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Gender based Labor Supply, Income Diversification and Household Welfare in Pakistan

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Summary

About seventy percent of the world's poor live in the rural areas and are highly prone to poverty, price shocks, unemployment, lack of information, high risk in production, and imperfect labor and factor markets. Being poor and having no economic viability, poor people have very little or no access to resources like land and capital. In the absence of these resources, labor is the only tool to combat poverty and to strengthen their economic position.

Women play a significant role in rural economy and constitute more than half of the rural labor force. They perform gender specific duties like preparation of food, storage of farm produce, taking care of infants, old or disabled family members, if any. Besides performing domestic duties, women also participate in farm and small scale non-farm activities. Despite of their valuable multidimensional responsibilities, their contribution towards household welfare is always underestimated. Rural development cannot be achieved without appreciating their dynamic role. To support this notion, there is need for gender analysis to estimate the role of women in accelerating the process of rural development. Commonly, gender refers to the position, responsibilities and activities assigned to men and women by the community, suggesting that the roles of men and women are different. Hence, in order to achieve a higher level of development, there is a need to appreciate the role of women in society.

In the past few decades, agriculture was thought to be the most common way of earning in rural areas of developing countries. With the rapid increase in population coupled with inherent risks such as non-predictable weather conditions, economic as well as household shocks, the agriculture sector now has a lower growth potential. There is need to focus on the other sector of rural economy. The development of non-farm sector is often regarded to beneficial in raising employment opportunities, alleviating poverty, ensuring food security, stabling farm income, and increasing household welfare.

This dissertation deals with the development activities of rural household of developing world, where poverty is wide spread and agriculture sector alone is insufficient to provide subsistence. In Pakistan, more than sixty percent of the population lives in the rural areas. Agricultural labor is the most common way of employment. The exponential increase in population has further stressed the depleting rural resources and created inability of the agricultural sector to absorb large labor force ; consequently resulting in social and economic

problems. Moreover, rural community is characterized by imperfect land and credit markets, missing insurance facilities and limiting access to inputs such as credit, fertilizer etc.

Due to imperfect labor markets and lack of resources, household's decision of labor allocation is affected. Thus, production and consumption decisions of the household are not separable, so household faces shadow wages which depend on the production technology and household's preferences. Chapter 3 evaluates the labor supply behavior of rural households in Pakistan by using shadow wages which is vital for policy design to improve the welfare of the rural household. The functioning of labor market in Pakistan is tested by applying three tests of separability. All these tests strongly rejected the presence of perfect markets in Pakistan.

Chapter 4 estimates the impact of non-farm work on the household welfare. The rural non-farm sector is growing rapidly, becoming an important source of income, attracting the large labor force, and contributing to rural growth. With regards to factors that influence the participation in non-farm work, probability of participation increases with increased level of education, adult household size, and physical infrastructure, while lack of access to land, livestock, and credit decrease the likelihood of participation in non-farm work, for both male and female. The study shows that non-farm work increases the welfare and reduces the poverty level of rural household.

One of the key challenges in the developing countries is to increase investment in order to enhance productivity in small-scale farming, which is the main source of income and food security for poor rural households. The poor households are unable to do agricultural investment due to liquidity constraints and insecure property rights. Chapter 5 investigates the role of non-farm work and land rights on the investment in soil conservation and productivity enhancing practices. The study shows that non-farm participation and secure land rights tend to encourage more investment in long-term soil-improving measures and less to short-term productivity-enhancing chemical fertilizers. The findings also show that non-farm participation and secure tenancy arrangements have a positive effect on agricultural productivity. Findings suggest boosting up high return employment opportunities by reducing entry barriers and implying changes in land tenure system for agricultural growth.

Zusammenfassung

Weltweit leben mehr als 70% der Armen in ländlichen Gegenden wobei sie Armut, Preisschocks, Arbeitslosigkeit, Informationsmangel, einem hohen Produktionsrisiko und unvollkommenen Arbeits- und Faktormärkten ausgesetzt sind. Aufgrund ihrer Armut und der fehlenden Wirtschaftlichkeit haben diese Menschen einen geringen oder keinen Zugang zu Land- oder Kapitalressourcen. Deshalb ist Arbeit die einzige Möglichkeit, ihre Armut zu bekämpfen und ihre ökonomische Situation zu stärken.

Frauen spielen eine bedeutende Rolle in der ländlichen Wirtschaft und stellen mehr als die Hälfte der ländlichen Arbeitskräfte. Sie erfüllen geschlechtsspezifische Pflichten wie das Vorbereiten von Mahlzeiten, das Einlagern von Agrarerzeugnissen oder die Betreuung von Kindern sowie älteren oder behinderten Familienmitgliedern. Neben diesen Pflichten nehmen Frauen an landwirtschaftlichen und kleineren nicht-landwirtschaftlich bezogenen Aktivitäten teil. Trotz ihrer wertvollen multidimensionalen Verantwortung wird der weibliche Anteil an der Wohlfahrt eines Haushalts grundsätzlich unterschätzt. Eine ländliche Entwicklung kann nicht erreicht werden, wenn die dynamische Rolle von Frauen nicht anerkannt wird. Um diesen Gedankengang zu verstehen, bedarf es einer Geschlechteranalyse, welche die Rolle von Frauen als beschleunigenden Faktor in dem Prozess der ländlichen Entwicklung berücksichtigt. Allgemein gilt, dass es geschlechterspezifische Positionen, Verantwortlichkeiten und Aktivitäten gibt, die den Männern und Frauen durch die Gesellschaft zugeteilt werden, wobei von einer unterschiedlichen Rolle der Geschlechter ausgegangen wird. Daher muss die Rolle von Frauen in der Gesellschaft anerkannt werden, sodass ein höheres Entwicklungsniveau entsteht.

In den letzten Jahrzehnten wurde die Landwirtschaft als übliche Einkommensquelle in den ländlichen Regionen von Entwicklungsländern betrachtet. Aufgrund des starken Bevölkerungswachstums hat dieser Sektor jedoch mittlerweile ein geringeres Wachstumspotential. Darüber hinaus haben Risiken in der Landwirtschaft wie Wetter, Saisonabhängigkeit oder haushaltsspezifische und wirtschaftliche Schocks das Potential zusätzlich verringert. Deshalb ist es notwendig, sich auf den Sektor der ländlichen Entwicklung zu fokussieren. Die Entwicklung des nicht-landwirtschaftlichen Sektors wir oft als nutzenbringend bezüglich der Schaffung von Arbeitsplätzen, der Milderung von Armut sowie der Ernährungssicherheit, der Stabilität der ländlichen Einkommen und der Haushaltswohlfahrt.

Diese Dissertation beschäftigt sich mit den Entwicklungsaktivitäten in ländlichen Haushalten in Entwicklungsländern, in denen Armut weit verbreitet ist und der Agrarsektor allein unzureichend ist, um den Lebensunterhalt zu sichern. In Pakistan leben mehr als 60% der Bevölkerung in ländlichen Gegenden. Die Landwirtschaft bietet die meisten Arbeitsplätze. Der stark ausgeprägte Bevölkerungszuwachs übt zusätzlichen Druck auf vorhandene Ressourcen aus und bringt soziale und ökonomische Themen an die Tagesordnung. Andere Faktoren betreffen unvollkommene Land- und Kreditmärkte, fehlende Absicherungsmöglichkeiten und eingeschränkten Zugang zu Ressourcen etc.

