RE-EXAMINING THE INVERSE RELATIONSHIP BETWEEN FARM SIZE AND PRODUCTIVITY IN PAKISTAN

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ABSTRACT

The purpose of this study is to analyze the relationship between farm size and productivity and its various correlates like total and partial factor productivity, cropping intensity, gross margins, on and off farm incomes, credit availability with reference to different farm sizes in the irrigated perennial areas of district Gujrat and Mandi Bahauddin. To achieve theobjectives,213 respondents were randomly selected and interviewed.Cobb-Douglas production functionwas employed to observe the productivity trends using various exogenous farm inputs while monetary values of output had been used as endogenous variable in the model. The cropping intensity and study specific total and partial factor productivities were also calculated.Results confirmed the inverse relationship between farm size and productivity, however, this relationship was found weak. Furthermore, cropping intensity, yield and gross margins per hectare were found higher at small farms as compared to larger ones.

Key words: Small Farms, Inverse Relationship, Farm Productivity, Total Factor Productivity, Partial Factor Productivity, Irrigation Productivity, Labour Productivity, Institutional and Non-institutional credit, Off Farm Income, On Farm Income, Cropping Intensity, Gujrat, Mandi Bahuddin, Pakistan.

INTRODUCTION

Being primary sector of production agriculture has paramount importance as it caters major chunk of employment for the rural population, provides basic food and raw materials for secondary sector of production (i.e. agro-based industries) in developing countries. Therefore, World Bank (2008) published its annual World Development Report with title "Agriculture for Development" focusing on the role of this particular sector to achieve Millennium Development Goals especially halving the poor and malnourished by 2015.

Although, many factors of production are required in lieu of food production but land is foremost in this business. In agricultural production inverse relationship (IR) is a stylized fact which corroborates negative connections between farm size and its corresponding productivity. It means that with the increase in farm size output per unit (i.e. acre, hectare etc.) of land decreases. Inverse relationship was first established in 1960s as a result of "Farm Management Survey" in India. Since then this evidence has been widely explored by agrarians in different countries like Pakistan (Heltberg, 1998; Mahmood and Jahnke, 2010), Brazil (Berry and Cline, 1979; Kutcher and Scandizzo, 1981), Colombia, Philippines, Pakistan, India, and Malaysia (Cornia, 1985), India (Khusro, 1973; Bharadwaj, 1974; Bhalla, 1979; Sen, 1981; Carter, 1984), Indonesia (Benjamin, 1995), Paraguay (Masterson,

2007)and Turkey (Unal, 2008). Despite a lot of work has been done in the favor of IR, the literature is still inconclusive on this relationship and have polarized scientists as its opponents and proponents.Moreover, farm size and productivity were studied with different perspectives by various agrarians e.g. Sen (1962)studied this phenomenon and concluded that smaller farms were more productive and the 'opportunity cost of a day's labor by family members might be well below the daily wage rate of hired labor'. Similar conclusion was drawn by Feder (1985) and he stated that small farmers have high labor/land ratios and, consequently, achieve higher yield per hectare. Likewise, Rosset (1999) mentioned small farm higher production as "small farm wisdom" and described their domination over larger farms in the following manner; a) small farmers till their land more intensively and cultivate more crops in a year while larger farmers depend only on one or two crops per year b) small farmers do not tend to fallow their parcels while large farmers leave their land untilled c) larger farmers hire alien labor which shows less commitment and determination to cultivation as compare to family labor employed by small farmers. Singh *et al*. (2002) observed that cropping intensity decreases with ascending farm size categories and, therefore, concluded that small farms were more productive than larger farms.While studying dates' production efficiency with reference to farm sizes with other indicators, it was concluded by Aelhendy and Alkahtani (2013) that small farmers were most efficient as compared to larger ones. Moreover, similar results

were obtained by Anyaegbunam *et al.* (2012) and Ali and Deininger (2013) in African continent, recently.

