An Analysis of Major Determinants of Poverty in Agriculture Sector in Pakistan

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Abstract

This study is an attempt to highlight the need to prioritize the agriculture sector in policies aimed at alleviating poverty. The objectives are (1) to estimate and compare the incidence of poverty across various sectors of the economy with special focus on the agricultural sector and (2) to identify the major determinants of poverty in the agriculture sector. Poverty is measured in terms of head count, poverty gap and severity of poverty indices all determined as a function of household consumption level. Households with adult equivalent consumption below a consumption level necessary to acquire basic needs are defined as poor. The estimated measures of poverty are used to compare incidence of poverty across sectors of the economy. Adult equivalent consumption is then regressed against a series of explanatory variables to identify determinants of poverty. Results from consumption model are then simulated to gauge impact of various policy scenarios on poverty levels. Data sets are from the 2001 Pakistan Integrated Household Survey and 2005 Living Standard Measurement Survey.

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Introduction

In Pakistan around two-third of the population live in rural areas and agriculture is a major source of livelihood to a majority of them. It contributes nearly 23 percent to the Pakistan's Gross Domestic Product (GDP) while employing 42 percent of the labor force (GoP 2004-05, p.9). This simple fact suggest that agriculture contributes less to the national GDP relative to its size of population and labor force compared to other sectors of the economy. So on any living standard scale, people associated with agriculture fare low compared to other sectors.

This simple fact is further supported by a review of literature indicating that in developing countries: (a) There exist a strong positive correlation between share of agriculture GDP and incidence of poverty suggesting that majority of poor reside in agriculture sector. (b) Countries with higher agriculture employment experience increased level of poverty. (c) Agriculture accommodates most of the unpaid family members wherein incidence of poverty is higher as compared to properly and regularly paid employees (FAO 2005, p.61-62).

The role of agriculture sector in poverty alleviation has also been emphasized by many studies. For instance, Pasha and Palanivel (2004) analyzed pro-poor growth and policies in Asian countries and concluded that "the key determinants of the degree of pro-poor growth are the rates of agricultural growth and employment generation". A study by FAO (2004a), covering 11 countries, examined the effect of agriculture-led growth on poverty and found that "the pro-poor role of agriculture can be dramatic and much more effective in reducing poverty and hunger than other sectors in both urban and rural areas". Examining the link between agriculture growth and

rural poverty, Malik (2005, p.1) stated that relationship between poverty reduction and overall economic growth is not as clear as the one between poverty reduction and agriculture growth. Along with the poverty growth nexus, the incidence of poverty is also viewed in the context of various individual level characteristics of the household. Here poverty of a household is studied as a function of the extent and level of various human and physical endowments of a household. There is an abundance of recent literature that links poverty to various characteristics of a household such as those related to demography, education, physical assets, community and infrastructure. While most of the studies present this link in the form of bivariate analysis in a shape of poverty profiles, recent emphasis is more on multivariate analysis that captures the effect of one variable conditional on the impact of other variables. Some recent examples of such studies include Fagernas and Wallace (2007), Datt and Jolliffe (2005), Simler et al. (2004) to quote a few.

This study is a mix of both. In the first place we tried to estimate and capture change in the incidence of poverty over time given the growth in overall and agricultural economy with a focus on the agriculture sector. Secondly we went on to identify the major determinants of poverty in the agriculture sector.

Background

Poverty is an international phenomenon. Some recent global estimates (based on one dollar a day) suggest around 1.2 billion people live in poverty and more than 850 million does not have enough access to sufficient food for an active and healthy life (FAO 2005, Forward). Of the total global population who live on less than a dollar a day, 1.089 billion live in developing countries and 0.431 billion live in South Asia, the region to which Pakistan is a part of; while of the total

undernourished people, 815 million and 301 million people reside in developing countries and South Asian Countries respectively (FAO 2005, p.80).

As far as Pakistan is concerned, it ranked 136 based on Human Development Index out of a total of 177 countries; well behind some of its neighboring countries like Sri Lanka with a ranking of 99, India 128 and Bhutan 133. Recent estimates of people living in poverty, based on 1 dollar a day, suggest that 17 % of the population live below poverty line in 2005 whereas based on 2 dollar a day criteria, the figure stand out at 73.6 %, more than two third of the population (HDR 2007-08, p. 231 & 239).

FAO estimates for 2001-02 pointed out that 20% of Pakistan's population is undernourished and 32.6% of its population is under poverty line (FAO 2005, p.150 & 177). Cheema (2005, p.15 & 16) estimated poverty, using Household Income and Expenditure Survey (HIES) 2001-02, at 34.46%, including 39.26% in rural areas and 22.69% in urban areas. While based on the recent available Living Standard Measurement Survey (LSMS), the government of Pakistan claimed that over all poverty has declined from 34.46% in 2001-02 to 23.9% in 2004-05, showing a decline from 39.26 to 28.13% in rural areas and from 22.69% to 14.94% in urban areas (GoP 2006, p.55 & UNDP 2007, p.9). This substantial decline in poverty is inherent in the methodology that is followed by the government of Pakistan for the recent estimates. On the one hand it did correctly, by keeping the base poverty line fixed and updating it by the inflation rate that has occurred between the two periods i.e. 2001-02 and 2004-05 and by paying heed to one of the main criticism that Pakistan's poverty lines are not consistent and hence not comparable (Kakwani 2003, p.10). But the real issue is the way the base poverty line is updated. In Pakistan poverty line is updated using the Consumer Price Index (CPI). Though, the use of CPI for calculating the inflation rate and subsequently for updating poverty line is a standard practice in

many countries. Its use in case of Pakistan is questionable as its coverage is only limited to the urban areas whereas a vast majority, around two-third, live in rural areas. So the use of CPI for updating the poverty line for 2004-05 seems to have under-estimated the incidence of poverty line (World Bank 2006, p.4). Updating the poverty line using CPI affects not only the incidence of poverty at the national level but also its decomposition across regions (urban/rural) and sectors of the economy including the agriculture sector.