Durch unvollkommene Arbeitsmärkte und den Mangel an Ressourcen wird die Haushaltsentscheidung bezügliche der Arbeitsverteilung beeinflusst. Daher sind Produktions- und Konsumentscheidungen eines Haushalts nicht voneinander zu trennen, da dieser sich mit Schattenlöhnen konfrontiert sieht, die wiederum von der Produktionstechnologie und den Haushaltspräferenzen abhängen. Das dritte Kapitel der Dissertation evaluiert das Arbeitsangebotsverhalten von ländlichen Haushalten in Pakistan mithilfe von Schattenlöhnen. Diese Bewertung ist grundlegend für die Politik, um die Wohlfahrt ländlicher Haushalte zu verbessern. Die Funktionsfähigkeit der Arbeitsmärkte in Pakistan wird durch die Anwendung von drei sogenannten "tests of separability". Alle Tests lehnen das Vorhandensein von perfekten Märkten in Pakistan ab.

Im vierten Kapitel wird die Wirkung von nicht-landwirtschaftlicher Arbeit auf die Haushaltswohlfahrt beurteilt. Der ländliche nicht-landwirtschaftsbezogene Sektor wächst stetig und entwickelt sich damit zu einer wichtigen Einkommensquelle, zieht Arbeitskräfte an und leistet einen wesentlichen Beitrag zur ländlichen Entwicklung. Unter Berücksichtigung von Faktoren, welche die Teilnahme an nicht-landwirtschaftlicher Arbeit beeinflussen, steigt die Wahrscheinlichkeit der Teilnahme mit einem höheren Bildungsniveau, der Haushaltsgröße und physischer Infrastruktur und sinkt hingegen bei einem mangelnden Zugang zu Land, Vieh und Krediten. Dies gilt für Männer gleichermaßen wie für Frauen. Die Studie zeigt, dass nicht-landwirtschaftliche Arbeit die Wohlfahrt erhöht und das Armutsniveau von ländlichen Haushalten verringert.

Eine der wichtigsten Herausforderungen in Entwicklungsländern ist der Einsatz von Investitionen, um die Produktivität kleinlandwirtschaftlicher Betriebe zu verbessern, welche die Hauptquelle für Einkommen der armen Haushalte in ländlichen Regionen darstellt und Nahrungsmittelsicherheit bietet. Arme Haushalte sind aufgrund von Liquiditätseinschränkungen und ungewisse Eigentumsrechte, nicht in der Lage agrarbezogene

Investitionen zu tätigen. Kapitel fünf erforscht die Rolle von nicht-landwirtschaftlicher Arbeit und Landrechten auf die Investitionstätigkeit in Bezug auf Bodenerhaltung und produktivitätssteigernde Maßnahmen. Die Studie beweist darüber hinaus, dass die nicht-landwirtschaftliche Teilnahme und gesicherte Landnutzungsrechte langfristige, Boden verbessernde Maßnahmen begünstigen und den Einsatz von kurzfristig, produktionsverstärkenden chemischen Düngern einschränkt. Die Resultate zeigen zudem, dass nicht-landwirtschaftliche Teilnahme und gesicherte Pachtverträge einen positiven Einfluss auf die landwirtschaftliche Produktivität haben. Basierend auf unseren Ergebnissen wird eine Verstärkung von Beschäftigungsmöglichkeiten mit einem hohen Einkommensniveau vorgeschlagen, indem Eintrittsbarrieren verringert und Veränderungen in Grundbesitzstrukturen vorangetrieben werden, die ein landwirtschaftliches Wachstum fördern.

Chapter 1

General Introduction

1.1 Introduction

This thesis focuses on the fundamental need of gender analysis to be incorporated into rural household development activities. The rural areas of developing countries are of major concern for development. Despite of huge efforts over the last two decades to alleviate poverty more than 1.4 billion in the world are still subject to it and three-quarters of all these poor people live in rural areas (IFAD, 2011). Rural poverty results from lack of assets and access to information, limited economic opportunities, poor education, imperfect labor markets, as well as disadvantages rooted in social and political inequalities. The rural poor are highly sensitive to various shocks such as price fluctuations, ill health, poor harvests, social expenses, or conflicts and disasters, therefore a large proportion of these households move in and out of poverty repeatedly, sometimes within a matter of years.

In the absence of other material and financial assets like land and capital, labor is the only principal and abundant asset to combat poverty and to strengthen the economic position of the rural poor people. Among the rural labor force, the female labor force accounts about 51 percent of the population and is primarily responsible to meet basic family needs in low-income food-deficit countries. Alongside of family needs they are also engaged in other productive tasks like participation in agricultural work, livestock caring, processing, and marketing of agricultural products, handicrafts and other small scale non-farm work. For instance in Asia, women produce 60 percent of the total food (Howard, 2003). Despite of the wide spectrum of their duties, their fundamental contribution is under-estimated and under-supported by statisticians and policy makers and is often adversely affected by prevailing economic and development policies (Mies, 1987). Given the significance of their role in society, sustainable rural development cannot be achieved by ignoring or excluding the efforts of more than half of the rural population (FAO, 2009).

Gender is commonly described as the position, responsibilities and activities assigned by the community endorsed to men and women. FAO (1997), defines the gender as perceptual and material relations between men and women, whose roles are based on the family structure, ownership and access to resources and are specific with different social, ethical and

ecological diversities. Difference in role of gender and social status is remarkably rigid. The situation not only varies among different cultures but even in the same culture within different social classes. Precisely, gender and its role are primarily associated with household decision making and setting the fate of households. Roles associated with gender describe the activities and responsibilities performed by both, men and women members socially assigned to them merely on the basis of gender and with prejudice (ICA-ILO, 2001; Mollel and Mtenga, 2001). So in order to achieve a higher level of development, there is need for the division of labor to excel in every sector of the economy.

Since the onset of green revolution when new high yielding input responsive crop varieties were developed, agriculture was thought to be the main source of income and employment and the most common way of lifting rural masses out of poverty (Canagarajah, 2001; World Bank, 2013). However, rapid increase in population, marginalization of lands, erratic weather pattern on the back of global climate changes, inaccessibility to efficient credit markets, production shocks, and diminishing capacity of the rural households to absorb these shocks has made this migration out of poverty a high risk and lower probability venture.

The possible strategies to move out of this poverty trap are: undergoing migration to urban areas or even foreign countries; diversifying crops; increasing savings; depleting asset; changing the allocation of labor; and enduring informal borrowing. The most drastic way is the income diversification through development of non-farm employment. During the past decades, non-farm employment is often regarded to be useful in reducing unemployment by absorbing emergent rural labor force, in moderating the rural-urban migration, in increasing the household welfare and food security, in alleviating rural poverty, in enhancing the farm income and in promoting a more equitable distribution of income.

Among the South Asian countries, Pakistan is a lower middle income country. Demographically it is characterized by poor rural and agrarian society where nearly two third of the population and 80 percent of the country's poor are residing in the rural parts of the country. Hence, the development of the rural sector is essential for the micro and macro economy of Pakistan. The survival of rural economies is largely dependent on agriculture which contributes almost one fourth of the GDP, engaging 45 percent of the labor force. However at present, agricultural sector has been facing a long list of problems: the small sized farm holdings (Wan and Cheng, 2001; Rusu, 2002), imperfect credit markets coped with missing insurance facilities (Dercon, 2002), limited access to inputs (Lamb, 2003; Duflo et al., 2011), unavailability of credit (Odhiambo and Magandini, 2008) and increased cost of

production (Tan et al., 2008). The ownership of land is highly uneven due to class stratification. For instance, World Bank (2006) reported that almost 40 percent of land area is under the control of 2.5 percent people while less than half of rural households do not own any agricultural land. There is no change in the value (0.66) of Gini coefficient for land ownership for the last three decades. Moreover, the agriculture sector has no more potential to absorb the fast growing rural labor force.