However, a handful of studies can be cited in the denial of IR in many of the countries. For example, Bhalla and Roy (1988), Benjamin (1997) and Dyer (1997) found that IR does not exist based on the argument that the variations in underlying land quality might be the cause of IR in some regions. Bhalla and Roy (1988) suspected the omission of soil quality variables from the estimated models of IR proponents as a reason behind the stylized fact of IR. Similarly, Deolalikar (1981) argued that the use of higher technology in agriculture may reject the IR phenomenon.The key controversies in the IR studieslike i) mis-specification hypothesis presented and supported by Bhalla and Roy (1988) ii) agricultural dualism/bimodal iii) non-competitiveness of factor markets and iv) farmer's attributes, revealed causal effects suggesting land redistribution as policy implications in the end of IR discussion. But it is beyond the scope of the study to discuss in details the pros & cons and opponents and proponent school of thoughts of aforementioned controversies in this particular area.

Significance of land holdings cannot be denied in Pakistan like other countries and it has serious implications for poverty and farm size productivity in the country. Strong evidence is available which shows that the rate of rural poverty is higher (Arif 2006) which is linked with lack of assets in rural Pakistan (Anwar *et al*. 2004). Landless are the absolute poor while largest farmers are the exception from this phenomenon. Furthermore, with the increase in land size the head count ratio decreases in the poverty trap (Ibid). It is, further, argued that land is used as mortgage weapon to attain institutional credit. Resultantly, landless farmers or small land holders are the loser and they have to, solely, rely on non-institutional credit and family labor force for cultivation.

Pakistan faces the dilemma of skewed land distribution where less than five hectares of land are owned by eighty one percent farmers holding only 38.7 percent of the total farm area in the country (Bhutto and Bazmi 2007).[1] Many researcher have proved existence of IR relationship in Pakistan (Kiani, 2008; Mahmood and Jahnke, 2010; Sial et. al., 2012) but fewer other rejected the hypothesis of IR in their studies (Khan, 1979). Therefore, it seems plausible to investigate the relationship between farm size and productivity in Pakistan which could have important economic implication for long standing political slogans "redistribution of land ownership".

Table 1.Farm size and Farm Area in Pakistan.

Size of Farm (Acre)	No. of Farms %						Farm Area %					
Size of Farms	1960	1972	1980	1990	2000	2010	1960	1972	1980	1990	2000	2010
<5	19	28.2	34.1	47.5	57.6	64.7	3	5.2	7.1	11.3	15.5	19.2
5<12.5	44.3	39.9	39.4	33.4	28.1	24.8	23.6	25.2	27.3	27.5	27.9	28.8
12.5<25	23.8	21.1	17.3	12.2	8.8	6.8	27	26.6	24.7	21.5	19.1	17.7
25<50	9	7.7	6.5	4.7	3.9	2.6	19	18.8	17.8	15.8	16.3	12.7
50<150	3.3	2.7	2.4	1.8	1.2	1	16	15.1	14.7	13.9	9.6	10.5
>150	0.5	0.4	0.3	0.3	0.2	0.2	11.5	9.1	8.5	10.1	11.6	11.1
Total	100	100	100	100	100	100	100	100	100	100	100	100

Source: Pakistan Agriculture Census Reports (1960, 1972, 1980, 1990, 2000, and 2010)

Objectives: The study wasdesigned with following major objectives:
1-   To re-examine the nexus between farm size and productivity in the study area.
2-   To gauge the level of cropping intensities with respect to farm size distribution in the study area.
3-   To provide policy recommendations to agricultural policy makers, researchers, and development planners in the light of study results.

Although the core objective of the study was to re-examine the inverse relationship but as per best knowledge of authors none of the previous work has covered such large range of dimensions (total and partial factor productivity, cropping intensity, on and off farm households' income, institutional and non-institutional credit, gross/profit margins) regarding various farm size categories which has been highlighted in the forthcoming results and discussion parts.