In this backdrop we attempted to first calculate the poverty line using HIES 2001-02 that serve as base poverty line and then updated it for LSMS 2004-05 by a survey based inflation rate (commonly known as the Tranqvist Price Index (TPI)). This TPI method helped in creating an overall picture depicting the change in overall incidence of poverty at the national, regional and sectoral level. An attempt has also been made to show 'who' benefited from the overall growth that occurred between the two survey periods before modeling the determinants of poverty, taking into account the individual and community level characteristics of the households related to agriculture. The following step explains the estimation of poverty line for the base survey year, its subsequent inflation by the TPI for the second survey year and the estimation results for both survey years.

Absolute Poverty in Pakistan: Data and Method

The study used the Pakistan Integrated Household Survey (PIHS/HIES) data set of 2001-02 and HIES part of Pakistan Social and Living Standard Measurement Survey (PSLM) 2004-05. These surveys have representative samples from all four federating units of Pakistan i.e. Punjab, Sind, NWFP and Baluchistan on urban-rural basis and provide detailed information on food and non-food consumption items of households. Only those households were included in the analyses that

have reported food consumption expenditure along with other non-food consumption expenditure. Table 1 shows the overall sample size, with province wise urban/rural breakdown.

Both the PIHS 2001-02 and LSMS 2004-05 provide a comprehensive coverage of consumption aggregates. This consumption aggregate includes both actual and imputed expenditure and include not only actual purchases but also self produced and consumed items, consumption of items that have been received as gift or assistance and those that have been given as wage or salary in kind. Consumption aggregate is a comprehensive one as it consists of almost all food items, fuel and utilities, housing (rent, imputed rent and minor repairs), frequent nonfood expenses (household laundry and cleaning, personal care products and services etc.) and other nonfood expenses (clothes, footwear, schooling, stationary, transportation, health related expenses etc.). However, expenses such as taxes, fines, and expenses on marriage/funeral have been excluded from the consumption aggregate.

Choosing an indicator of welfare

Income and consumption stand out to be the two main candidates for measuring welfare. This study took consumption as an indicator of welfare as it works relatively well in the context of developing countries (Ravillion1992 and Cheema 2005). The reasons of choosing consumption over income are: (a) in developing countries like Pakistan where the bulk of the population is living in rural areas and mostly associated with agriculture, derive their income from farm produce which tends to fluctuate because of the nature of seasonality. So in such context consumption best capture welfare as it tends to remain relatively stable as households rely on credit or savings to smoothen their consumption. (b) Also, almost all the farmers with the exception of a negligible few do not keep records so in the survey interview there is strong likelihood that they miss to report own farm produced and consumed as income. (c) In many

instances households feel comfortable while giving information on consumption as compared to income. (d) Some part of income is difficult to measure, specially the change in value of a property or livestock and (e) since income is having the potential welfare as in many instances not all income is consumed and also not all consumption is financed from income, so it is better to use consumption as a welfare indicator as it captures attained welfare as compared to income which capture potential welfare (Atkinson 1989).

Defining and Construction of absolute poverty line

After deciding on the approach to poverty estimation and indicator of welfare, this step explains the construction of absolute consumption based poverty line. Typically, all absolute poverty lines "z" are set in terms of the cost of buying a basket of goods (World Bank 2005, p.50).

$$u = f(y) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where, u = Utility or standard of living and

y = Consumption expenditure.

This equation explains that utility or standard of living "u" depends on expenditure "y" then:

$$y = f^{-1}(u) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

Equation (2) explains that for any level of utility or standard of living, there is some expenditure level that is needed to achieve it.

Considering "u_z" the utility that is just sufficient to avoid being below the poverty line then;

$$z = f^{-1}(u_z) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

Equation (3) says that for an absolute poverty line that is absolute in terms of welfare, there is a corresponding absolute consumption-based poverty line.

In case of Pakistan, this corresponding absolute consumption-based poverty line is officially defined as the level of consumption or income that provides enough food to generate 2350 calories per adult equivalent per day (GoP 2002).

Estimation of poverty line

After deciding to use the official poverty absolute poverty line, this section explains how to work out the level of consumption expenditure that provides enough food to generate 2350 calories per adult equivalent per day. For this purpose we employed the modified form of Greer and Thoerbeck (1986) method called the cost of calories function as follow:

$LnY = a + bX + u$ ……...4

Where, Y = Monthly per adult equivalent consumption expenditure (food and nonfood)

X = Daily per adult equivalent calorie intake

"a" and "b" are the parameters to be estimated.

$Z = e^{(a + bR)}$ …….5

Where "Z" is the poverty line and "R" is the recommended Calories per Adult Equivalent of 2350.

This method implicitly assumes that those households that reach the minimum requirement of calories consume also necessary non-food items. Greer and Theorbeck (1986) method, also known as Food Energy Intake (FEI) method, is modified in the sense that they used only the food expenditure regressed against caloric norm where in equation (4) we regressed the total (food plus non-food) against the caloric norm. This approach is termed as one of the variant of Cost of Basic Needs (CBN) method (CRPRID 2002, p.13). This approach to estimation of poverty assumes that along with food which is a basic necessity, households consume some non-food

necessities also otherwise they would have increased their caloric intake in the form of increased food consumption.

Adjustment to the consumption aggregate

An absolute poverty line captures the minimum standard of living as per the society's prevailing socio-economic conditions; it needs to be constant/fixed and consistent over time and across region; and should treat all individuals/households equally (Kakwani 2002). As the households differ in size and composition, their food and non-food requirement vary. The nutrition requirement of adults is different from those of children and of male from female. Similarly households located in different parts of the country face different cost of living and face different set of prices across different time periods. Inconsistency will arise if different households located in different regions but with the same standard of living are treated differently (Ravillion and Badani 1994). So, for the absolute poverty line to be consistent across regions and time, the following adjustments were made:

Adjustment to Household Size: Per Adult Equivalent Calories Consumption

Calorie requirements vary with age and sex. Children need much less calories compared to adults. Males require more calories than females. As households differ with respect to calorie needs, so household size needs to be adjusted keeping in view sex and age of household members. Calories per adult equivalent are obtained by dividing the total household calories consumed by the adjusted household size based on nutrition based adult equivalent scale as published by Nutrition Cell, Planning Commission (CRPRID 2002, p.79).