Hence, as a result of class stratification, increasing landlessness of small farmers, and population growth, non-farm sector in Pakistan is expanding. This sector in Pakistan, like in many other developing countries, is a heterogeneous sector covering a wide spectrum of activities. Generally, it includes non-farm self-employment, wage-labor, migration, non-labor work, renting of household and farm assets, and all other activities other than production of primary agricultural commodities. This sector is getting importance to rural economies for its productive and employment effects. Almost 45-50 percent of the rural population in Pakistan is directly dependent on non-farm income. Contribution of this sector is also critical for food security, poverty alleviation, farm sector competitiveness and productivity. It offers agricultural services and products to the food and fiber system. These products are critical to the dynamics of agriculture (GOP, 2011).

This dissertation deals with the development activities of the households living in rural areas of developing countries, where poverty is pervasive and farming alone is incapable of providing sufficient means of survival. Labor activities are principal determinant in defining the welfare of rural households. Despite its fundamental role in welfare gain of rural people, there is inadequate evidence on labor supply decisions in developing countries. Engagement in high return non-farm activities enhances the economic status of household by attracting the large labor force. The rural non-farm sector is growing rapidly but it is difficult for the rural poor to enter into high returning non-farm work. Poor household generally has lack of access to capital, skills, information and social networks to enter into lucrative non-farm market (Barrett et al., 2005). On the other hand, richer households have more assets and resources that enable them to undertake high return non-farm work. Hence, it is significant to examine the determinants of participation in non-farm work and the impact of non-farm participation on household welfare. Non-farm income can also be used for making investment in farming in order to increase productivity by relaxing liquidity constraints and providing steady flow of income. These investments might be short-term like purchase of fertilizer and other variable

inputs or might be long-term like soil-improving and productivity-enhancing investments (Pfeiffer et al., 2009).

The study is structured as follows. Chapter 3 evaluates the gender-based labor supply behavior of rural household under the assumption of non-separability between production and consumption decisions of households in Pakistan. A reasonable understanding of gender-based labor supply behavior is essential for policy design to improve the welfare of the rural household in developing countries. Household decisions on how to allocate resources such as land, capital and labor are a function not only of available opportunities, but also of the need to minimize the possibility of shocks that can throw the household into poverty, prevent it from moving out of it, or reduce its ability to spend on its primary needs. Labor markets are often imperfect or missing, particularly in the rural areas. This market imperfection coped with constrained access to assets affects household's decision of labor allocation and leads to different production regimes (Lovo, 2012). Under these conditions, production and consumption decisions of the household are not separable, so household faces shadow wages which depends on the production technology and household's preferences. The findings reveal that labor supply of both male and female is sensitive to changes in shadow wages and income.

The main objective of this study is to shed light on the determinants of household labor supply decisions that represent individual preferences and the intra-household bargaining process to cope with risks and to increase the welfare outcome. Education significantly increases the labor supply of both male and female in non-farm work and decrease the labor supply of own-farm and agri-wage work, suggesting the potential role of education in shifting labor from agriculture to high return non-farm sector. It shows the potential role of education to mobilize capital through high returning non-farm employment. Thus, education improves the ability of individuals to assign resources in response to changing economic conditions. Caste plays an important role in overthrowing the autonomy of female which is closely related to income inequality and distribution of land ownership. Female's labor supply decreases in non-farm and agri-wage work as we move up to the caste category, indicating cultural and social barriers that prevent women from entering and remaining in the labor force. The study also shows that socially backward castes have higher constraints to enter in non-farm sector in the sense they face higher transaction costs. The proximity of physical infrastructure like factory or small scale industry in village can enable households to engage in high returning activities. The functioning of labor market in Pakistan was tested by

applying three tests of separability. All these tests strongly rejected the separability assumption showing the dependence of production and consumption decisions of rural households in Pakistan. This finding is in line with much of development literature showing the existence of imperfect markets in developing economies.

Chapter 4 investigates the role of non-farm work of male and female on the welfare of rural household. In this study, we employ endogenous switching regression approach to examine the factors that influence the household's decision to participate in non-farm work and the impact of participation on household welfare measures such as per capita expenditure and poverty levels in rural areas of Pakistan. As participation in non-farm work is not random, rather based on the net benefits of participation, so we rely on endogenous switching regression model to control for selection bias based on observables and unobservables. Given the significance of the non-farm work in contributing to household welfare, the focus here is to assess the role that gender plays in enabling or disabling these livelihood choices and to address gender heterogeneity.

The participation equations reveal that education level of household head, adult household size, and physical infrastructure tend to positively and significantly influence the probability of participation of both male and female in non-farm work. On the other hand, lack of access to physical assets such as land and livestock, as well as lack of access to credit tend to decrease the likelihood of participation in non-farm work, for both male and female. The results also show that several household characteristics affect the welfare of participants and non-participants differently. In particular, adult household size tends to positively and significantly increase the welfare of participants, but has negative impact on the welfare of non-participants. Education of household head seems to be a key factor to increase welfare and to reduce poverty of both participant and non-participant by increasing the efficiencies of individual activities. The study shows that although the participation rate of female in non-farm work is low but its contribution towards increased welfare is more as compared to male, depicting the importance of female participation in improving the welfare and reducing the poverty status of farm household. Overall the results from this study generally confirm the potential positive role of the non-farm work in improving household welfare and alleviating poverty in rural areas of developing countries. From a policy perspective, this study also highlights strategies that can be employed to reduce entry barriers to the non-farm sector, particularly for females, who face substantial barriers.

Chapter 5 evaluates the impact of non-farm work and tenancy arrangements on the intensity of investment in soil-improving and productivity-enhancing measures, as well as on farm productivity. One of the most enduring challenges in the developing countries has been the question of how to increase investment in order to enhance productivity in small-scale farming, which is the main source of income and food security for poor rural households. There is a need to focus on the intensification of agriculture practices by sustainable management of land and other natural resources. Investment measures are the key components of sustainable management of resources which ultimately enhance productivity of the farm sector. The poor households are not able to undertake soil-improving and productivity-enhancing investments because of the two major limiting factors. The first one is the irregular income and high covariate risk in agriculture sector. The second one is the lack of secure property rights of land. This situation has pushed the resource poor and land constraint households away from agriculture and urged to find employment opportunities in non-farm sector. Non-farm income may enhance investments in agriculture sector by providing capital in the context of imperfect credit and insurance markets. Hence, the role of non-farm sector has become increasingly significant in recent decades.

Similarly, the secured property rights provide incentives for farmers to stimulate long-term land-improving and productivity-enhancing investments in many ways. First, the 'assurance effect' which is related to the security involved in undertaking long-term land improvement and conservation measures, without any fear of expropriation. The second effect, which is known as the 'transaction effect', operates through the trade effect when land is easily convertible to liquid assets as a result of tenure security. Third, secure tenancy improves farmer's access to credit to finance agricultural investments by using land title as collateral.

The problem of endogeneity of non-farm work participation and tenancy arrangements is addressed by employing multivariate tobit model. This study reveals that land tenancy arrangements influence investment intensity in soil-improving and productivity-enhancing measures. In particular, owner-cultivators invest more in soil-improving measures, but less in chemical fertilizer. On the other hand, fixed-rent tenants invest less in soil-improving measures, but more in chemical fertilizer. This highlights the fact that farmers on short-term fixed-rent contracts normally aim for short-term benefits and therefore tend to invest more in static inputs such as chemical fertilizer. However, owner-cultivators, with secured property rights, mostly target longer term benefits from their agricultural investments.

Further, the study also shows that participation in non-farm work increases the intensity of investment in soil-improving measures such as organic manure and green manure, but decreases the use of chemical fertilizer. Thus, household participation in non-farm work induces a shift toward investment in soil-improving measures with long-term benefits, and away from static inputs such as chemical fertilizer with short-term benefits. We also find evidence that participation in non-farm work exerts positive and significant impact on farm productivity, suggesting that access to non-farm work opportunities can contribute to higher farm household income and poverty reduction in rural areas.

