Impact of full time and part time farming on rural households' labor productivity in Central Punjab, Pakistan

Reception of originals: 04/05/2020
Release for publication: 09/14/2020

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Abstract

Part time farming is very common to overcome the unexpected income fluctuations in agriculture and to fulfill the economic needs of large families in rural areas of Pakistan. But, it has implications on labor productivity. Therefore, the study objective was to assess the impact of full time and part time farming on rural households' labor productivity. For this purpose, the heads of 200 randomly selected rural households from the central Punjab region were directly interviewed. The study disclosed that the shifting from full time to part-time farming involves a self-selection process, and does not occur in a random manner. This study concentrated on the issue of sample selection with the application of propensity score matching. The results of logit regression for estimating p-score described that the farm households with few acres of land, small animal inventory, large family size, distant market, higher education level of family head and families with more sick members are more likely to

engage in part-time farming. It was noted that the part-time farming has significant negative impact on agricultural labor productivity and positive impact on non-agricultural labor productivity. Similarly, full time farming has a significant positive impact on agricultural labor productivity. Part-time farming has potential of improving labor productivity of rural households in study area. Moreover, the well managed utilization of family resources, specifically, the use of family labor can contribute in uplifting the economic growth and development of rural areas in Punjab province.

Keywords: Part time. Full time. Labor productivity. Propensity score matching. Punjab. Pakistan

1. Introduction

"Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker". (Paul Krugman (1994)

The labor productivity difference among different regions, sectors and working groups is central for the advancement of growth theory and development economics (Adelman and Morris, 1968) and the investigation of household labor productivity is pivotal for the progression of the theory. Still in 21st century, the world is a home of 700 million extremely poor people and most of them are living in rural areas (FAO, 2017). Therefore, improving labor productivity of rural community is essential to poverty alleviation (Datt and Ravallion, 1998; Ivanic and Martin, 2018), food security and for the overall welfare of the society. Although, the developing countries have shown tremendous improvement in enhancing labor productivity overtime, but still, a wide gap persists among their productivity. Income and labor productivity are interrelated and enhancing labor productivity is prime source to increase GDP per capita (UNCTAD, 2014; Xie and Jiang, 2016). Therefore, there exists a huge disparity in income levels and living standards not only among developed and emerging nations, but also among rural and urban community of same nation in developing countries.

This huge divergence in living standards of developed and underdeveloped nations is attributed by two simple facts (1) developing nations are less productive than developed ones, particularly, in agriculture (2) developing countries devote major portion of their labor force to agriculture than developed ones (Restuccia et al. 2008; Gollin et al. 2007). Almost half of the world total population (3 billion) lives rural areas and agriculture is their main source of livelihood (FAO, 2010). Therefore, low labor productivity of rural community not only hinders the growth of agriculture sector but also the income of rural households (Christiaensen et al. 2013; Jin and Jayne, 2013). But, these facts do not take anything away

from the agriculture as it is absolutely vital sector for human existence and in developing economies, it contributes overwhelmingly to the GDP (Dua and Garg, 2019) and also stimulates the growth and development of other non-agricultural sectors by providing raw material (Subramaniam and Reed, 2009). The developing countries generate three-quarters of the world's total agricultural value added products (FAO, 2010).

Pakistan is also a developing country and its economy is characterized by large number of rural households with gradual increase in urban community, low income level, large family size, gender discrimination, and small landholdings. Agriculture is still a substantial contributor to the GDP (18.5%) and employment (38.5%) like in most of emerging economies (Government of Pakistan, 2019). It is one of the largest beneficial of natural resources (land, labor, fresh water) in the country, but, its share in development is decreasing gradually since 1947 (Rehman et al. 2017). The numbers of small subsistence level farms are on the rise due to land division inheritance laws among family successors in the country and almost 64% of farming community in the country has landholding less than 2 hectares (Pakistan bureau of statistics 2010).

Therefore, rural households have opportunity to apportion their time to different uses to maximize their utility (Tokle and Huffman, 1991) and to fulfill the needs of large families. Moreover, their selection of different work and leisureliness activities shows the individual characteristics and inclinations towards available choices (Brosig et al. 2017) such as to work as a part time or full time labor. Rural community with more than one occupation is economically more sustainable than full time farm rural households due to their enhanced capacity to resist against economic adversities. The degree of financial stress experienced in developing countries by rural families always remained a concern (Goodwin and Mishra, 2004) and small landholding is not the only single reason to be fragment of part time labor force (Bessant, 2000). Moreover, many researchers (Schultz, 1990; Mishra and Goodwin, 1997) consider the pluriactvity as a risk managing strategy. The income generated through part time employment helps the rural household to meet complex economic needs and goals ranging from leisure lifestyle to basic necessities (Barlett, 1986). The level to which rural households participate in off farm activities is a subject of prime importance to have an idea about the social well-being of rural households. Yet, researchers often ignore the significant participation of most rural community in nonfarm labor markets.