Adjustment to Household Size: Per Adult Equivalent Consumption Expenditure

While the earlier section explains the adjustment of household size for food consumption only, this section explains the adjustment of household size for total consumption expenditure (both

food and non-food). The values (expenditure) of items purchased and consumed, own produce and consumed, wages and salaries in kind and those received as gifts and assistance are added up and converted into monthly household consumption expenditure. Household members below the age of 18 years were given weight of 0.8 while those of 18 years and above were given weight of 1 to calculate adult equivalent size for every household. Total household monthly expenditure was divided by household adult equivalent size to arrive at per adult equivalent consumption expenditure.

Price Adjustment (Paasche Price Index)

Both the Household surveys are spread over a year time and the households faced different prices over the duration of the surveys. PIHS 2001-02 started in January 2001 and ended in January 2002, similarly LSMS 2004-05 started in September 2004 and ended June 2005. Using the consumption expenditure as such in the equation 4, without adjustment may give misleading results. Consumption expenditure of a household surveyed at the beginning of the survey is not comparable with one that is visited at the end of the survey. Also households that are located in different regions and provinces are expected to face different set of prices for different consumption items. So, it is important to correct the welfare indicator according to real values in order to make data comparable.

Though Kakwani (2002) advocated the use of market prices for consumption expenditure adjustment, this cannot be done simply because of the fact that the surveys used for this study do not provide information on market prices. But still it is possible to calculate spatial price index for each survey using unit-values as a proxy of market prices. Unit values are obtained by dividing expenditure per food and fuel item by quantity consumed. As different households came up with different unit values for each item, so in calculating the Paasche Price Index median unit values are used instead of mean values as they remain to stay more stable and not prone to

extreme values (Deaton and Tarozzi 2000 and Cheema 2005). Additionally Paasche Price Index is calculated at Primary Sampling Unit (PSU) level as almost each of the PSU was covered within a week time (with slight variation on both ends though) and unit values averaged at such clusters (PSU) are considered to provide good information on price variation (Deaton and Zaidi 2002, p.39).

To remove the price differences between urban and rural areas and also among provinces the index is calculated by using median unit values, average budget share in each PSU and median unit values at national level by using the following equation:

$$p_i^{\,P} = \left[\sum_{k=1}^{n} w_{ik} \left(\frac{p_{ik}}{p_{0k}} \right)^{-1} \right]^{-1} \quad \text{.....5}$$

Where, w_{ik} is the budget share of item k in the Primary Sampling Unit i;

p_{ik} is the median unit value of item k in the Primary Sampling Unit i;

p_{0k} is the national median unit value of item k.

The per adult equivalent monthly expenditure of each household, as calculated in the earlier step, is divided by the Paasche Price Index of the respective PSU to which each household belong to arrive at the real per adult equivalent expenditure per month.

After adjusting the household consumption expenditure by its size and composition; and prices they face, the regression is run for the first three quintiles. This is done to avoid the consumption behavior of the richest segments of the society and the risk of over estimation of the poverty line.

Poverty Measures: The choice of aggregator

After estimation of the poverty line then one has to decide on the choice of the aggregator. We followed the widely used poverty measures proposed by Foster, Greer and Thoerbeck (1984) which are head-count ratio (P_0), poverty gap ratio (P_1) and squared poverty gap ratio (P_2).

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left[\left(Z - y_i\right)/Z\right]^\alpha \ldots\ldots\ldots\ldots\ldots\ldots 6$$

Having information on per adult equivalent consumption expenditure and the poverty line, one can estimate the incidence of poverty, poverty gap and severity of poverty depending on the value of α. If α = 0, the index captures the Head-Count ratio which is the number of poor as a percentage of the whole population. If α = 1, then P_α captures the poverty gap which is an estimate of the average shortfall of the consumption expenditure of the poor expressed as a share of the poverty line. For α = 2, P_α give a measure of severity of poverty by giving more weight to the poorest of the poor. It corresponds to the squared average distance of the consumption expenditure of the poor to the poverty line. This measure has an advantage as it satisfies the axiom of decomposability and additivity.

Concentration Index

Given information on the incidence of poverty and poverty line, the study also attempted to compare the contribution to poverty and its concentration by/across regions and sectors. Concentration Index was estimated as:

$$C\,i = Pi\,/\,Pop_i * 100 \ldots\ldots\ldots\ldots\ldots 7$$

Whereas, C_i is the concentration index, P_i is the percentage contribution of region/sector *i* to the overall poverty and Pop_i is the percentage population of region/sector *i* in the overall population.

A value of C_i =1, suggests that sector/region i contributes equally to the poverty in relation to its size of population. Similarly, a value of $C_i < 1$, suggests that sector/region i contributes less to the poverty in relation to its size of population and in case of a value of $C_i > 1$, suggests that sector/region i contributes more to the poverty in relation to its size of population.

Updating the Poverty Line

The basic logic behind using absolute poverty approach in the context of developing countries is that any progress (or otherwise) can be measured against a fixed target. This implies that poverty lines estimated under this approach should remain consistent and fixed over time. Consistency requires that every individual must be measured against the same yard stick. For the poverty line to remain fixed over time, it also requires that once estimated it should only be changed/ updated by changes in prices. Adjusting the poverty line for inflation only gives estimates that are comparable over time (Ravillion and Badani 1994; Kakwani 2002, World Bank 2005 and Cheema 2005).

For the recent survey period (LSMS 2004-05), the government of Pakistan updated the base poverty line (PIHS 2001-02) by an inflation rate based on CPI. But as pointed out earlier the use of CPI for calculating overall inflation has its own limitations especially in the context of Pakistan. First is the coverage of CPI which is limited to only the urban areas covering only 35 cities and 71 markets (GoP 2008) whereas more than two-third of the population lives in rural areas. Second, CPI being a Laspeyer's index uses fixed weights of the base year (in this case PIHS 2001-02) and as consequence does not take into account the substitution of commodities as a result of inflation. Third, the share (weight) of a commodity in total consumption expenditure does not come from household survey in case of CPI, rather it is based on price and quantity information from market surveys conducted by Federal Bureau of Statistics.