The study also used propensity score matching approach to examine the direct effects of investment in organic manure, green manure, and chemical fertilizer on farm productivity. It indicates that investment in organic manure, green manure, and mineral fertilizer exert a positive impact on farm productivity, indicating that it may partly account for the productivity impacts of tenure security. This study suggests boosting up high return employment opportunities and implying changes in land tenure system for agricultural growth.

1.2 References

Canagarajah, S., Newman, C. and Bhattamishra, R. (2001). Non-farm income, gender and inequality: Evidence from rural Ghana and Uganda, *Food Policy* 26, 405–420.

Dercon, S. (2002). Income risk, coping strategies and safety nets, *The World Bank Research Observer* 17, 141–166.

Duflo, E., Kremer, M. and Robinson, J. (2011). Nudging farmers to use fertilizer: Theory and experimental evidence from Kenya, *American Economic Review, American Economic Association* 101, 2350–2390.

FAO. (1997). Gender: The key to Sustainability and Food Security. Rome: Food and Agriculture Organization of the United Nations.

FAO. (2009). Gender, Equity and Rural Development. Rome: Food and Agriculture Organization of the United Nations.

Government of Pakistan. (2011). Economic Survey 2010-11, Finance Division, GOP, Islamabad, Pakistan.

Howard, P. (2003). *Women and Plants: Gender Relations in Biodiversity Management and Conservation.* ZED Books, London.

ICA-ILO. (2001). Gender Issues in Cooperatives: An ICA-ILO Perspective.

IFAD. (2011). Rural Poverty Report. Rome: International Fund for Agricultural Development.

Lamb, R. (2003). Fertilizer use, risk and off-farm labor markets in the semi-arid tropics of India, *American Journal of Agricultural Economics* 85, 359–371.

Lovo, S. (2012). Market imperfections, liquidity, and farm household labor allocation: The case of rural South Africa, *Agricultural Economics* 43, 417–428.

Mies, M. (1987). Indian women in subsistence and agricultural labour, *Vistaar, New Delhi.*

Mollel, N. M. and Mtenga, N. A. (2001). Gender roles in the household and farming systems of Techenzema, Morogoro-Tanzania, *South African Journal of Agricultural Extension* 9, 73–88.

Odhiambo, J. and Magandini, N. (2008). An assessment of the use of mineral and organic fertilizers by smallholder farmers in Vhembe district, Limpopo province, South Africa, *African Journal of Agricultural Research* 3, 357–362.

Rusu, M. (2002). Land fragmentation and land consolidation in Romania. Paper presented at the international CEEC symposium, 25–28 February, Munich, Germany.

Tan, S., Heerink, N. and Kruseman, G. (2008). Do fragmented landholdings have higher production costs? Evidence from rice farmers in northeastern Jiangxi province, P. R. China, *China Economic Review* 19, 347–358.

Wan, G. and Cheng, E. (2001). Effects of land fragmentation and returns to scale in the Chinese farming sector, *Applied Economics* 33, 183–194.

World Bank. (2006). Development and the Next Generation. World Development Report 2007. World Bank, Washington, DC.

World Bank. (2013). Implementing Agriculture for Development. World Bank, Washington, DC.

Chapter 2

Background

The first part of this chapter includes introduction and geographic information of Pakistan, focusing on economic indicators like poverty status, population growth and labor force participation. The chapter also describes the role of agriculture sector, access to land and land reforms, and growing need of non-farm sector in the development of rural economy. At the end of this chapter problem setting, motivation, objectives, and significance of the study are presented.

2.1 Pakistan – Geographic Profile

Pakistan is an Islamic Republic, sovereign and a multiethnic country, situated in South Asia in the western part of the Indian subcontinent, with India (2912 km) on the east, Durand line with Afghanistan (2430 km) on the northwest, Iran (909 km) on the southwest, China (523 km) on the northeast, and the Arabian Sea and Gulf of Oman (1046 km) on the south. Pakistan is the world's 36th largest country with an area of 796,095 km2 (ICIMOD, 1998). The name Pakistan is derived from the Urdu words Pak (meaning pure) and stan (meaning country). Islamabad is the capital city with an approximate population 832,000 and other large cities include Karachi (13,125,000), Lahore (7,132,000), Faisalabad (2,849,000) and Rawalpindi (2,026,000) (Pakistan encyclopedia, 2013).

The lowest point in Pakistan is sea level at the Arabian Sea (0 ft) and ranges to the northern and western highlands of Pakistan, including the gigantic Karakoram and Pamir mountain ranges. These mountain ranges take account of some of the world's highest pinnacle: K2 (28250 ft) and Nanga Parbat (26660 ft). The Plateau of Baluchistan lies to the west, and the Thar Desert and an expanse of alluvial plains, the Punjab and Sind, lie to the east of the country.

Five rivers flow in the country. The Indus River rises in southwestern Tibet with a catchment area of about 1 million square kilometers. Other major rivers of Pakistan include Jhelum, Chenab, Ravi, and Sutlej. These rivers also flow into Indus River. The Indus River basin is a fertile plain created by the silt deposited from the Indus River.

Figure: 2.1: Map of Pakistan.

Source: en.wikipedia.org

Pakistan lies in the temperate zone and has a record of one of the highest temperatures in the world, 53.5 °C (128.3 °F) as on 26 May, 2010. The climate is subject to change from tropical to temperate on daily and seasonal basis as Pakistan is located on a wide land area starting from latitudes 25° and 35° N. Arid conditions prevail in the coastal south. Monsoon season follows a dry season. Rainfall ranges from 10 inches to 150 inches per annum. Punjab is the most rainfall receiving province (ICIMOD, 1998).

There are four seasons in Pakistan: a cool but dry winter from December to February, a hot and dry spring from March to May, the rainy season or the monsoon from June to September and the retreating monsoon period of October and November. The onset and duration of these seasons varies significantly according to the location. The climate in the capital city of Islamabad varies from an average daily low of 5 °C (41.0 °F) in January to an average daily high of 40 °C (104 °F) in June. Half of the annual rainfall occurs in July and August, averaging about 300 millimeters (11.81 in) in each of those two months. The remainder of the year has significantly less rain, amounting to about 100 millimeters (3.94 in)

per month. Hailstorms are common in early spring. These climatic conditions are very suitable for the cultivation of wide variety of crops, beans, nuts, fruits, and vegetables (Pakistan encyclopedia, 2013).

2.2 Poverty in Pakistan

Poverty refers to lack of food, shelter and basic necessities like medical care, education, electricity and clean drinking water (World Bank, 2001). Like in several developing countries, poverty is also very common and widespread in Pakistan. The basic reasons behind this increasing poverty include corruption, inflation, high population growth rate, high unemployment level and to some extent, natural disasters like floods and earthquakes. United Nations (2013) reported that according to Human Development Index (HDI), about 53.4 percent of the population in Pakistan lives in a state of deprivation of basic needs.

Most of the poor people in Pakistan are concentrated in the rural areas where main source of livelihood is agriculture sector. This sector is poorly managed due to unequal distribution of land and financial constraints, causing poverty. During 1960s, poverty in rural areas was estimated about 42.28 percent whereas in the next decade the rural poverty had a decreasing trend. The factors responsible for this decrease in poverty were the increased private investment in agriculture sector and urbanization as a result of migration from rural areas to cities in quest of better living. Coped with agriculture sector development and remittances, this decreasing trend of poverty continued till 1980s (ADB, 2002). In the late 1980s, again the poverty level started to increase. During 1990s and in 1999, the poverty rate decreased to 36.3 percent in rural areas as compared to 22.6 percent in urban areas (Zaman et al., 2011).