Previously, a few studies have been conducted worldwide especially in developed countries by Bessant (2000), Kimhi (2000), Woldehanna et al. (2000), Huffman (2001), Paudel and Wang (2002), Fall and Magnac (2004), Ngstad and Hedlund (2017) ranging from

determination of characteristics to the efficiency of part time farmers and full time labor force. But in developing countries, no attention has been given to this subject and very scarce literature is available about this important issue to guide the policy makers. Even though, part time working is important to fulfill economic needs of rural community, but increasing dominance of part time labor force over full time labor is a real concern as expertise are starting to pulling away from farming (Goodwin and Mishra, 2004). In this multi job era, questions have been raised about its impact on labor productivity. This paper is an effort to fill the gap present in literature and will try to answer the questions about impact of full time and part time farming on household labor productivity.

2. Material and Methods

2.1. Study area and sampling procedure

Five stage sampling process i.e., region, district, town (tehsils: urdu), village and rural households was adopted to collect data from 200 rural households. Central Punjab region having largest number of rural households among all other regions of Punjab province with an expansive irrigation system was selected as study area. The region is characterized by large rural household population and large family sizes (Pakistan Bureau of Statistics, 2017). The population data of rural households used for this study was based on Pakistan population census, 2017. At the district level sampling stage, one district (Faisalabad and Sialkot) from each agro-ecological zone of Central Punjab with highest number of rural household was selected for assessment of labor productivity of rural household. Faisalabad is famous for its manufacturing sector as it is a home of textile in Pakistan with several textile firms, spinning mills and chemical plants (Bhalli et al. 2012). It is also known for its agricultural contribution to the economy (Haq et al. 2016) as a large portion of its population (51.5%) still resides in rural areas. Sialkot is a commercial and industrial center. It is playing very vital role in contributing the economy not only through its export of sports items, but also though very good agricultural market as 70% of the total household lives in rural areas (Pakistan Bureau of Statistics, 2017). Probability proportional to size (PPS) sampling technique was used to have an unbiased and representative sampling from each selected district. Similarly, at township selection, one town from each district with largest number of rural household was chosen for further sampling. One town comprises of a large number of villages. Therefore, in the fourth step of the sampling process, 10 villages with largest number of rural household from each

town were selected to represent the study area. In the fifth and final step of the sampling, again (PPS) sampling technique was used to have samples from each selected village. Similar method was used by Saguye (2016), Wang et al. (2016), and Shahbaz et al. (2017) for sample selection in their studies.

These rural household were selected to provide representative and unbiased samples of farm and non-farm contexts in rural households. In addition, the phenomena of part time and full time farming coexist in study area, which is also representative of most rural households in Pakistan as the severe climate hazards, the small landholdings in the country force people to look employment opportunities other than farming to meet their economics needs. A well-constructed questionnaire was used to collect data through face to face survey in August/September 2018 from sampled rural households. The study area map is displayed below in Figure 1.