Keeping in view these limitations, we used the Tranqvist Price Index (TPI) for updating the base poverty line. As the TPI is a survey based index it takes into account the price changes from both the urban and rural areas. It also incorporates the substitution effect because changes in prices over time by taking average of the weights of a commodity in the base and current survey periods. In contrast to CPI, the weight assigned to a commodity by the TPI is the average share of a commodity in total expenditure and is averaged for all the households covered by the survey.

One of the main limitations of TPI is that being survey based, its coverage is restricted to only those commodities for which unit values (a proxy of prices) can be calculated. Thus for the two surveys used in this study, its calculation is based on the unit values of 73 commodities (food and fuel only). In contrast the CPI is based on prices covering 374 commodities. Nevertheless, we preferred the use of TPI over CPI because of its coverage of both the urban and rural areas and it's assigning of weights to every commodity based on actual household consumption expenditure rather than the one that is not survey based and is restricted to urban consumers only.

We calculated the TPI separately for eight regions (four provinces on rural and urban basis) and then arrived at a composite index by weighting the TPI for every region by its respective share represented in the household surveys. The index is calculated as follow:

$$TPI = I_{Ti} = \prod_i \left(\frac{p_{i1}}{p_{io}}\right)^{si} \ldots\ldots\ldots\ldots\ldots 8$$

Where, p_{i1} is the median unit value (price) of commodity i in period 1 (LSMS 2004-05),

p_{io} is the median unit value of commodity i in period o (PIHS 2001-02),

$s_i = 0.5(e_{i0}/\sum e_{i0} + e_{i1}/\sum e_{i1})$ is the mean expenditure share of item *i* in the two surveys with $e_{i0}/\sum e_{i0}$ and $e_{i1}/\sum e_{i1}$ representing the expenditure share of item *i* in total expenditure in the base survey period (2001-02) and recent survey period (2004-05).

Poverty in Pakistan and its decomposition across regions and sectors

Based on the methodology explained above, we estimated the poverty lines and measures of poverty for 2001-02 and 2004-05. The estimated poverty line of Rs 730.10 per adult equivalent per month for 2001-02 was updated by an inflation rate of 28.37 percent that occurred between PIHS 2001-02 and LSMS 2004-05 survey periods. By doing so the poverty line remained constant over time and the poverty measures calculated remained consistent and comparable over time. The poverty line estimated through equation 4 is given as:

$$\text{Ln}Y_i = 6.1125 + 0.000205X_i$$

(701.52)* (46.07)*

$R^2 = 0.195$ Standard Error of the Estimate = 0.2114

Figures in parentheses are *t*-ratios that are significant at 1 percent level of significance. Given the information on the parameters, monthly per adult equivalent total expenditure (food and non-food) required for the officially recommended daily caloric norm of 2350 was worked out through equation 5 as fallow:

Poverty Line for PIHS 2001-02 = $Z_{01} = e^{(6.1125 + 0.000205(2350))} = \text{Rs.}730.10$

Poverty line for LSMS 2004-05 = $Z_{05} = 730.10 * 1.2836 = \text{Rs } 937.45$

While calculating inflation between the two surveys, the Tornqvist Price Index (TPI) calculated from the survey data at median unit values were weighted by percentage of households represented by the respective region in total samples. The information is given in the table 2.

Poverty Measures

Based on our estimated poverty lines, the head count index (incidence of poverty) decreased by 5.74 percent between the two survey periods i.e. from 35.44 percent in 2001-02 to 29.70 percent in 2004-05 (table 3). In absolute count the number of poor decreased from 44.34 million in 2001-02 to 38.57 million in 2004-05. Absolute poverty decreased by 5.67 percent and 4.48 percent in rural and urban areas respectively between the surveys periods. However, in relative terms urban poverty fell by 23.48 percent and rural poverty by 16.37 percent. The fall in incidence of poverty is much less compared to ones provided by the government sources which show a decrease in incidence of poverty by 10.52 percent between 2001-02 and 2004-05. The difference in the estimate lie in the methodology followed, mainly, for updating the base poverty line.

While the head count measure in table 3 shows the proportion of the population below the poverty line, it does not show the depth of poverty (how poorer the poor are) and the measure does not change if the individuals below the poverty line become poorer. The poverty gap captures this shortcoming. The poverty gap figures (table 3) at the national level shows that averaged over the whole population, the poor's consumption shortfall is equivalent to 7.30 percent of the value of the poverty line in 2001-02 and like the head count index, it decreased to 6.17 percent of the value of poverty line in 2004-05. In relative terms the rural poverty gap fell by 14.68 percent while for urban areas it showed a decline of 25.46 percent between the two surveys.

The poverty gap measure captures the depth of poverty but cannot capture the severity of poverty. The severity of poverty measure which is a distributionally sensitive measure takes into account the distribution of consumption expenditure of those individuals who fall below the poverty line. Depending on the value of α (as in equation 6), it gives more weight to the

consumption short fall of the poorest of the poor. When α, approaches infinity the measure estimates the poverty of the poorest person. The value of $\alpha = 2$ for the figures in table 3 which in other words is a squared poverty gap index. At the national level, the measure decreased from 2.23 to 1.96 between the survey periods. In relative terms the severity of poverty fell by 9.40 percent and 23.47 percent for rural and urban areas respectively between 2001-02 and 2004-05. Poverty measures (head count index, poverty gap and severity of poverty) clearly illustrate that poverty in Pakistan is more of a rural in nature. While all the measures showed a decline between the survey periods, the relative decrease is more skewed towards urban poverty.

An important characteristic of poverty in Pakistan as shown by the poverty measures is the clustering of the poor around the poverty line. This is shown by the low values of the poverty gap and severity of poverty which further suggest that any minor shock to the economy can have a profound effect on the incidence of poverty.