Government of Pakistan is making valuable efforts to eradicate poverty and has allocated 4.5 percent of GDP for this purpose. Government has identified seventeen sectors being the poorest and efforts are being made to strengthen them all. Pakistan Poverty Alleviating Fund (PPAF) has disbursed about 7.5 billion PKR to different poverty alleviation projects like microcredit, supply of clean drinking water, education and health during July – December 2012. Benazir Income Support Program (BISP) has spent about 165 billion PKR for the prosperity and wellbeing of the poor in terms of employment, health and education (GOP, 2013).

Apart from these numerous programs and poverty alleviation strategies, NGOs, Public and Private Organizations are helping to combat and finally eradicate poverty but these efforts

prove to be much smaller against the gigantic and ever increasing population. It proves that poverty cannot be alleviated merely by giving donations, providing food to the foodless and giving clothing to the needy. In fact, there is a need of investment in human and physical capital. The true remedy of poverty is not to help the poor in kind or cash, instead making poor able to combat and overcome poverty. Helping poor people in skill development and ability to cope with risks can help them to earn their own income and to increase the standard of living.

2.3 Population Growth and Labor Force in Pakistan

Pakistan's estimated population in 2012 was 184.35 million, which makes Pakistan the world's sixth most-populous country. The sex ratio at birth is 1.05 male(s)/female, less than 15 years is 1.06 male(s)/female, 15–64 years is 1.09 male(s)/female, 65 years and over is 0.92 male(s)/female and the total population ratio is 1.07 male(s)/female. The population growth rate now stands at 2 percent. This increasing population is a great hurdle for economic growth and poverty alleviation strategies. The undeveloped economy lacks the potential to absorb this colossal labor force in productive activities and results in increased unemployment. Moreover, this labor force being unskilled receives low wages and cannot increase their standard of living. Keeping in view less employment opportunities and low wage rates, rural people tend to migrate to big cities. Increasing population promotes urbanization in developing countries and both are the joint tools to get high economic growth and to combat with poverty.

In Pakistan, almost 69.87 millions are living in urban area and 114.4 millions in rural area. During 1950–2011, Pakistan's urban population expanded over seven times, and the total population increased by over four times. Migration is the major cause of urbanization that ensures more employment opportunities, better education and health facilities, as well as better mobilization and empowerment of women. There is a significant trend of overseas employment in Pakistan, for instance the number of emigrants increased from 0.45 million in 2011 to 0.63 million in 2012 (GOP, 2013).

Pakistan has one of the largest labor sources available in the world. According to CIA World Fact book (2013), the total number of Pakistan's labor force is 57.2 million, making it the ninth largest country in terms of available human workforce. About 43 percent of this labor is involved in agriculture, 20.3 percent in industry and the remaining 36.6 percent in other services. Female participation rate in agricultural wage work is high in Punjab and Sindh provinces of Pakistan; 58 percent in Punjab and 54 percent in Sindh. However, the

participation rate of female in non-farm work is extremely low due to limited independence, immobility, and burden of domestic duties. For instance, only 4 percent of females between the ages of 18-60 had worked in non-farm sector in the past year (IFPRI/IDS, 2012).

2.4 Sources of Rural Income

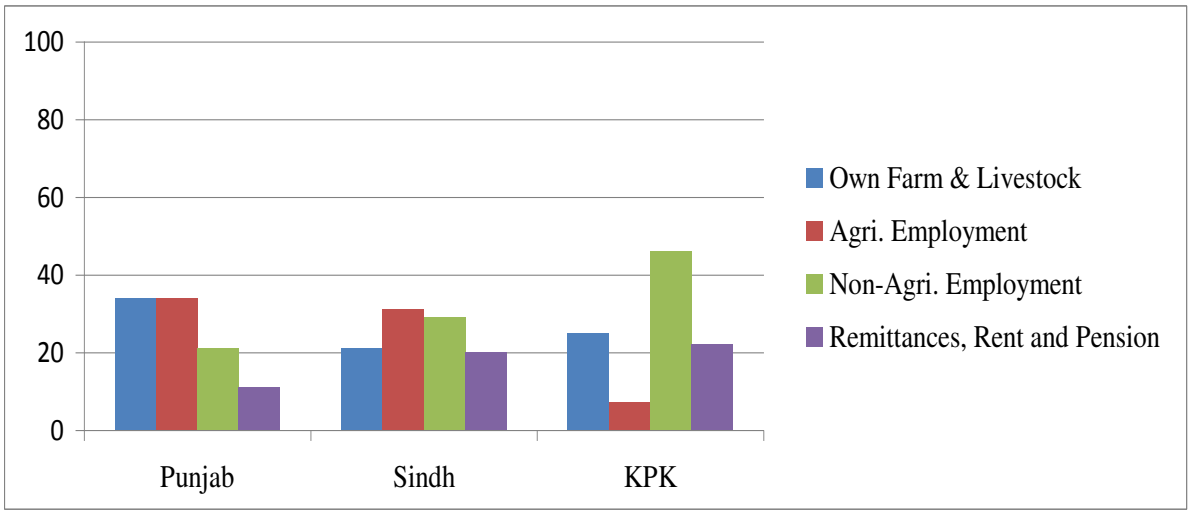
The country has a developing mixed economy based largely on agriculture, light industries, and services. Remittances from Pakistanis working abroad are a major source of foreign exchange. Rural families earn their livelihood from variety of sources which varies across provinces. Overall, almost 31 percent of income comes from agriculture sector, non-agricultural employment contributes 24 percent and businesses and remittances account for 8 percent of total rural household income. Other sources include pensions and rent from property (IFPRI/IDS, 2012). Provincial wise sources of rural income are shown in Table 2.1 and Figure 2.2.

Table 2.1: Sources of income in rural Pakistan

Provinces	Own Farm & Livestock	Argi. Employment	Non-Agri. Employment	Remittances, Rent and Pension
Punjab	34	34	21	11
Sindh	21	30	29	20
KPK	25	7	46	22

Source: (IFPRI/IDS, 2012)

Figure: 2.2: Sources of income in rural Pakistan



Source: (IFPRI/IDS, 2012)

2.5 Agriculture Sector in Pakistan

Agriculture being a major source of income and employment is central to economic growth and development in Pakistan. It currently contributes 21.4 percent to the GDP with 3.3 percent growth rate, generates employment for 45 percent of country's labor force, and 62 percent of rural population depends on this sector for its livelihood. It is an important component in the economy of Pakistan in securing food security, reducing poverty, improving employment for poor rural people, enhancing overall economic growth, and stimulate domestic demand for industrial goods and services (GOP, 2013). Agriculture contributes to the economy by three ways: first, it provides food to consumers and raw material to industry; second, it is a source of national income and export earnings; and third, it provides market for industrial goods. Thus agriculture exerts a multiplier effect on the socio-economic conditions of the people and development of industrial sector.

Generally, the agriculture sector includes five sub-sectors: major crops, minor crops, livestock, fisheries, and forestry. Major crops grown in Pakistan are cotton, wheat, rice, sugarcane, maize etc. which contribute 25.2 percent of the value added in overall agriculture and 5.4 percent to the GDP. Minor crops consist of oilseeds, vegetables, pulses, chilies, tobacco and other small crops which account for 12.3 percent of the value added to agriculture. On average, Pakistan annually produces over 24 million tones of wheat, more than 62 million tones of sugarcane, and 5.5 million tones of rice (GOP, 2013). According to Food and Agriculture Organization (2011), Pakistan is the second largest producer of buffalo milk, fourth largest producer of cotton, fifth largest producer of mango, dates, and sugarcane, sixth largest producer of apricot, and chickpea, seventh largest producer of wheat and tenth largest producer of rice. Livestock is an important sub-sector of agriculture which includes cattle, buffalos, sheep, goats, camels, donkeys, horses and poultry. Small holders in rural areas depend on it for their daily nutrition and cash income. Livestock contributes 55.4 percent to the agricultural value added and around 12 percent to the national GDP. Fisheries share in GDP is very less but it adds substantially to the national income through export earnings (GOP, 2013).