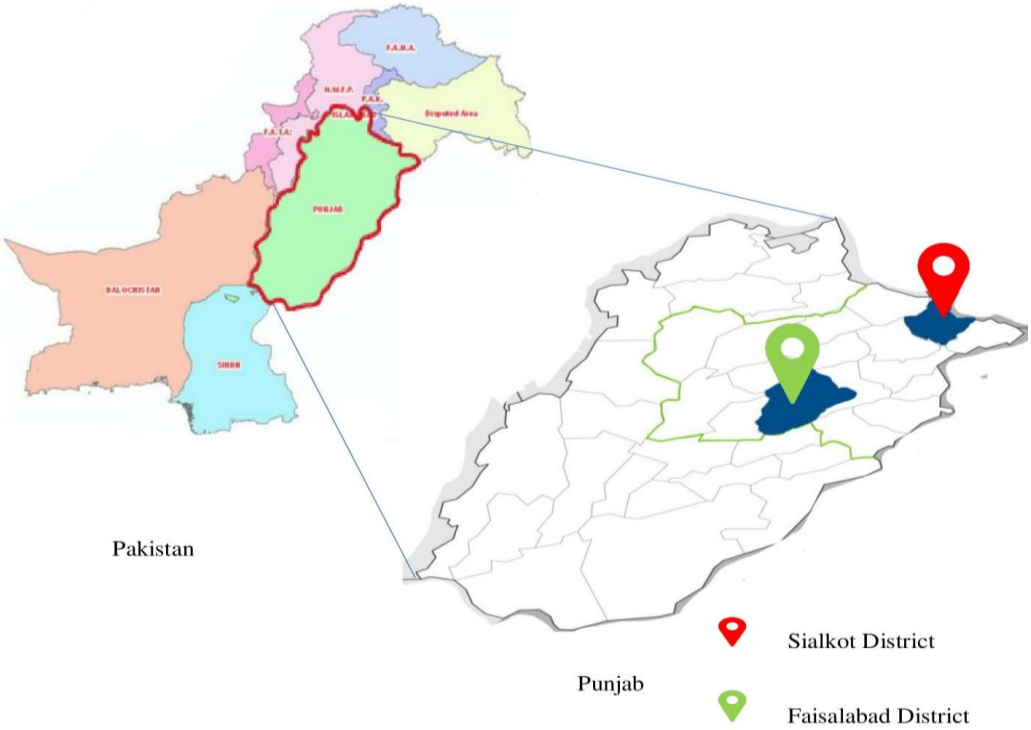

Figure 1: Study area map

2.2. Conceptual framework

Part time and full time farming is a mutually exclusive state of market labor participation. In part time farming, the rural households also allocate their available family labor resources to the activities other than farming. While on the other side, full time farming rural households devote their all family labor only to the farming enterprise and they can also

hire extra labor to help in farm activities. (Brosig et al. 2009). Bishop (1955) defined part time farming as combination of farm and off-farm uses of work resources controlled by individual or decision making unit. Paudel and Wang (2002) defined part time farming as an activity where rural household is also involved in non-farm working for 150-200 days during a year and gets a significant financial support from that activity. The share of part time and full time labor force differs significantly not only among different sectors but also in branches of same occupation (Ingstad and Hedlund, 2017). Yıldırım (2018) separated this concept with wage share in total labor cost. If the share of family wage was more than 2/3 of total labor cost in a production period, then it was named as full time farming. If family labor had fewer shares than 2/3, it was considered as part time farming.

The previous studies applied different criterion i.e. number of hours in a day or week, number of days in a month or year, share of off farm or farm income in the total family income to differentiate between these two concepts of labor market. But, in current study, the k-mean cluster analysis was applied on the basis of two criterion I) share of daily family labor hours in total labor hours at farm, and II) share of agricultural income in total family income. The purpose of using this criterion and application of cluster analysis was to decrease the subjective interference. The results of cluster analysis depicted that the rural households with full time farming status were giving 84% of their working hours to the farms, and they were earning 90% of their income from farming activities. While, the part time farming rural households were allocating 72% of the available family labor hours to the farming, and were earning 40% income from farming. The result of k-mean cluster analysis is presented below in Table 1.

Table 1: Share of labor hours and farm income in full time and part time farming

	Rural Households	
	Part-time	Full-time
Share of daily family labor working hours in total labor hours	0.72	0.84
Share of agricultural income in total family income	0.40	0.90

2.3. Measuring labor productivities of farm households

As the rural households have leisure to engage in both farm and off farm activities at a time to satisfy their needs. Therefore, cultivation of different crops at farm cannot fully constitute a family's total output. Hence, the total household income was valued by adding

both farm and off-farm earnings. Rural household labor productivity (LP) was measured by dividing the household's total family income by the total available family labor. Agricultural labor productivity (ALP) was calculated by dividing the total farm income of rural households by the family labor engaged in farming activities. Similarly, non-agricultural labor productivity (NALP) was measured by dividing total off farm family income of rural household with the non-agricultural labor allocated to activities other than farming. All labor productivities were presented logarithmically to reduce heteroscedasticity and outliers.

Table 2 spectacles the different rural household labor productivities of both full time and part time farming. The results enlighten that there exist a difference among productivities of these labor groups. The ALP, NALP, and LP describe different aspects of labor market that depicts the different occupational condition. The Logarithmic expression of LP indicated that the LP of rural households, who were not associated with the part time farming, was only 0.54% higher than those who were associated with part time farming. The analysis revealed that the full time farmers are more productive in farming as compared to part time farmers and they had 5.61% higher ALP than those of part time farming rural households. But, the rural households involved in part time farming have higher NALP as compared to full time rural households. Additionally, the NALP of part time rural households was 5.62 in logarithmic form and 3.31 was of full time households. The NALP of part time farming households was 5.59 percent more than that of full time farming households. These labor productivities related results depicted that the farm households engaged in part time farming were not significantly different in their LP than that of full time farming households. It implies that rural households should adopt the part time farming if they really need. Therefore, engaging in part time or full time farming have important role in improving the households LP. However, the concept that shifting full time farming to part time farming is endogenous suggests that the causal explanation cannot be applied for a simple comparison of the practices of full time or part time farming. Accordingly, the empirical analysis using the survey data was conducted to evaluate that how LP changed as result of shifting to part time farming.

Table 2 Descriptive statistics for rural household labor productivity.