For comparison with overall sample and urban and rural areas we also plugged in the poverty measures for agriculture sector in table 3. The table shows that the head count index for agriculture at 39.10 and 31.90 for 2001-02 and 2004-05 respectively is more than the national figures for the same survey periods. The estimates for poverty gap and severity of poverty portray the same trend. However, all these measure for poverty in the agriculture sector showed a decline between the two surveys. Nevertheless, one can deduce from these figures that for an individual the probability of being poor when associated with a household in the agriculture sector is more than other sectors on average.

Assessing the decrease in the overall poverty measures and those in the agriculture sector, it is important to look at the growth rates in the overall economy and the agriculture. Table 4 shows that overall economy grew by an annual average of 5.26 percent between the survey periods.

During the same period the agriculture GDP grew at an annual average of 2.18 percent. It needs also be noted that the overall real GDP growth rate was at its lowest in the base survey period and the agriculture GDP growth rate was negative for the same period whereas the overall growth rate and the agriculture GDP growth rate was at its peak when LSMS 2004-05 was conducted.

Table 3 and table 4 when read together support the poverty growth nexus and the argument that poverty is negatively correlated with growth when it is measured in absolute terms. To see the distribution of the benefits in terms of consumption expenditure as a result of increase in the growth of overall economy and the agriculture GDP growth, we gave a comparison of per adult equivalent consumption expenditure of individuals belonging to various quintiles in the overall sample and those who belong to the agriculture sector in table 5.

Table 5 shows that increase in growth rate of overall GDP and agriculture GDP translated into an overall increase in the monthly average per adult equivalent (PEA) consumption expenditure of 10.50 percent between the two survey periods (from Rs 1004.20 in 2001-02 to 1109.51 in 2004-05). The data also showed that the percentage change in monthly PAE consumption expenditure of the richest 20 percent is nearly 5 times that of the poorest 20 percent, suggesting the skewed nature of the distribution of the benefits of growth. A comparison of percentage change in overall mean consumption expenditure for every quintile suggests that for 80 percent of the population the percentage increase is below the national average percentage increase. The absolute monthly PAE consumption expenditure of the richest 20 percent as a ratio of poorest 20 percent increased from 3.6 in 2001-02 to 4.20 in 2004-05, showing the worsening of the expenditure inequality. The table shows the same trend for the agriculture sector where average monthly PAE consumption expenditure increased by 9.80 percent between the survey periods. Quintile wise

average PAE consumption for every quintile in the agriculture sector is lower than the overall figures of the corresponding quintile. Consumption inequality in the agriculture sector grew from 3.36 in 2001-02 to 3.87 in 2004-05. Overall, table 5 shows that the benefits of the growth were reaped more by the already well-off segments of the society. Additionally, it also points to the fact that given the growth structure, there are other factors related to household characteristics, the level and extent of which define the participation in reaping the benefits of growth.

Concentration Index

The concentration index, defined as the ratio of the percentage contribution to the overall poverty of region/sector *i* to its share of population in the overall population, is given in table 6. The concentration index shows that region wise rural areas contribute 14 percent more to the overall poverty relative to its size of population in 2001-02 while in 2004-05, though the overall poverty declined, it contribute 17 percent more to the overall poverty relative to its size of population. This suggests that between the survey periods, the incidence of poverty decreased more in urban areas compared to rural areas thus further strengthening the argument that in Pakistan poverty a more rural issue.

Table 6 further shows that industry/sector wise, the concentration index for agriculture and construction is more than 1 suggesting the concentration of poverty in these sectors compared to other sectors. While the concentration index for the construction sector stands out to be the highest in both the surveys followed by the agriculture sector but it is the share of population of these sectors that is responsible for such a difference. The population share of agriculture sector in both the surveys is almost two-fifth of the whole population while for construction it is less than one-tenth in both the surveys. The concentration index and the share of agriculture sector in total population make it a focus of attention in any poverty alleviation policy drive.

Modeling the determinants of poverty in the agriculture sector

A general and simple way of looking at the characteristics of the poor is to summarize the information in a shape of poverty profiles. These profiles are usually bivariate in nature and decompose poverty measures according to geographical location, demographic characteristics, schooling level, access to various amenities etc. Though these profiles are useful in some cases, like which area needs policy attention more compared to another, but they are nevertheless bivariate correlations between incidence of poverty and some socio-economic factors without controlling for the effect of other factors (Ravillion 1996 and Fagernas and Wallace 2007). Apart from the usefulness of the unconditional poverty profiles recent emphasis is more on the multivariate determinants of poverty which captures the effect of one factor conditional on the contribution of other factors. Based on the review of literature, there are several approaches to modeling multivariate determinants of poverty: (1) the first approach is to analyze the determinants of poverty through categorical regression such as probit or logit, depending on the distribution of the error term. Here the dependent variable is taken as a binary variable with 1 representing the individual being poor and 0 otherwise. (2) The second approach is to run a multinomial logit where poverty indicator takes the form of several categories instead of binary one, such as the one based on poverty bands. (3) The third is to regress per capita (or adult equivalent) consumption against a series of explanatory variables.

The binary response model such as probit and logit has been criticized specially in the context of modeling poverty on the ground that they are estimated under the assumption that the actual consumption expenditure is not observed. Rather an artificial construct is used as a dependent variable that suppresses the consumption expenditure and related information on the households who lie above the poverty line and treat them as one homogeneous group and treat them as

censored data (Datt and Jolliffe 1996). While doing so information about the actual relationship between the level of consumption and the independent variable is sacrificed. Ravillion (1996) pointed out that in such cases the consumption expenditure as dependent variable "is not latent at all but observed" and suggested the use of probit or logit as irrelevant.

This study used the last approach where per adult equivalent consumption expenditure is regressed against various explanatory variables. Since our poverty line is consumption based and we have defined poor as those whose consumption expenditure is below the poverty line, this approach makes more sense in figuring out, first the various factors that affect the level of consumption and subsequently the incidence of poverty. The parameters of the model and the probability of a household being poor are estimated through ordinary least squares (OLS) while making weaker assumption about the distribution of the error term (Ravillion 1996 and Gibson and Rozelle 2003).