Although, the agricultural sector plays a vital role for defining the livelihood of rural people but this sector, however, has been facing challenges like: rapid population growth, unequal distribution of landholdings, inadequate farm infrastructure, lack of access to credit, imperfect markets, traditional methods of production, lack of investment etc. All of these have

contributed to low productivity and incapability for new employment opportunities in the agriculture sector.

2.6 Land Tenure and Land Reforms in Pakistan

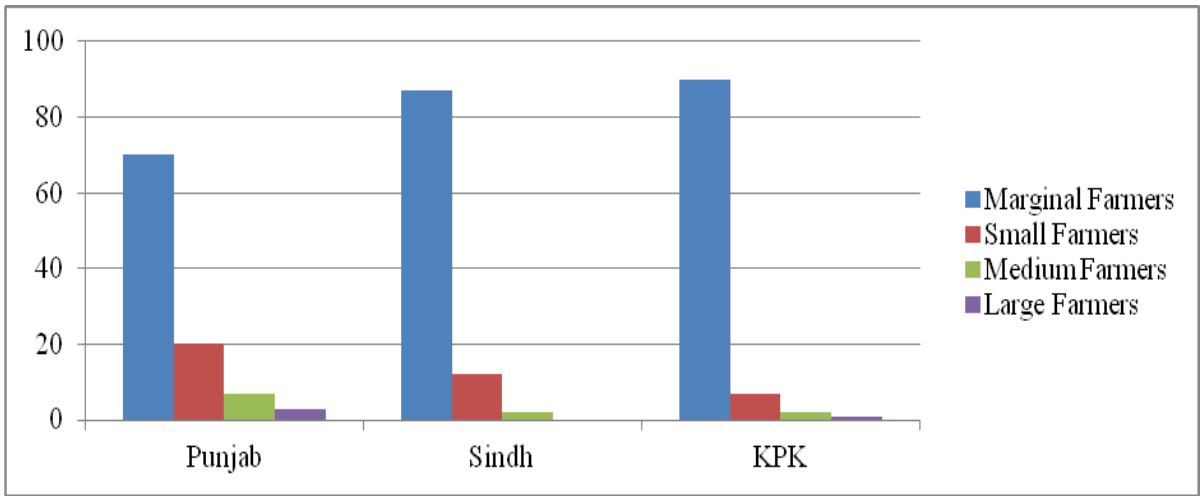
Land has a strategic position in rural areas because of its multidimensional roles: key factor in production, collateral in credit markets, security against natural disaster or shocks, and symbol of social, economic and political status. Although, land is the major asset of farm families in rural areas of Pakistan but its distribution is highly skewed, as 5 percent of large landholders possess 64 percent of total farm land and 65 percent small farmers hold 15 percent of land. Rural poverty and food insecurity is strongly correlated with landlessness (USAID, 2010). Provincial distribution of land shows that 70 percent farmers in Punjab cultivate less than 5 acres of land while large farmers are extremely low. Same trend is observed in other Provinces as shown in Table 2.2 and Figure 2.3:

Table 2.2: Proportion of farmers by size of farm and Provinces

Province	Marginal Farmers	Small Farmers	Medium Farmers	Large Farmers
Punjab	70	20	7	3
Sindh	87	12	2	0
KPK	90	7	2	1

Source: (IFPRI/IDS, 2012)

Figure: 2.3: Proportion of farmers by size of farm and Provinces



Source: (IFPRI/IDS, 2012)

In Pakistan there is feudal system which is inherited from British Raja. The large landlords have political powers and enjoy all economic advantages. They hold thousands of acres and do little agricultural work themselves. The monopoly of their power and status has a leading hindrance in the way to achieve social and economic wellbeing of rural poor families. There is need of land reforms not only to increase agriculture growth but also to raise the social and economic status of peasants in Pakistan's rural society.

After independence in 1947, Pakistan has subjected to three land-reform efforts (1959, 1972, and 1977) under different governments but they failed to achieve their objectives of implementing tenancy, land ceiling and land distribution measures. 1959's land reforms fixed the ceiling of 500 acres for irrigated and 1000 acres for un-irrigated land for private ownership. Only 0.65 million acres was distributed amongst 59,906 tenants and small owners. The number of beneficiaries was very low as government occupied only 35 percent of the holdings that exceeded the ceiling. Hence, this reform was not a big achievement. For instance in 1947, less than 1 percent of farm owners control more than 25 percent of agricultural land and after the 1959 reforms, 42 percent of agricultural land was occupied by less than 8.5 percent of farm owners. Average landholding was still 7,208 acres in Pakistan and 11,810 acres in Punjab due to the state's inefficiency.

Second attempt of land reforms was done in 1972 in which the ownership ceiling was reduced to 150 and 300 acres for irrigated and un-irrigated land respectively. Nearly 1.3 million acres of land was resumed and 0.9 million of that was distributed amongst 76,000 beneficiaries. Again landlords were succeeded to manage land within the extended joint family system as the ceilings were again in terms of individuals rather than families. Under the 1977 reform, another 1.8 million acres of land was resumed, out of which almost 0.9 million acres were distributed amongst 13,143 small farmers and tenants.

Unfortunately, these all reforms did not radically change the nature of land tenure in practice and land ownership is still highly concentrated in Pakistan. As a consequence, lease markets are very active where large land owners employ hired labor or lease their land to tenants in order to release themselves and their families from manual labor. Small land owners rely primarily on family labor including women labor, but they may abstain from manual labor if their status maintenance requires it (Rehman, 1987).

Land in Pakistan is classified as state land, private land or community land. Generally three types of tenancy arrangement exist there; ownership, lease and sharecropping. The most

common type of tenancy is ownership where private individuals have rights to use land. Lease refers to written or oral agreement where rates are fixed and it may continue from one year to many years. This arrangement is common for the area of more than 30 hectares of land. Sharecropping arrangement is common among small and medium sized parcels of land, usually less than 30 hectares, where the landlord usually receive 50 percent of produce (USAID, 2010). Nearly, 66 percent of cultivated land was under sharecropping arrangement in 2010 and productivity of sharecropped land was 20 percent lower than that of owner-operated land. Tenants and sharecroppers have little incentive to invest in sustainable production practices and insecurity of property rights has led to increased degradation of agricultural land (World Bank, 2007; Barnhart, 2010).

2.7 Non-farm Sector in Pakistan

As a result of increasing landlessness of small farmers, low farm productivity and population growth in rural Pakistan, rural labor force is shifting from agriculture to non-farm sector. The non-farm sector has great importance to rural economies as it helps in generating employment opportunities, ensuring income diversification, enabling food security, reducing poverty, improving income distribution, reducing risks and vulnerabilities, as well as relaxing liquidity constraints to enhance farm investment and productivity. For instance, Arif et al. (2000) noted that even a low return non-farm work contributed to stable household income and consequently increased in the welfare of rural families.

Rural economy of Pakistan derives important share of income from non-farm activities which employ large labor force. The share of non-farm labor in the country was about 40 percent and about 45-50 percent of the rural population is directly dependent on non-farm income (GOP, 2011). Non-farm sector in Pakistan includes diverse range of economic activities in rural areas such as non-farm self-employment, wage-labor, migration, non-labor work, renting of household and farm assets, and all other activities other than agriculture. Generally, non-farm rural household falls into three categories: agricultural wage labor, non-agricultural wage labor, non-agricultural enterprises (or businesses). According to IFPRI/IDS (2012), about 40 percent of total non-agricultural household are agricultural wage labors, 34 percent belongs to non-agricultural enterprises and 26 percent derive their income from non-agricultural wages.

