonstrated a marked improvement in the type and use of latrines compared to our sanitation control group.

Table 6.2.1 Percentage of Drainage and Sanitation Households with Access to Drainage and Type of Latrine

	Control		Treatment	
	2007	2009	2007	2009
Drainage	75%	60%	73%	82%
Latrine - Inside	40%	60%	80%	93%
- Outside*	0%	0%	1.8%	1.8%
- Open Field	60%	40%	18.2%	5.2%

*Outside refers to latrine within the household compound but with access from outside the home.

Table 6.2.1 above also demonstrates that while access to drainage increased amongst our drainage and sanitation sampled treatment households to almost 82% in 2009 compared to 73% in 2007, the corresponding level of access to drainage in our control sample demonstrated a decrease to 60% in 2009 compared to 75% in 2007. Overall the comparative improvement in drainage and latrine facilities in our treatment sample demonstrated positive outcomes in Punjab due to CPI drainage and sanitation interventions.

6.3 Perception on Drainage:

Perceptions regarding the seriousness of drainage problems in sampled drainage and sanitation communities improved considerably amongst the treatment group compared to the control group. Whereas earlier, at the baseline survey, almost 38% households had categorized drainage as a serious or very serious problem, in 2009 this figure dropped to just 23% of sampled households.

Table 6.3.1 Perception of Sampled Drainage and Sanitation Households

	Control		Treatment	
	2007	2009	2007	2009
No Problem	80%	60%	45%	33%
Slight Problem	-	-	16%	44%
Serious Problem	20%	40%	22%	11%
Very Serious Problem	-	-	16%	12%

Indeed, the greatest improvement was witnessed amongst households that believed drainage was a serious constraint/problem as they decreased from 22% to 11% in 2009. Conversely in our sampled control group, the percentage of households which considered drainage to be serious problem increased from 20% to almost 40%. This increase in the percentage of households which considered drainage to be a serious problem could be a result of continued deterioration, such as clogging of existing drainage systems.

7. CONCLUSION

In conclusion, the impact of CPI conventional interventions on direct outcomes amongst intervention communities has been positive. Indeed, improvements in agricultural yield, cultivable land, cropping patterns, irrigation time, water frequency, connectivity with drainage systems, use of latrines and access to drinking water have had a demonstrable impact amongst our treatment households. Impact indicators however, have proven to be more difficult to measure accurately and though they too have reported positive changes their impact has been relatively less.

A key learning from this study has been that conventional infrastructure interventions designed and implemented in periods of relative growth act as important and significant contributors towards helping intervention communities cope with recessionary dynamics. Significantly, while 2007 was a period of relative growth for Pakistan, 2009 has been mired by rising food, energy and input costs coupled with a systematic decrease in business activity. Nevertheless, our study has demonstrated that treatment households were better prepared to mitigate the effects of a recessionary cycle due to structured interventions which helped improve productivity, livelihoods and living conditions than control communities which suffered considerably greater hardships as a result of the recessionary trend. Importantly, while 40% of sampled control households fell under the poor and below category in 2007 they increased to almost 44% in 2009. Correspondingly, while 39% of sampled treatment households had fell on or below the poor category in 2007 they decreased to 35% in 2009. Consequently, intervention communities demonstrated a slight decrease in the number of poor households while the non-intervention communities demonstrated an increase in poor households. This illustrates the fact that infrastructure interventions, particularly under irrigation, proved extremely useful in helping intervention communities mitigate the negative effects of the economic recession.

Pakistan Poverty Alleviation Fund

House 1, Street 20, F-7/2, Islamabad, Pakistan.
Tel: 051-111-000-102, Fax: 051-2652246
E-mail: info@ppaf.org.pk, Website: www.ppaf.org.pk