	Variables	Mean	Std. Deviation	Minimum	Maximum	N
Full Time	Log of ALP	5.65	0.38	4.27	6.66	138
	Log NALP	3.31	2.55	0.00	6.08	138

	Log LP	5.57	0.31	4.86	6.46	138
Part Time	Log of ALP	5.35	0.44	4.00	6.06	62
	Log NALP	5.62	0.35	5.03	6.26	62
	Log LP	5.54	0.28	5.00	6.04	62
Overall	Log of ALP	5.56	0.42	4.00	6.66	200
	Log NALP	4.03	2.38	0.00	6.26	200
	Log LP	5.56	0.30	4.86	6.46	200

2.3. Theoretical framework

Theoretical as well as empirical studies have validated that there exists a difference between skills of part time and full time labor force (Goodwin and Mishra 2004). Thus, it affects the labor productivity of rural households. However, the studies were unable to find a causal relationship between type of labor force and rural house labor productivity in most of the studies.

The subject of non- randomization for example self-selection is getting researchers' attention in economics gradually since 1980. Sample affected by an activity is considered as treatment group and the others not affected by any activity is considered as control group. In this research, treatment group constitutes those rural households, who were doing part time farming along with other non-farming activities. The control group comprised rural households, who were involved only in farming. The propensity score (PPS) matching is effective in resolving the issue of non-randomization through identification and comparison of matched object from the control group, according to PPS (p-score), relative to an object from the treatment group. Thus, both self-selection and confounding prejudice were eradicated.

2.4. The propensity score matching procedure

In current study, it was presumed that the shift from full time to part time farming was a function of various apparent characteristics associated with rural households and these characteristics varies from farm to farm Therefore, it was assessed that this shift is influenced by a certain number of factors such as demographic characteristics of rural households, farm and family assets. The observable characteristics of the rural households balanced the distribution of observed characteristics between a control group (full time farmer) and

treatment group (part time farmers) based on the resemblance of their forecasted probabilities of changing from full time to part time farming.

The important characteristic of the matching process described generating the condition of randomized experiment to evaluate the impact of shifting to part time farming on rural households' labor productivity, as in control (full time farming) experimentation. It needs a supposition of provisional objectivity, indicating that after controlling the observable characteristics regarding the farm households, the shift of full time to part time farming was assumed casual action uncorrelated with rural households' labor productivity. Therefore, the effect function of shifts of full time to part time farming was describes as

$$\varphi(X) = E[Y_i^1 - Y_i^0|X] = E[Y_i^1|T = 1, X] - E[Y_i^0|T = 0, X]$$

Where, the average effect of full time to part time shifts was

$$ATT = E\{\varphi(X)\}$$

Where, Y_i^1 denotes the labor productivity of rural household in case of rural household is involved in part time farming, and Y_i^0 is labor productivity of household in case the household is involved in full time farming. Similarly, the T=1 indicate that rural household is also engaged in activities other than farming and T = 0 denotes that rural household is only engaged in farming activities. At last, X was the observed characteristics/variables affecting the choice of whether to shift to part time farming. ATT describes the average effect on rural households' labor productivity as a result of shifting from full time to part time farming.

As disclosed by above analysis, as long as the shift take place casually, the labor productivity of alike rural households with different statuses of farming (i.e. those involved in full time farming, and those involved in part time farming, defining these households according to the values of X variables) can be compared. The propensity of score matching method specifically reduce the conditioning problem, and generally decrease the high level of household dimensionality, by comparing the households with same probability of shifting to part time farming based on the X variables (Haviland et al. 2008; Dehejia and Wahba, 2012;).

Based on various X variables, the conditional probability of the rural households i involved in part time farming is described as

$$P(X_i) = pr\,(T_i = 1|X_i) = \frac{\exp\,(\beta Xi)}{1 - \exp\,(\beta Xi)}$$

Where, $P(X_i)$ = Propensity score indicating the conditional likelihood of rural household's involvement in part time farming, and X_i describes the observable characteristics of the i^{th} farm household. In this way, similar rural households with in treatment (part time farming) group and control group (full time farming) can be created. It must be eminent that

estimated p-score ranks the rural households according to their own performance regarding shifts of farming type. Therefore, the current study describe the impact of full time to part time shifting among the control and treatment groups of rural households corroborating similar kind of behavior. This was a crucial aspect of this study because it is essential to look at farmer's choice of whether or not involved in part time farming, when analyzing the causal effect of full time and part time farming on labor productivity.

Until now, it is not possible to assess the impact of full time and part time farming on labor productivity, despite matching sample and estimation of p-scores. Since, the p-scores are continues variable, and it is very hard to locate two households having similar p=score within two different groups (control and treatment groups). By using the p-scores, the farmers in the treatment group can be matched with the farmers in control group. Therefore, there are three widely used matching methods in literature such as radius-based matching (RBM), nearest neighbor matching (NNM), and kernel-based matching (KBM) (Mayne et al. 2015).