For this section we relied heavily on the methodology used by Datt and Jolliffe (2005). The methodology is followed in three steps. In the first step the determinants of the log of consumption are modeled. Here, monthly per adult equivalent consumption used was normalized by the spatial cost of living index to arrive at real per adult equivalent consumption.

$$Lny_i = \beta_i x_i + \mu_i \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots 9$$

The dependent variable is in log form which is a standard way of allowing for the log normality of the variable (World Bank 2005, p. 133). The use of dependent variable in such form stabilizes the error variance and improves the predicted power of the equation (Jamal 2004, p.5). The $ß_i$ estimates indicate the partial marginal contribution of x_i on the dependent variable.

In the second step having estimated the parameters of the model, the monthly per adult equivalent consumption for every household *i* is calculated. For a lognormal variable following

lognormal distribution having estimated standard error of the estimate σ, then $E(x) = e^{\mu+\hat{\sigma}^2/2}$ (Green 2003, p. 854). So in this case it's given by:

$$E(y_i) = e^{\hat{\beta}_{xi}+\hat{\sigma}^2/2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 10$$

In the third step the probability of a household being poor associated with every estimated monthly per adult equivalent consumption expenditure level is calculated and is given by:

$$\hat{P}_{oi} = prob(Ln\hat{y}_i - Lnz) < 0 = \Phi\left[\frac{(Lnz-\hat{\beta}_{xi})}{\hat{\sigma}}\right] \ldots\ldots\ldots\ldots\ldots 11$$

Where $\hat{P}_{oi}$ is the estimated probability of household *i* being poor, z is the poverty line and Φ is the standard normal distribution. The weighted average, weighted by population weight, of household probabilities of being poor is calculated to give the predicted incidence of the poverty. The population weight here is the product of household sampling weight and household size.

Data and Estimation Strategy

The data used in this section comes from PIHS 2001-02 as the LSMS 2004-05 data does not provide detailed information on the variables of interest required for this study. Even the PIHS 2001-02 provide relatively detailed information on the households associated with agriculture sector compared to other sectors. The survey carries a detailed data in the agriculture sheet attached to it. The household included for this analysis are those whose head of the household have reported to be in the agriculture sector and whose information is available in the agriculture sheet.

While modeling the determinants of poverty for households in the agriculture sector, we estimated separate models for irrigated and un-irrigated areas. We based our decision on the assumptions that irrigated and un-irrigated areas have different farming systems and follow different cropping systems. The key factor that dictates the allocation of household resources

towards different farm and non-farm enterprises is the availability or the absence of irrigation water.

Description of the explanatory variables

We group the potential explanatory variables into the following headings: demographic, education, employment, agriculture specific physical assets and infrastructure. A key rule in selecting potential explanatory variables is that they are exogenous to the current consumption expenditure which is taken as dependent variable. For example the value of crop and livestock produce, education expenditure or dwelling characteristics are not included because its value as such or in the form of imputed value is already included into the consumption expenditure.

Under the demography we included variables related to household size (the number of members in household), number of household members below 10 years of age, number of household members above 60 years of age and age of the household head.

Education variables include variables on number of schooling years of the head of the household, number of schooling years of spouse of household head and average schooling years of the household that include all those members of the household who are above 18 years of age and have completed their education and not pursuing any more schooling. Those household members who are 18 years and above and still going to school were excluded because their expenditure on schooling has been included in the dependent variable.

Four variables are included in the employment and income variables. Two dummy variables were included related to remittances, one for household receiving these from within Pakistan and one for receiving remittances from abroad. As all the households in the sample are those whose head of the household is in agriculture sector, so two variables relating to employment of second or additional member of the household were created. One variable include the number of

household members who are 18 years and above and are working in the agriculture or construction or transport and communication industry. These three industries were grouped together as the estimated average monthly per adult equivalent expenditure in these sectors was less than the national average. The other variable includes the number of household members employed in other industries. All other sectors, except the three mentioned earlier, were grouped together as the estimated monthly per adult consumption expenditure in these sectors was more than the national average.

Three agriculture specific variables related to physical assets were separately included. One variable is related to the amount of land ownership in acres. Since because of the skewed nature of the land distribution, households having more land usually do not cultivate all their land and in some cases they are absentee landlords who do not cultivate their land or a portion of it at all. In such cases the land is cultivated by tenants or share cropper or rent in by those who are interested in cultivation but do not have land or sufficient land to do so. Keeping this in mind we also included another variable that is related to amount of land cultivated (in acres) by those who are tenants, share croppers and those whom rent in land for such purpose. The third variable in this group is related to livestock. The data in the agriculture sheet in the PIHS 2001-02 provides information on the value of livestock including cattle, buffaloes, sheep and goats, camels, horses and donkeys . The information in this shape is of little use since we are interested in the marginal contribution of a unit of a livestock to the dependent variable. A dummy variable for livestock is also not a solution for this as different types of livestock are simply not comparable. A separate dummy variable for every kind of livestock was also not feasible as in some cases one household is having different kinds of animals. In such a scenario we made an arbitrary decision, though on the expert opinion of some who work in the livestock market, by setting the price of an average

cow to Rs 25000/- per head. We then divided the value of cows by this price and got the units (numbers) for it. We then converted the respective values for all kinds of animals accordingly and termed this unit as Livestock Equivalent Unit (LSEU). For example, a buffalo with a value of Rs 37500/- is equal to 1.5 LSEU and four goats worth Rs 25000/- is 1 LSEU. Apart from this, it has an additional advantage of capturing quality difference within the same type of animals. For instance a very good quality cow worth Rs 50000/- is two times LSEU. Additionally and more importantly it helped in keeping the model parsimony by having more information in just one variable.

One variable, the infrastructure index, is also included. This variable is a composite index of access to the following facilities: electricity, natural gas (fuel), paved road and; market, bank, fertilizer depot and tractor rental within the locality. We made a simple assumption by assigning a weight of one to every facility and then taking its average for every household.