MATERIALS AND METHODS

Data, Sample and Sampling Techniques: The data was, originally, collected for the project titled as "Impact Assessment for Infrastructure Development on Poverty Alleviation" for the sake of impact evaluation of irrigation infrastructure development in District Gujrat and Mandi Bahaudin of the Punjab province, Pakistan, commissioned by Japan Bank for International Cooperation (JBIC) from 2001-2003[1].Cross-sectional

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[1]The Principal author of this paper was part of the data enumerators' team of the said project and he is very much

data was used in this study which was collected from different types of farming systems belonging to perennially[2] irrigated areas from the bordering zones of District Gujrat and Mandi Bahaudin along the distributaries of Upper Jehlum and Gujrat Branch canals.Multistage stratified and cluster sampling methods were used by employing systematic random sampling techniques of probability sampling design for data collection. Overall, 213 respondents were interviewed by using structured questionnaire to achieve the objectives of the study.

Analytical Tools: On the basis of available data, farm households were divided into three farm size groups' i.e. small(< 2 hectares), medium (2-4 hectares) and large farms (> 4 hectares). The section delineates the major analytical tools to gauge total and partial factor productivity, cropping intensity, and analyze distinctions of various indicators (i.e. total and partial factor productivity, cropping intensity, on and off farm households' income, institutional and non-institutional credit, gross/profit margins) amongst different farm sizesusing Kruskal Wallis Test.   Moreover, Cobb-Douglas Production function was employed to observe the impacts of different deterministic and efficiency variables on farm productivity trends in the study area.

Total Factor Productivities: Total factor productivity is the ratio of aggregate outputs to aggregate inputs (FAO, 2005) whichwas determined by using the following formula,

$$TFP = \frac{\sum_{i=1}^{n} Ri \, / \, hectare}{\sum_{i=1}^{n} CPi \, / \, hecater} *100$$

Where,
TFP =   Total Factor Productivity
R =   Farm Revenue obtained by multiplying multiple crop outputs and their prices
CP =   Cost of Production of all of the factors involved (Ploughing + seed + fertilizers + chemicals + weeding + labour + irrigation + harvesting + threshing)
i=   number of farmers(ranges from 1-n)

Partial factor Productivity (PFP): PFP can be expressed as a ratio of output to aquantity of particular input. In this regard, partial productivities of irrigation and labour were estimated by using following methods;

a.   **Irrigation   Productivity:**   The   partial productivity for irrigation was calculated dividing farm

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grateful to director INPIM (Dr. Intizar Hussain) for providing him this data to use for research.
[2]Perennial irrigation means year round surface water availability from the public sector infrastructure.

revenues by total costs of irrigation (i.e. canal + owned tube well + purchased water) incurred by the farmers. The following formula was used to calculate the irrigation productivity i.e.

$$IP = \frac{\sum_{i=1}^{n} Ri \, / \, hectare}{\sum_{i=n}^{n} ICi \, / \, hectare} *100$$

Where,
IP =   Irrigation Productivity
R =   Farm Revenue obtained by multiplying multiple crop outputs and their prices
IC =   Sum of irrigation costs (canal + owned tube well + purchased water)
i=   number of farmers (i.e. 1-n)

b.   **Labour   Productivity:**   As   far   as   labor productivity calculation is concerned, it was determined by dividing farm revenues by labour costs (i.e. family labor man days + hired man days). In this regard, hired labour cost were directly asked from the respondents while family labor costs were determined by multiplying labour man days with average wage rate per day in the study area. Labour productivity can be expressed in a following manner,

$$LP = \frac{\sum_{i=1}^{n} Ri \, / \, hectare}{\sum_{i=1}^{n} LCi \, / \, hectare} *100$$

Where,
LP = Labor Productivity
R = Farm Revenue obtained by multiplying multiple crop outputs and their prices
LC = Family and hired labor costs together incurred on crop production
i= number of respondents (i.e. 1-n)

Cropping Intensity (CI): Cropping Intensity is an effective measure to estimate the intensiveness of agriculture production on per unit of land per annum, in a specified area. Following formula was utilized to determine CI at various farm sizes categories under study,

$$CI = \frac{\sum_{i=1}^{n} TCRAi}{\sum_{i=1}^{n} TCAi} *100$$

Where,
CI=   Cropping Intensity
TCRA =   Total cropped area
TCA =   Cultivated area
i= number of respondents (i.e. 1-n)