The radius-based matching identifies the rural households in control group falling in a radius R and comparing these rural households' sample with those in the treatment group. The second method, nearest neighbor matching perform the forward and backward searching to classify one or several of the closest p-scores for the rural households in the treatment groups from the households in the control group. Accordingly, two samples with similar p-scores within different groups are matched. The third method kernel-based matching is somewhat different from the other two matching methods. Since, each farm household in treatment (part time farming) group is matched with a weighted average of all of the weighted controls that are inversely proportional to the distance between the p-scores of the treatment and control samples.

After performing the matching of rural households, it was required to confirm, whether the two rural households from treatment and control group were actually similar or not. For this, balancing hypothesis and common support supposition were executed. Therefore, the balancing hypothesis describes that the rural households having similar p-scores should demonstrate same dissemination of X, irrespective of their farming type. This is the crucial test for checking the behavior of the households within each group was in fact similar. The second common support assumption method needed the p-score density function of two groups to be proximate, representing analogous characteristics of X in both groups after matching. Simultaneous, satisfaction of balancing hypothesis and common support supposition would indicate that the rural households actually had the similar behave (Li et al. 2016).

The specific procedure for controlling sample self-selection bias developed by Rosenbaum and Rubin (1983) was adopted as follows. First, propensity score was attained by using the logit model. Then, the similar households for treatment group based on the propensity score were found from control group with three matching approaches. At last, the average effect on the labor productivity of treatment on the treated group was estimated by comparing the different matching groups.

Based on the characteristics of the farm households used in logit model to predict the probability of engaging in part time farming estimate the p-score. The model specification was distinctly important for ensuring that the matching procedure was valid. For this different logit model was performed. Therefore, the criterion for diagnosing the accuracy of the model specification was not simply available. However, there were two indirect diagnostic methods widely reported in literature, such as pseudo R^2, which is extensively used in logit regression, and area under receiver operating characteristics (ROC) curve commonly known as area under curve (AUC) (Wang et al. 2017). The critical value for the pseudo R^2 which has been reported in literature to have a good fit of model with micro data is in the range of 0.149-0,159 for all the specified models. Similarly, the AUC provides the more precise causal inferences. Therefore, the model having value of AUC greater than 0.70 depicts that the specification of model is appropriate (Fan and Yang, 2016). The maximum likelihood estimates based on the backward stepwise method was executed. The model which represents the all those variables that could have more influence on the behavior of farm households regarding their involvement in part time or full time farming, was considered for estimating the p-scores.

Finally, the impact of shifting full time farming to part time farming on households' labor productivity was estimated. However, the small sample size biasness in the statistical analysis was solved by bootstrap method to estimate the standard error for further analysis (Li et al. 2015). Consequently, the impact of farming type shifts on labor productivity was described as.

$$\text{ATT} = E[Y_i^1 - Y_i^0 | T_i = 1] = E\{[Y_i^1 | T_i = 1, p(X_i)] - E[Y_i^0 | T_i = 0, p(X_i)]\}$$

Where, T_i signifies the i^{th} rural household's status, $T_i = 1$ represents the part time farming household and $T_i = 0$ denotes the full time farming households. The reaming parameters remained same as described above.

3. Result and Discussion

Table 2 describes that 69% of the total rural households in the study area were engaged in full time farming indicating that majority of the them earn their income from farm activities. On the other side, descriptive statistics revealed that reaming 31% of total farmers are involved in part time farming. The results related frequency and percentage of rural household involved in part time and full time farming are shown in Table 3.

Table 3: Status of full time and part time farming in study area

	Frequency	Percent	Valid Percent	Cumulative Percent
Full-Time	138.00	69.00	69.00	69.00
Part-Time	62.00	31.00	31.00	100.00
Total	200.00	100.00	100.00	

3.1. Variables used in estimation of propensity scores

The potential variables which could affect the involvement of rural household in full time and part time farming is shown Table 4.There were eight different variables that could influence the behavior of rural household to engage in part time or full time farming. First of them is socio economic and demographic characteristics such as age, education, family size. The average age of the full time framer was 42 years and that of part time farmers was 39.31 years. The age difference between two groups was found statistically significant. Similarly, the education of the part time farmers (9.76 schooling years) was also significantly higher than full time farmers (8.47 schooling years). Moreover, the part time rural households' family size was also significantly greater than full time farmers. The average land (11.30 acres) area of full time farmers was also significantly greater than the average land (7.81 acres) operated by the part time farmers. Additionally, the animal inventory at the farms of full time farmers was found 10.84 animals that were significantly greater than number of animals (7.81) at the farms of part time farmers. The full time farmers were having easy access to the food and grain market while part time farmers were not having easy access to the food and grain market. Similarly, the number of part time farmers under debt was significantly greater than that of full time farmers. Most of the family members of part time

farmers suffered from epidemic diseases as compared to the family members of full time farmers.