Results of the Models

The results of both the models are given in table 8. In general the models performed well. The R^2 a measure of goodness of fit is 0.426 for irrigated areas and 0.395 for un-irrigated areas. For models with cross-sectional data it is sufficiently reasonable. Most of the coefficients and their respective signs are as per prior expectation and are statistically significant.

All demographic variables except the age of the households are negatively related to the monthly per adult equivalent (PAE) consumption expenditure. The two variables, numbers of household members below 10 years of age and above 60 years taken as a proxy of the dependency ratio shows that more the number of dependents in a household the more negative impact it has on the PAE consumption expenditure. So by implication they are positively related with poverty. The age of the head of the household with positive sign is almost the same for both the models.

In the education variables, the schooling year of the household head is only significant for irrigated areas while for un-irrigated areas it turns out to be insignificant. A possible reason for this may the individuals with a little bit education background prefer to be out of the agriculture sector especially in the un-irrigated areas. The other two variables have almost the same effect. In the agriculture related variables, land ownership and livestock turned out to be significant for both areas. As expected the gains from an extra unit of land (acre) in irrigated areas is more than 3.5 times that of un-irrigated areas. Because of the importance of the livestock in un-irrigated areas its marginal contribution is greater in these areas compared to irrigated areas. The cultivated land variable (the variable that include land cultivated by tenants, sharecroppers etc) is not significant in the un-irrigated areas.

Other variables that contribute significantly to the household consumption are remittances from abroad and the infrastructure index. The remittances from within the country have no significant effect on the consumption. The reason for this may be that these household members do not have sufficient skills or the resources to either go abroad or to participate effectively in the local market. The insignificance of this variable also suggests low market demand for unskilled labor that is evident in the form of low wage rate prevailing in the country. The significance of the infrastructure index suggests that those households who have enough access to various facilities tend to increase their welfare. It also suggest more investment on the part of the government in this area as it happen to be the only area where the policy makers can make an influence relatively easier compared to targeting other potential factors highlighted earlier.

Potential policy simulations

Table 9 shows the results of various policy simulations done with both models. The simulation results are shown in terms of percentage change in the PAE consumption expenditure and

percentage change in head count index. The simulations results were compared with a base simulation results that were estimated based on the parameters of the models for both the models. Simulation 1 deals with increasing land of households who are already owners. We did not assume redistribution which is rather an impractical scenario as the Pakistan has a background of various failed land reforms since its inception. The increase of land by 1 acre also looks impractical that without redistribution how it can be increased? We looked at it from another perspective, from the perspective of increasing the productivity of land. If five acres of land are made productive enough to produce equivalent of six acres so, at least, theoretically it got increased by one acre. The simulation result shows that 1 acre of land increases the PAE consumption by 5.24 percent and 2.31 percent in irrigated and un-irrigated areas respectively. It decreases the head-count index by 6.23 percent and 2.83 percent in these households accordingly. The result of increasing livestock unit by one is more pronounce in un-irrigated households than irrigated ones for both consumption and head-count index. Simulation 3 is related to increasing the mean schooling years of households with 18 years and above members by 1 year. The results are somewhat the same for both irrigated and un-irrigated households. In simulation 4 we increased infrastructure index by one unit for those households who were atleast deficient on access to any one component of the infrastructure index. For un-irrigated households the impact on both consumption and incidence on poverty is the maximum whereas for irrigated households its second only to increase in the land ownership.

Conclusion

Our results for the incidence of absolute poverty in Pakistan show that for LSMS 2004-05 the figures provided by the government are bit under estimated. We pointed out the reason for it being the inflation of the base poverty line by the CPI which is an urban based index. We

inflated the base poverty line by the TPI, a survey based index and the results showed that the decrease in incidence of poverty is almost half as reported in official documents. Our results support the poverty growth nexus but also pointed out that the benefit of the growth was reaped more by those who were already rich and showed the worsening of the consumption expenditure inequality over time.

Overall poverty is concentrated more in rural areas and agriculture sector contributes more to the national poverty as compared to other sectors. The monthly average per adult equivalent consumption expenditure is lower for all quintiles of the agriculture sector compared to the national averages for both the surveys. Any effort to alleviate poverty in Pakistan needs a focused attention to this sector because of the bulk of the population attached to this sector and the reliance of other sectors on it through backward and forward linkages.

The results indicate the importance of investment in increasing the productivity of land and livestock to help people in poverty in the agriculture sector and to invest in infrastructure for overall decrease in poverty.

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Table 1. Households included in the study

Province/ Region	PIHS 2001-02			LSMS 2004-05		
	Urban	Rural	Total	Urban	Rural	Total
Punjab	2542	3768	6310	2510	3605	6115
Sind	1533	2173	3706	1497	1980	3477
NWFP	840	1825	2665	1087	1878	2965
Baluchistan	621	1403	2024	713	1434	2147
Total	5536	9169	14705	5807	8897	14704

Table 2. Inflation Rate Based on Tranqvist Price Index (TPI)

Region	HH Weight*	TPI	Weighted TPI
Punjab - Urban	0.176	26.858	4.733
Rural	0.412	31.401	12.948
Sind - Urban	0.105	18.793	1.970
Rural	0.141	26.106	3.669
NWFP – Urban	0.019	25.578	0.495
Rural	0.105	28.101	2.939
Baluchistan - Urban	0.008	32.526	0.2479
Rural	0.035	39.479	1.363
Inflation (%)			**28.365**

*HH Weight shows the share of households represented by the region in over-all sample

Table 3. Comparison of Poverty Estimates (PIHS 2001-02 and LSMS 2004-05)

Region / Sector	Poverty Estimates					
	Head Count		Poverty Gap		Severity of Poverty	
	2001-02	2004-05	2001-02	2004-05	2001-02	2004-05
Urban	23.56	19.08	4.73	3.77	1.42	1.15
Rural	40.29	34.62	8.35	7.28	2.56	2.34
Total	35.44	29.70	7.30	6.17	2.23	1.96
Agriculture	39.10	31.90	8.02	6.58	2.43	2.14

Table 4. Real Growth Rates*

Year	Over all	Agriculture
2000-01	2	-2.2
2001-02	3.1	0.1
2002-03	4.7	4.1
2003-04	7.5	2.4
2004-05	9	6.5

*GDP at Factor Cost
Source: Economic Survey (2006-07), Government of Pakistan.