The scale of non-farm sector in rural Pakistan varies enormously, ranging from small-scale home based cottage industries to large scale agro-processing industries. Its performance

is heavily dependent upon the availability of raw material from agriculture, supply of household labor force and access to financial services. Non-farm sector has a significant importance for the marginalized poor segment of rural populace, especially women who usually participate in home-based informal activities because of domestic and childcare responsibilities, social barriers, and differential access to education and physical resources.

Although non-farm sector has a significant contribution in the rural economy of Pakistan (Adams and He, 1995), but the full expansion of this sector is overlooked because of the existing political and feudal system. High return large-scale enterprises such as rice, sugar, and flour mills are generally occupied by landlords or big businessmen, while poor people are engaged in low return small-scale activities such as crafts, local vendors, shops, small hotels, and cottage industries. This situation calls for three important strategies for the generation and promotion of non-farm activities in rural Pakistan; the first is the access to resources, specially finance, the second is to improve the quality of product and the third one is the provision of institutional approach to build human capital, to develop rural infrastructure and to enforce law of minimum wage rate. There is also a need to understand factors that determine the performance and growth of non-farm sector and to formulate the policies and investment measures that would stimulate the growth of the sector.

2.8 Problem Setting and Motivation

The rural areas of developing countries are of major concern for development where at least 70 percent of the world's poor community is residing. Agriculture is the main source of livelihood of rural households. But at present this sector has limited potential to create new job opportunities due to unequal distribution of landholdings, disguised unemployment, low farm productivity, high covariate risks, and imperfect labor and input markets. Moreover, rapidly growing population is depleting natural resources like land, water, energy and facing extreme poverty. Labor is the only principal and abundant asset of rural economy. There is need of proper utilization of available resources, especially labor to increase the welfare of rural families. Hence, the biggest challenge of rural community is how to increase farm output from the shrinking agricultural sector, while sustaining the productivity potential of the available natural resources, as well as creating gender based job opportunities in high return non-farm sector.

Several studies have investigated the involvement and role of rural women in crop activities (Quadri and Jahan, 1982; Mumtaz, 1993; Saghir et al., 2005; Jamali, 2009), meeting

food requirement of family (ESCAP, 1997), participation in decision making in agriculture (Atta, 2000; Rasheed, 2004), inequality in resource access (Chaudhry et al., 2009). Few studied the importance of gender participation in non-farm sector of rural areas of Pakistan. The rural non-farm sector in Pakistan, like in many other developing countries, is a heterogeneous sector covering an extensive range of earning activities. It ranges from small scale home-based enterprises to large scale manufacturing industries. This situation calls for investigating the potential of whole range of these non-farm activities. There is a substantial body of literature on poverty reduction in Pakistan but they ignore the significance and contribution of non-farm sector for reducing poverty. Very few studies have investigated the linkages between rural non-farm sector and poverty but their studies were based on relatively small sample size. For example, Adams and He (1995) examined sources of non-farm income inequality, and Nasir (2001) made links between poverty and formal and informal sector employment in rural and urban areas of the country. Nevertheless, the factors that are effecting the participation of rural household in earning activities and its impact on household welfare and poverty are not examined extensively in literature. In view of the growing importance of gender role in non-farm activities in the rural economy, this examination is critical particularly in drawing policy recommendation for poverty alleviation in rural areas. The present study fills this gap and examines the issues surrounding non-farm gender employment and rural poverty in Pakistan.

2.9 Objectives of the Study

The overall objective of this dissertation is to study the gender based labor supply, income diversification and household welfare in Pakistan, the specific objectives of the study are:

1. To examine the labor supply responses of male and female of rural households in Pakistan under the assumption of non-separability.

2. To analyze the impact of participation of male and female in non-farm work on household welfare in Pakistan.

3. To examine the impact of non-farm work and tenancy arrangements on investment in soil conservation and productivity-enhancing measures and productivity in Pakistan.

4. Based on the findings, to suggest policy recommendations for improvement of household welfare in Pakistan.

2.10 Significance of the Study

Rural communities in the developing countries are facing a key challenge of combating poverty and are continuously trying to increase the social and economic status of their families. The biggest asset that rural communities hold is their abundant labor force. The agriculture sector is overcrowded and is incapable of absorbing surplus labor. Given the abundant labor and low agricultural productivity, household welfare can be achieved through the involvement and appreciating the contribution of female labor force and finding new earning opportunities other than agriculture.

The women play an important role in the rural economy but their participation is always ignored and thought to have no economical significance which has caused negative effect on the rural development. Their role in daily household work is considered as nonproductive. Women contribute more than half of the rural population. Although being in a majority, they are underestimated and their services have no value. This study reveals the importance of women's contribution towards a better living and a well developed rural economy.

This study also highlights the importance of non-farm sector for the increasing welfare and reducing poverty level of land constraint rural households. Non-farm income is also useful for enhancing investment in agriculture sector by providing capital in the context of imperfect credit and insurance markets. This study also pinpoints the inequality/discrimination regarding the access of resources and ownership of land. Thus, this examination is significantly important in drawing policy recommendation for poverty alleviation in rural areas of Pakistan.

2.11 Structure of the Thesis

The dissertation is organized as follows: Chapter 2 presents the general introduction of the study which is about setting the need of this research and summarizes the findings of chapter 3, 4, and 5. Chapter 3 examines the labor supply of male and female on own-farm, agri-wage and non-farm activities under the assumption of non-separability. This chapter focuses on the sensitiveness of labor supply to changes in different socio-economic conditions. Chapter 4 analyzed the impact of non-farm work of male and female on the household welfare and poverty reduction. Chapter 5 estimated the impact of non-farm work and tenancy arrangement on the decision of soil-improving and productivity-enhancing measures and farm productivity. Chapter 6 concludes and makes some recommendations for policy formulations.

2.12 References

ADB. (2002). Poverty in Pakistan; Issues, Causes and Institutional Responses. Asian Development Bank (ADB). Pakistan Resident Mission, Islamabad.

Adams, R. H. J. and He, J. J. (1995). Sources of income inequality and poverty in rural Pakistan. International Food Policy Research Institute, Washington, D.C.

Arif, G. M., Nazli, H. and Haq, R. (2000). Rural non-agriculture employment and poverty in Pakistan, *The Pakistan Development Review* 39, 1089–1110.

Atta, N. (2000). Involvement of rural females in decision making process in Faisalabad, M.Sc. Rural Sociology Thesis, University of Agriculture, Faisalabad, Pakistan.

Barnhart, J. (2010). Email communication from USAID Pakistan Mission (June 25, 2010), *Rural Development Institute, Seattle*.

CIA. (2013). The World Fact Book for Pakistan. Central Intelligence Agency, Pakistan.

Chaudhry, I. S. and Rahman, S. (2009). The Impact of gender inequality in education on rural poverty in Pakistan: An empirical analysis, *European Journal of Economics, Finance and Administrative Sciences* 15, 1450–2887.

ESCAP. (1997). Women in Pakistan: A country profile. United Nations, New York.

FAO. (2011). Statistical Division. Rome: Food and Agriculture Organization of the United Nations.

Government of Pakistan. (2011). Economic Survey 2010-11, Finance Division, GOP, Islamabad, Pakistan.

Government of Pakistan. (2013). Economic Survey 2012-13, Finance Division, GOP, Islamabad, Pakistan.

ICIMOD. (1998). Land cover assessment and monitoring Pakistan, *Environment Assessment Technical Reports* 10-A.

IFPRI/IDS. (2012). Pakistan Rural Household Panel Survey 2012. Pakistan Strategy Support Program (PSSP) of IFPRI Washington, DC, and IDS Islamabad, Pakistan.