Table 2 Potential influential variables in full time and part time farming

	Full Time		Part Time		
Characteristics	Mean	Std. Deviation	Mean	Std. Deviation	p-value
Operational land	11.30	14.16	7.81	5.22	0.06 ***
Age of farmer	42.00	10.72	39.31	11.56	0.11
Educations	8.47	4.66	9.76	5.10	0.08***
Family size	8.89	5.48	11.39	7.28	0.01*
Animal inventory	10.84	10.07	7.81	5.86	0.03**
Market access	0.86	0.35	0.63	0.49	0.00*
Debt condition	0.23	0.42	0.37	0.49	0.04**
Family members health	0.48	0.50	0.74	0.44	0.00*

*, **,*** show significantly different at 1%, 5% and 10% respectively

3.2. Propensity score to shift from full time to part time farming

It was discussed earlier that the use of traditional methods for performing multi-dimensional matching is not feasible. Therefore, an index that could reveal the household characteristics and also appropriate to constitute the characteristics of the N-dimensional vectors based on rural households was pursued. For estimating p-scores as a single index, logit models' specification is represented in Table 5. The AUC in current study exceeded 0.7 for all specified models are an indication that the model specification was appropriate. Moreover, the pseudo R^2 value for all three specified models was also satisfactory. The logit regression results described that the operational land was significantly negative at 5%, which indicates that households with large operation land were not likely to involve in part time farming. Moreover, the rural households with more the animal inventory at their farms are less likely to engage in part time farming similarly, the location of farm household near to the market of agricultural commodities also had significant negative influence on the rural household's behavior to engage in part time farming. It implies that the easy access to the input and output market could enhance the probability of the household to fully engage in full time farming. The characteristics of the household, like education of the family head, which was significantly negative at 10%, indicating that the higher probability of household to adopt

part time farming, the household with large family size was also more likely to engage in part time farming. Additionally, the rural households having more family members with epidemic diseases were more likely to adopt-part time farming. All evidence supported the notion that the rural households with few acres of land, few numbers in animal inventory, large family size, far away from market, higher education of family head and more sick family members were more likely to engage in part time farming in study area.

Table 3: **Logit model to estimate propensity score for full time and part time Farmers**

	Model-1		Model-2		Model-3	
Characteristics	B	t-value	B	t-value	B	t-value
Operational land	-0.077**	-2.03	-0.078**	-2.07	-0.083**	-2.18
Education	0.063	1.6	0.072**	1.92	0.069***	1.86
Family size	0.066**	2.32	0.065**	2.27	0.063**	2.2
Animal inventory	-0.042	-1.59	-0.044***	-1.66	-0.047***	-1.72
Market access	-1.005**	-2.44	-1.041*	-2.55	-1.087*	-2.69
Family members health	1.098*	2.98	1.076**	2.93	1.096*	3.01
Debt condition	0.459**	1.22	0.47	1.25		
Age of farmer	-0.015	-0.87				
Log likelihood	-101.343		-101.729		-101.507	
LR chi-square (8)	44.95*		44.18*		42.63*	
Pseudo R-square	0.18		0.17		0.17	
AUC	0.75		0.75		0.78	

*, **, *** show significantly different at 1%, 5% and 10% respectively

3.3.Sample matching

The estimation of p-scores facilitated to attain and extract analogous samples from two different groups after the sample matching. The results regarding the balancing hypotheses are presented in Table 6. The results described that the findings of the matching procedure were according to the balancing hypothesis that there was no significant difference between the variables after matching. Rosenbaum and Rubin (1985) described that the insignificant p-

values of matching variables confirms the balancing hypothesis. It describes that the behavior of the farm households after matching procedure within each groups was actually similar.

Table 4*:* Variable characteristics before and after matching with Balancing hypothesis test

Variable	Matched	Treated	Control	Bias (%)	t-value	p-value
Operational land	U	7.81	11.30	-32.70	-1.88	0.06
	M	7.81	8.94	-10.50	-1.18	0.24
Education	U	9.76	8.47	26.30	1.75	0.08
	M	9.76	10.66	-18.50	-0.98	0.33
Family size	U	11.39	8.89	38.70	2.68	0.01
	M	11.39	11.81	-6.50	-0.31	0.76
Animal inventory	U	7.81	10.84	-36.80	-2.21	0.03
	M	7.81	9.29	-18.00	-1.37	0.17
Market access	U	0.63	0.86	-53.10	-3.70	0.00
	M	0.63	0.65	-3.80	-0.19	0.85
Family members health	U	0.74	0.48	55.80	3.57	0.00
	M	0.74	0.79	-10.20	-0.63	0.53

3.4. Common support assumption test results before and after matching

Figure 2 and Figure 3 describes the pre and post matching kernel density function of the two groups. The differences in the density function of the two groups before matching in Figure 2 was apparently highly significant. After matching procedure was completed, the distribution density function of two groups was very alike, and there was an evident decline in their deviation. This comparison depicted that the common support assumption was satisfied and the characteristics of rural households in both samples after matching was similar.