Kruskal Wallis Test (KWT): KWT measures variation amongst different categories when data does not support normal distribution to calculate Analysis of Variance. All pre-requisites[3] of KWT were tested and it was applied to observe differences in various farm sizes (i.e. small, medium and large) within the context of different indicators of interest as mentioned earlier in the start of this part of the paper. It can, statistically, be expressed as below,

$$KWT = \frac{12}{N(N+1)} \sum_{i=1}^{k} \frac{R_i^2}{n_i} - 3(N+1)$$

Where,
N= total sample size
n_i= sample size of particular group
R_i=sum of ranks for each group

Econometric Model: Cobb-Douglas Production Function was employed to test the nature of relationship betweenoutput and other variables of interest. However, all of the assumptions of Multiple Linear Regression were tested and had been satisfied using various measures .e.g., different kinds of input costs were added together under the title of "intermediate inputs" to avoid Multi-collinearity problems and to reduce the number of variables. Moreover, ordinary least square (OLS) method of estimation was rendered to determine the said econometric model. .

Ln FREV = + $_1$Ln OPHLD + $_2$ Ln LAB + $_3$Ln IRRIG + $_4$Ln INTINPUT + $_5$Ln CREDIT + $_6$ Ln FAMSIZ + $_7$Ln AGE + $_8$Ln EDU + $_9$Ln PERFW + $_{10}$ Ln OFFARMINC + $_{11}$ Ln TRACTOWN + $_{12}$Ln TUBWOWN +
Where,
FREV=Farm Revenue (Rs./ha),OPHOLD=Operational Land Holding, LAB=Labor man days/ hectare (family labor +hired labor), IRRIG = Irrigation Cost (Rs/ha), INTINPUT = Intermediate input costs (seed,fertilizers, manure, chemical, mechanization) (Rs/ha), CREDIT=Credit (Rs./ha), FAMSIZ=Family size,AGE=Age of household head (yrs), EDU=Education of household head (yrs),PERFW=Percentage of family workers working in agriculture sector, OFFARMINC=Off-farm income of households,TRACTOWN=Dummy of tractor ownership,TUBWOWN=Dummy of Tube-well ownership.

RESULTS AND DISCUSSION

Farm and Family Attributes of the Households: Figure-1 and 2 exhibit means of farm and family attributes of the households, respectively.[4] Family attributesreveal some of the interesting facts regarding family size, literacy rates and dual job statusalongwiththe other demographic indicators.
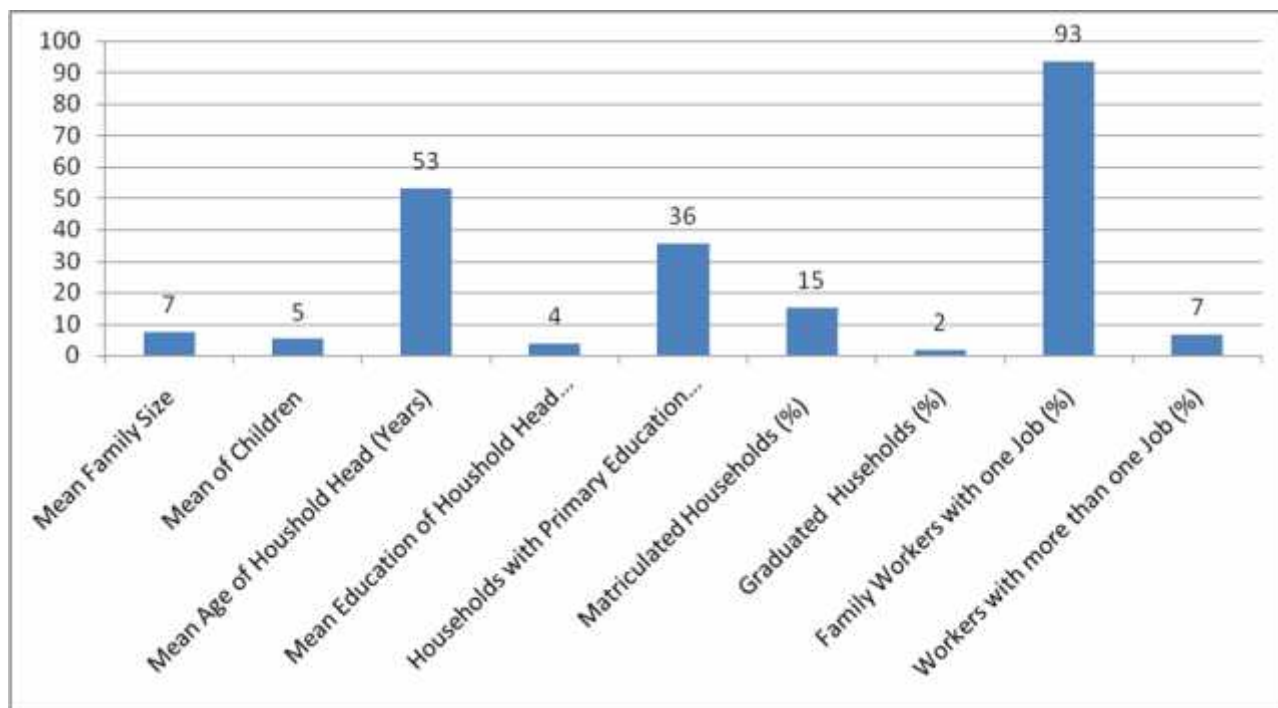