Table 5. Mean Monthly Per Adult Equivalent Consumption Expenditure (Rs)

	Overall			Agriculture Sector		
Expenditure Quintile	PIHS-2001	LSMS-2004-05 (2001-02 Prices)	%Change	PIHS-2001	LSMS-2004-05 (2001-02 Prices)	%Change
Poorest 20%	507.40	524.85	3.44	506.62	519.54	2.34
2	690.31	733.24	6.21	689.30	728.46	5.37
3	845.36	909.34	7.56	844.50	904.46	6.72
4	1070.14	1171.90	9.51	1069.06	1162.56	8.74
Richest 20%	1907.34	2207.90	15.75	1706.96	2012.27	17.90
Overall	1004.20	1109.51	10.50	916.80	1006.73	9.80

Table 6. Contribution to Overall Poverty by Region and Sectors

Region/Industry	2001-02				2004-05			
	Percent Contribution				Percent Contribution			
	Poor	Non-Poor	Pop* Share	Concen. Index**	Poor	Non-Poor	Pop Share	Concen. Index
Region	19.25	34.28	28.95	0.66	20.4	36.52	31.73	0.64
Urban	80.75	65.72	71.05	1.14	79.6	65.48	68.27	1.17
Rural	35.44	64.56	100	0.35	29.7	70.3	100	0.30
Industry/Sector								
Agriculture, Livestock	44.39	38.26	40.44	1.10	40.24	35.89	37.18	1.08
Mining and Manufacturing	8.11	8.91	8.63	0.94	7.89	8.14	8.07	0.98
Electricity, water and gas	0.79	1.46	1.22	0.65	0.49	1.04	0.88	0.56
Construction	13.19	5.68	8.35	1.58	10.27	5.89	7.18	1.43
Wholesale, retail, restaurant	11.46	16.03	14.41	0.80	13.27	18.22	16.76	0.79
Transport and communication	6.46	6.65	6.58	0.98	5.37	5.47	5.44	0.98
Finance, Insurance, Real Estate	0.18	1.08	0.76	0.23	0.15	0.56	0.54	0.27
Community and personal services	13.87	19.10	17.24	0.80	18.07	19.92	19.37	0.93
Not adequately defined	1.56	2.83	2.38	0.66	4.25	4.87	4.69	0.90

*Population Share
**Concentration Index

Table 7. Descriptive Statistics

Variable	Irrigated (N= 2578)		Un-irrigated (N=1706)	
	Mean	SD	Mean	SD
Log: Monthly Per Adult Equivalent Expenditure	6.858	0.430	6.727	0.406
Dummy Sind	0.260	0.440	0.239	0.427
Dummy NWFP	0.080	0.270	0.160	0.366
Dummy Baluchistan	0.030	0.175	0.060	0.238
Dummy Urban	0.030	0.183	0.053	0.223
HH size	7.530	3.485	6.697	3.168
Number of members below 10 years of age	2.255	1.944	2.119	1.845
Number of members age 60 and above	0.502	0.699	0.440	0.662
Age of HH head	45.550	13.567	45.308	13.751
Household Head's Schooling years	2.406	3.554	1.675	3.112
Number of Schooling Years of Spouse of HH head	0.354	1.541	0.226	1.160
Average Schooling Years of HH	4.222	3.685	3.218	3.638
Log: Land Owned	1.745	2.915	2.13	2.786
Log: Cultivated Land	1.042	2.886	1.01	1.02
Livestock cattle-head equivalent unit (LSEU)	1.613	1.993	0.926	1.403
No. of HH members employed in agri., construction and Transport	1.756	1.832	1.209	1.423
No. of HH members employed in other sectors	0.170	0.501	0.175	0.522
Dummy: Remittances from within country	0.070	0.262	0.137	0.344
Dummy: Remittances from Abroad	0.020	0.130	0.030	0.171
Infrastructure Index	0.375	0.175	0.347	0.225

Table 8. OLS Estimates of the Model of Log Per Adult Equivalent Consumption

VARIABLE	Irrigated		Un-Irrigated	
NAME	COEFFICIENT	t-Ratio	COEFFICIENT	t-Ratio
HH size	-0.030	-6.36	-0.049	-8.36
Number of members below 10 years of age	-0.042	-6.24	-0.033	-4.00
Number of members age 60 and above	-0.032	-2.65	-0.032	-2.14
Age of HH head	0.002	3.15	0.002	2.79
Household Head's Schooling years	0.016	6.60	0.004	1.06
Number of Schooling Years of Spouse of HH head	0.027	4.64	0.026	3.07
Average Schooling Years of HH	0.121	2.89	0.011	3.06
Log: Land Owned	0.103	10.02	0.028	6.89
Log: Cultivated Land	0.077	7.58	0.005	0.72
Livestock cattle-head equivalent unit (LSEU)	0.037	4.67	0.043	5.54
No. of HH members employed in agri., construction and Transport	-0.031	-5.59	-0.022	-2.94
No. of HH members employed in other sectors	0.055	3.26	0.018	1.07
Dummy: Remittances from within country	0.061	1.71	0.017	0.59
Dummy: Remittances from Abroad	0.282	4.77	0.230	5.18
Infrastructure Index	0.104	2.02	0.185	2.83
CONSTANT	7.243	122.90	6.962	121.20
R^2	0.426		0.395	

Table 9. Potential Simulations (% change over base simulations)

Simulation	Irrigated		Un-irrigated	
	Mean Consumption	Head-Count index	Mean Consumption	Head-Count index
Increasing Land by 1 acre	5.24	-6.23	2.31	-2.83
Increasing LSEU by 1 unit	2.81	-3.21	3.33	-4.15
Increasing Mean Schooling Years by I year	2.12	-2.89	2.21	-3.12
Increasing Infrastructure Index by 1 Unit	4.75	-6.13	5.76	-6.87