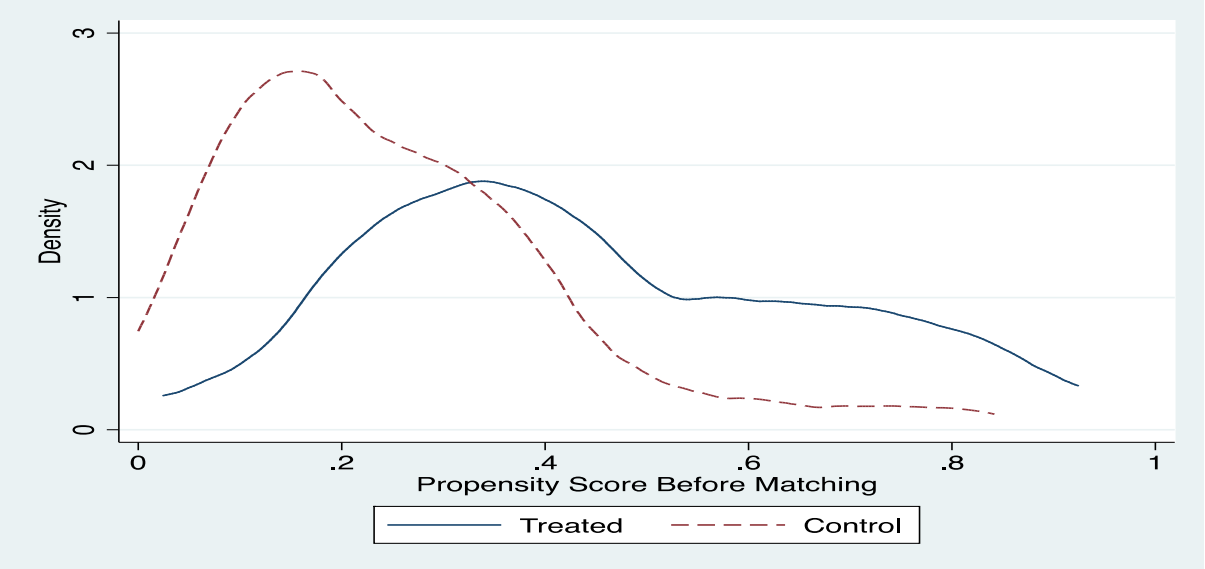

Figure 2: Common support assumption tests to assess the densities of p-scores before and after matching; before matching

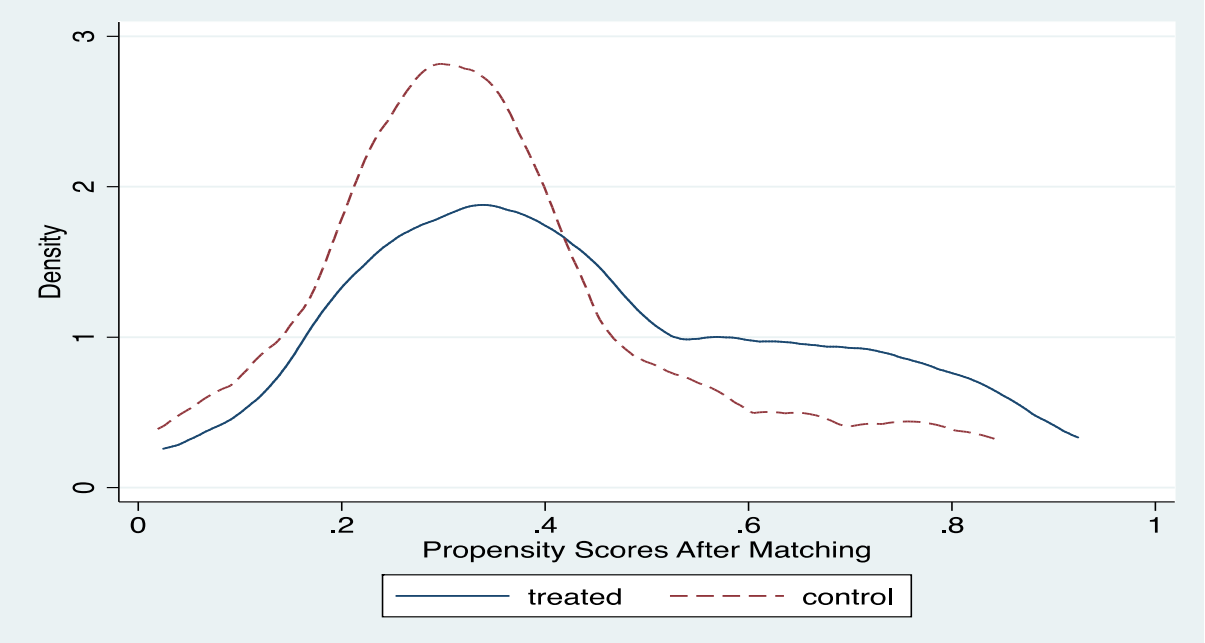

Figure 3: Common support assumption tests to assess the densities of p-scores before and after matching; after matching