Figure 1. Family Attributes of the Study Area

Moreover, the descriptive statistics reveal that target households owned 3.14 hectares of average land while per capita landownership was found as only 0.43 hectares. Figure 2 portrays the dominance of family

laborover hired labor in the area that may be due to small land holdings in the area while mean ownership of tractorwas found extremely low. However, tubewell ownership by the households was found much higher (i.e.

72 %) due to its high dependence on irrigation. Moreover, greater percentage of tubewells verified the complaints about the canal water shortage in the study area.
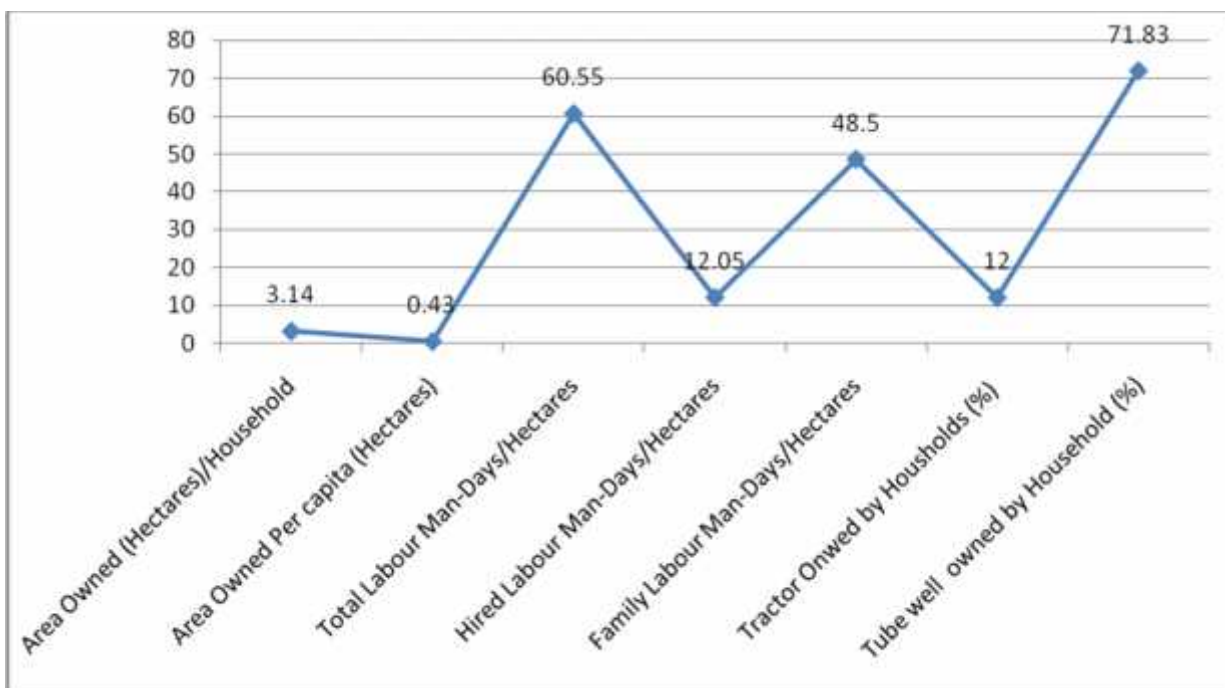