3.5. The impact of part time farming adoption on labor productivities

Table 7 describes the pre matching and post matching impact of treatment (part time farming) on the labor productivities. Moreover, the results regarding the all three matching methods were also presented. Based on NNM, RM and KM, almost same impact of treatment on labor

productivities was assessed after matching procedure completed. The results interpretation regarding ATT is based on NNM, because it was not very much different from other two RM and KM methods. The average effect of treatment on the treated (ATT) group described that the ATT of performing part time farming on ALP was significant at a value of -0.22. Moreover, the pre-matching and post-matching difference of ATT was negative which described the decline in ALP of treatment. Consequently, post-matching impact of treatment (part time farming) proved the engaging in part time farming lower the ALP by 24%.

The second finding was that the ATT of NALP was highly significant at 1%. Thus, the average difference between the two groups was 3.44 which revealed that the average NALP of part time farming households was 49% higher than the NALP of those not engaged in part time farming.

The ATT of LP was not statistically significant. However, the average difference between two groups was 0.02 which presents that the average LP of those rural households engaged in part time farming was higher than those not engaged in part time farming. The results of empirical analysis described that the part time farming although reduces the ALP significantly, but rise in NALP can compensate the overall LP of farm households. From here an important result can be extracted that full time and part time rural households are more skilled and have expertise in their respective areas (farming and non-farming) as full time rural household have higher ALP and part time higher NALP and their overall, household labor productivity could be improved if they work in those fields, in which they are more productive.

Table 5*:* Matching estimates for the effect of shifting to part-time farming on the labor productivity

		Near Neighbor Matching (NNM)				
Variable	Sample	Treated	Controls	ATT	S.E.	T-stat
	Pre-matching	5.35	5.65	-0.29	0.06	-4.77
Log (ALP)	Post-Matching	5.35	5.57	-0.22	0.08	-2.59
	Pre-matching	5.62	3.31	2.31	0.34	9.84
Log (NALP)	Post-Matching	5.62	2.18	3.44	0.48	7.23
	Pre-matching	5.54	5.59	-0.05	0.05	-1.01
Log (LP)	Post-Matching	5.54	5.52	0.02	0.07	0.34

Radius Matching (RM)						
Variable	Sample	Treated	Controls	ATT	S.E.	T-stat
Log (ALP)	Pre-matching	5.35	5.65	-0.29	0.06	-4.77
	Post-Matching	5.35	5.65	-0.29	0.06	-4.97
Log (NALP)	Pre-matching	5.62	3.31	2.31	0.34	9.84
	Post-Matching	5.62	2.30	3.32	0.12	26.69
Log (LP)	Pre-matching	5.54	5.59	-0.05	0.05	-1.01
	Post-Matching	5.54	5.59	-0.05	0.04	-1.32
kernel Matching (KM)						
Variable	Sample	Treated	Controls	ATT	S.E.	T-stat
Log (ALP)	Pre-matching	5.35	5.65	-0.29	0.06	-4.77
	Post-Matching	5.35	5.59	-0.24	0.08	-3.14
Log (NALP)	Pre-matching	5.62	3.31	2.31	0.34	9.84
	Post-Matching	5.62	2.06	3.56	0.37	9.58
Log (LP)	Pre-matching	5.54	5.59	-0.05	0.05	-1.01
	Post-Matching	5.53	5.55	-0.01	0.06	-0.22

4. Conclusion

The level of labor productivity is the only difference, which divides the countries into developing and developed nations. The labor productivity of developed countries is much higher than the developing nations. The current study revealed the impact of full time and part time farming on rural household labor productivity. Moreover, logit regression described that the farm households, with few acres of land, small animal inventory, large family size, large distance from market, higher education level of family head and more sick family members were more likely to engage in part time farming in study area. Afterward, the application of propensity score matching revealed that the part time farming has a significant impact on ALP and NALP. Similarly, full time farming has significant positive impact on ALP. There exists a

huge potential to improve LP of rural households by improving ALP of part time farmers as their ALP is much lower than full time farmers.

Therefore, it was concluded that the part time farming has potential of improving the labor productivity of rural households in study area. Moreover, the well managed utilization of family and farm resources, specifically, the use of family labor can contribute significantly in uplifting the economic growth and development of rural areas in Punjab province.

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