Figure- 2 Farm Attributes of the Study Area

Cropping Intensity: Cropping Intensity indicates the extent to which the cultivated area was used for repeated cropping in a particular year (Mahmood and Jahnke, 2010; Government of Pakistan, 2012). The cropping intensity in study areas, as a whole, was found 161 %. It is noteworthy that small farms were observed as most crop intensive (186 %) followed by medium (152%) and large farms (137%) with the highest level of significance (i.e. less than 1%). The results of the study are supported by Singh *et al* (2002) and Shah (2011) strengtheningthe IR theory that small farms are more crop intensive thanthe larger ones.

Total and Partial Factor Productivity Analysis: It is evident from table-2 that Total Factor Productivity

(TFP)was higher at small farms (1.60) followed by medium (1.49) and large ones (1.38). By investing one rupee each on farm activities the small farmers earned rupees 1.6 while medium and large farmers earned Rs. 1.49 and Rs. 1.38, respectively. TFP on all farms was found 1.50 showing that famers earned Rs. 1.5 by investing 1 rupee on all kinds of inputs. It was observed that small farmers were more productive as compared to larger oneswhich had been validated on the basis of results of Kruskal Wallis test ($\chi2=5.31$) with its higher p value(i.e. 10 percent level) that is an endorsementof the differences of productivity levels amongst farm size categories. These results are inline with previous literature in Pakistan (Qasim, 2012).

Table 2. Total, Irrigation and Labor Factor Productivities by Farm Size

Farm Size Categories	Small	Medium	Large	All	tC
Total Factor Productivity (Rs.)	1.60	1.49	1.38	1.50	5.310[*]
Irrigation Productivity (Rs)	14.98	7.98	6.49	10.38	7.687[**]
Labor productivity (Rs)	5.47	5.49	6.66	5.79	14.71[***]

[*], [**] and [***] are values significant at 10 %, 5 % and 1 % significance level respectively

Comparison of irrigation cost on small, medium and large farms reveals some interesting facts.Table 2 provides the assessment of small, medium and large

farmer'stotal, and partial factor productivities (i.e. irrigation and labour productivity). As far as TFP is concerned, it acquires decreasing trend from small to

large farms in the study area as per expectations. Same trend was observed in Irrigation productivity and it was also found as highest at small farms (i.e. Rs14.98) followed by medium farms (Rs7.98) and then at large farms (Rs6.49). In this regard, it is concluded that small, medium and large farmers earned Rs. 14.98, Rs. 7.98 and Rs. 6.49, respectively, by investing only rupee 1 on irrigation. However, irrigation productivity was found Rs 10.38 in the overall study area which was observed as less than small farms but greater than medium and large farms. Our results regarding irrigation productivity and TFP confirm stylized fact of IR in the study area. Likewise table 2 displays that labor productivity increases from small to large farms and labor productivity at small, medium and large farms were found 5.47, 5.49 and 6.66 that was achievable when the target farmers invest rupee 1 each on their farm per hectare, respectively. The labor productivity of overall area was 5.79 which is equally good when compared with farm sizes categories. Kruskal Wallis test statistics were found highly significant that confirm the clear differences of

TFP and PFP amongst various farm size categories in the study area.Again these results are supported by the findings of Qasim (2012).

Gross Margins: In agricultural production businesses, profitobtained from one hectare by subtracting input costs from gross revenue is designated as gross margins per hectare. Table 3 depicts the scenario of gross margins variability of different farm size categories under study. Per hectare profit margins in the overall study area were estimated as Rs. 8778. However, in the farm categoriesgross margins per hectare were found highest in small farm categories (i.e. Rs. 11033) followed by medium farms (i.e. Rs. 8999) and large farms (i.e. Rs. 5112). This comparison showed the supremacy of the small farmers over the other ones in case of gross expenditures and gross returns per hectare while meager differences were found amongst the gross revenues in all of the categories under study. The table validates the difference exhibited by Kruskal Wallis test results which is highly significant for the said comparisons.

Table 3. Gross Margins in the Study Areas (Rs./Ha)

Outflows and Inflows	Small	Medium	Large	All	Kruskal Wallis (t^c)
Gross Expenditures	21640	22377	27148	23337	---
Gross Revenue	32672	31376	32260	32126	---
Gross Margins	11033	8999	5112	8788	6.15[**]

Note: Gross expenditure is the sum of costs/hectare .i.e. seed, labor (hired and imputed for family labor), irrigation, fertilizer, manure, chemicals, and mechanization (machinery costs rented in for cultivation)
Gross Revenue= gross value of grown crops per hectare, Gross Margins= gross revenue - gross expenditure

Farm and Off Farm Income in the Study Area: As land is a symbol of prestige and a major support to livelihoods in rural areas, therefore, people stick with it for the sake of pride, food production and income. Table (4) shows that82 percent of total income is earned from farming enterprise while the rest 18 percent is attained by off-farm sources. It is interesting to note that farm income was always higher than off-farm income in all of the categories under consideration and the share of off-farm income of the small farmers was higher (i.e. 22 %) than the medium (i.e. 15 %) and large farms (17 %). Although the share of farm income earned by the medium farmers is highest as compared to small and large famers, however, the difference in farm income between medium (85 %) and large farmers (83 %) is small as given in the table (4). . These findings are not fully supported by the literature which shows increasing, initially, trend of farm incomes from small to medium and then decreasing trend from medium to large farms (Anriquez and Valdés, 2006; European Commission for Agriculture and Rural Development, 2011).

Table 4. Off and On farm Income Share of the Households in the Study Area (Percent)

Farm Size	Small	Medium	Large	Total	Kruskal Wallis (t^2)
Off Farm	22	15	17	18	
Farm	78	85	83	82	2.44[**]

Farm Income = Crop income,sale of byproducts of crops, livestock sale and livestock products, rent out machinery
Off farm Income = Salaries, foreign and local remittances, enterprise income, artisan income, daily labor income etc.

Farm size and Credit Availability: The role of financial resources has been vital in progressive agriculture production. An analytical view of credit availability to the farmers shows different attitude of the varying sized farms regarding credit sources. Almost more than 75 percent households getinstitutional as well as non-intuitional credit altogether. Table 5 reveals that only 8 percent of small farmers borrowed from the intuitional sources and this borrowing keeps on increasing with an increase in farm size which confirms that large farmers have high tendency to get credit from institutional

sources as compared to smaller one. Moreover, large farmers borrowed least from their kith and kin as they have easy access to institutional credit because of ample assets to be pledged as collaterals.

Table 5. Institutional and Non-Institutional Credit Availability by Farm Size (%Farmers)

Farm Size	Small	Medium	Large	All
No credit	24	25	27	25
Credit	76	75	73	75
Institutional credit	8	24	36	21
Non-institution Credit	72	68	55	66

No credit= neither institutional nor non-institutional credit was taken by households
Institutional credit= Credit taken from banks and cooperatives
Non- Institutional Credit= Credit taken from friends, relatives, non-relatives, traders and dealers

Inverse Relationship of Farm Size and Productivity: This section explores the nature of relationship, direct or inverse, between the output per hectare and various factors of production. The focus has been on the explanatory factors that can directly affect the crop productivity per hectare. Cobb-Douglas production function results are reported in table 6 that verify the negative relationship between operational land holdings and output per hectare. However, this relationship is small and statistically insignificant. The results of farm size productivity confirms the negative relationships as delineated by latest studies like Unal (2008) Mbam (2011), Ali and Deininger (2011), etc. It is found that the age of household head is inversely proportional to output per hectare. Nevertheless, crop productivity is positively associated with increase in labor, intermediate inputs andpercent family workers in agriculture sector in the study area.

Table 6 illustrates that the labor (man-days) and intermediate inputs cost the maximum effect on farm productivity and, in this regard,1 percent addition in labor man days increases productivity by 0.46percent while the 1 percent addition in intermediate inputs enhances productivity by 0.37percent. An unusual revelation was that off-farm income and tractor ownership made no differences in the productivity per hectare.The credit availability per hectare, irrigation, family size, education of the household head and ownership of tube well also had no significant effect on productivity.

Table 7. Regression Results with Dependent Variable Yield per Hectare (Rupees).

Variables	Coefficients	Variables	Coefficients
Constant	4.53***	Age of household head (yrs)	-0.08*
Operational holding (ha)	-0.05	Education of household head (yrs)	0.01
Labor (m days/ha)	0.46***	Family workers in agriculture (%)	0.10*
Irrigation cost (Rs./ha)	0.03	Off-farm Income (Rs./ha)	0.0013
Intermediate inputs (Rs./ha)	0.37***	Tractor ownership (D)	0.0023
Credit obtained (Rs./ha)	-0.01	Tubewell ownership (D)	0.08
Family size	0.08		

R^2= 0.75   F= 49.48***,
*, **, *** *Indicates significant at 10 %, 5 % and 1 % significance level, respectively*

Conclusions and Recommendations: The purpose of the study was to analyze the relationship between farm size and productivity and its various correlates as total and partial factor productivity, cropping intensity, gross margins, on and off farm incomes, credit availability with reference to different farm sizes in the irrigated perennial area of district Gujrat and Mandi Bahauddin. For this purpose, 213 respondents were randomly selected and interviewed from the target site.

It was found that in the study area people owned small land and a few used to rent it out. Intensive farming was witnessed due to small land holdings and the small farms were the most intensive.Unexpectedly farm size groups and crop diversity were linked positively. Total factor productivity in small farms was higher as compared to medium and large farms. Labor productivity revealed increasing trend with different categories of farm size while the irrigation productivity showed decreasing trend from small to large farms. On average farmers were earning high profits per hectare and small farmers earned more gross margins than large farms categories. Likewise expenditure was lower in small farms than larger ones which show the supremacy of small farmers. The farm income was more than three forth of the non-farm income. Further the percentage of off-farm income was higher for small farmers as compared to medium and large farmers. In respect of credit, it was found that more than 75 percent household borrowed from different institutional and non-intuitional sources. Institutional borrowing was positively correlated with the farm size aslarge farmers have ample assets to be

pledged as collaterals a necessary condition for attaining institutional credit.

Cobb-Douglas production function showed that operational land holding and household head age was inversely related with productivity. However the results were insignificant at conventional level of significance. Hired as well as family labor and intermediate inputs have positive effect on agricultural productivity. An unusual result was that off-farm income and tractor ownership made no differences in the productivity per hectare.Other factors of production like irrigation, family size, household head education, credit availability, tractor ownership, off-farm incomes and own tube well did not have significant effect on productivity. Many indicators used in the study showed that small farms were better than medium and larger ones. The results of the econometric model corroborated the inverse relationship between operational holding and productivity yetthis inverse relationship is weak in the area under study. The farmers hold small lands and family size and family labor available for farming is higher particularly for the small farms. Except crop harvesting many of the farm operations are operated by farm machinery. The labor productivity of small holders is lowest and it increases with increase in land holding.

This study draw some policy implications based on the analysis. For example increase in sowing of high value crops like fruit and vegetable can enhance the labor productivity and farm income of small holders. This ultimately may help in poverty alleviation of the area. A credit scheme targeting small farmers with low interest rate can increase farm income as they don't have enough resources to pledge and get loan from institutional sources. Availability of cheap credit will encourage small farmers to invest on improved inputs like seed and fertilizers which can lead to enhanced agriculture productivity as intermediate input usage has strong positive effect on it. Furthermore, farmers may invest this money in high value agriculture crops. On one hand it will increase their farm income and ensure food security and on the other hand it will fulfill the fruits and vegetables demand of urban population. .

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