Jamali, k. (2009). The role of rural women in agriculture and it's allied fields: A case study of Pakistan, *European Journal of Social Sciences* 7, 71–77.

Mumtaz , K. (1993). Gender issues in agriculture and rural development policy in Asia. Food and Agriculture Organization of the United Nations 3, 87.

Nasir, Z. M. (2001) Poverty and labor market linkages in Pakistan. Pakistan Institute of Development Economics, Islamabad. (MIMAP Technical Report No. 7.)

Pakistan Encyclopedia. (2013). http://en.wikipedia.org/wiki/Punjab,_Pakistan

Qadri, S. M. A. and M. K. Jehan. (1982). Women in agriculture sector in Sindh, studies on rural women in Sindh. Women's Division Cabinet Secretariat, Government of Pakistan, Islamabad.

Rasheed, S. (2004). Women participation in decision making process regarding agricultural business and family matters: A case study in Tehsil Gojra. M.Sc Rural Sociology Thesis, University of Agriculture, Faisalabad, Pakistan.

Rehman, M. (1987). Women and rural development in Pakistan, *Journal of Rural Studies* 3, 247–243.

Saghir, A., Zakaria, M., Hassan, Y. and Javed, A. (2005). Gender participation in crop production activities, *Journal of Agriculture and Social Sciences* 4, 343–345.

United Nations Development Programme. (2013). Human Development Report 2013. Oxford University Press, New York.

USAID. (2010). USAID Country Profile: Property Rights and Resource Governance, Pakistan. Land Tenure and Property Rights Portal. United States Agency for International Development.

World Bank. (2001). World Development Report 2000–01. Oxford University Press.

World Bank. (2007). Pakistan: Promoting Rural Growth and Poverty Reduction, Report No. 39303-PK. The World Bank, Washington, DC.

Zaman, K., Shah, I. A., Khan, M. M. and Ahmad, M. (2011). Exploring the link between Poverty–Population–Pollution (3Ps) in Pakistan: Time series evidence, *Journal of Economics and Sustainable Development* 2, 27–50.

Chapter 3

Gender based labor activity of farm households: A case of market imperfections in rural Pakistan.

This paper will be submitted to the Journal of Agricultural Economics

Abstract

This article evaluates the labor supply of male and female on own-farm, agri-wage and non-farm activities, using cross-sectional data of 341 rural households of the Punjab province of Pakistan. The estimation in this study proceeds in two steps. In the first step, shadow wage is estimated through production function analysis. The estimated shadow wages and income are then used to calculate the labor supply in the second stage. Our analysis reveals that education, caste, village infrastructure appeared to be important determinants for labor supply of both male and female. Hypothesis of separability in agricultural household models was tested by applying three tests. All tests strongly rejected the separability hypothesis, indicating the dependence of production and consumption decisions of rural households in Pakistan.

Keywords: labor supply, non-separability, shadow wages, Pakistan

3.1 Introduction

Labor activities are the significant determinant in rural household's welfare in developing countries. To cope with the higher levels of poverty in these countries, different welfare projects have been introduced to increase the overall productivity level and demand for labor resulting in higher returns. On contrary, in addition to demand for labor, rural household welfare is also determined by the labor supply behavior. Hence, the effectiveness of the welfare projects also depends on the gender based labor supply behavior and the knowledge of which is an important tool in policy designing.

Generally, gender is most commonly described as the position, responsibilities and activities assigned by the community endorsed to men and women. Roles associated with gender describe the activities and responsibilities performed by both women and men members socially assigned to them just on the basis of gender and with prejudice. Differences in role of gender and social status are remarkably rigid. However, this situation varies among different cultures and even in different social classes in the same culture. Commonly, it is associated with overall decision making about the fate of households (ICA-ILO, 2001; Mollel and Mtenga, 2001).

Women constitute more than half of the rural labor force and are the backbone of their communities in low-income food-deficit countries. They perform wide spectrum of tasks ranging from household domestic duties to commercial income generating activities. But women efforts for such activities are not measured in economic term. Given the significance of the role of women, rural development cannot be achieved by ignoring the efforts of such a large segment of society (FAO, 2009). It is quite common to underestimate their contribution by statisticians and policy makers and their work might go under the label "housewives" (Mies, 1987).

In Pakistan, there is male dominant society, both in villages and cities. Males head about 92 percent of the households (Elahi, 2006). Seventy percent of the Pakistan's population live in rural areas and 51 percent of them are the women, fulltime dwelling in villages and socially bound to carry out household activities like food processing, food storage, taking care of children and sick family members, raring of livestock, engaging artisan and handicrafts, and helping male members in agricultural work. According to the Government of Pakistan, the participation of rural women in agricultural work is about 79 percent as compared to men's participation, which is 63 percent showing that women's

participation is higher than that of men. Despite this fact, women are suffering from their social position and wage rate discrimination. This condition is even worse and women are more discriminated in the villages nearby cities (Nazir, 2009).

There is a major split in the activities of rural farm household: production of farm output for income earning on one end and production of food for household consumption on the other end and both the processed go side by side. In the past studies, it was considered that there is independence between farm household production and consumption decisions (Barnum and Squire, 1979; Rozenzweig, 1980; Singh et al., 1986; Tockle and Huffman, 1991; Abdulai and Delgado, 1999). This assumption does not fit in developing countries because of the market imperfections, so the emphasis of development economics has shifted to the separability assumption in the last decade (Stark, 1991; Benjamin, 1992; Jacoby, 1993; Skoufias, 1994; Abdulai and Regmi, 2000; Taylor and Martin, 2001). A country, like Pakistan is no exclusion and the labor and factor markets are imperfect especially in the rural areas (Heltberg, 1998; Fafchamps and Quisumbing, 1999) and hence, there is no evidence of separability and rural households are the producers as well as consumers of farm produce simultaneously.

Several studies have investigated the involvement and role of rural women in crop activities (Qadri and Jahan, 1982; Mumtaz, 1993; Saghir et al., 2005; Jamali, 2009), meeting food requirement of family (ESCAP, 1997), participation in decision making in agriculture (Atta, 2000; Rasheed, 2004), inequality in resource access (Sen, 2001; Chaudhry et al., 2009), linkages between agrarian change and gender relations (Mackenzie, 1990; Carney, 1992; Francis, 1998; Kabeer and Tran, 2000) and; effect of human capital on productivity and labor allocation of rural household and tested existence of imperfect labor and factor markets as a by-product (Fafchamps and Quisumbing, 1999). To the best of our knowledge no study has examined the labor supply responses of male and female of farm-households in Pakistan under the assumption of non-separability. The purpose of this study is to fill this gap and to make contribution to scarce empirical literature by investigating the effects of education, family caste, and infrastructure on the allocation of labor between own-farm, non-farm and agri-wage activities of farm households based on gender by using the shadow wages.

The rest of the paper is organized as follows. In section two, the theoretical framework is presented. In section three, description of the survey area and data set are provided. In section four, estimation strategy and empirical results are reported. Finally, some concluding remarks are given in section five.

3.2 Background and Conceptual Framework

3.2.1 Household Model of Labor Allocation

To investigate the labor supply behavior of farm household based on gender, we present basic household model of labor allocation below. We draw upon the economic theory of farm household based on the work of Singh et al. (1986); Bardhan and udry (1999), empirical studies of household resource allocation based on the work of Abdulai and Delgado (1999); Heltberg et al. (2000), income diversification in developing countries based on the work of Abdulai and CroleRees (2001), and the use of shadow wages and labor supply of agricultural household based on the work of Jacoby(1993); Skoufias (1994); Abdulai and Regmi (2000); Linde-Rahr (2001); and Le (2009).

Household model of labor allocation assumes here that rural household consists of two income earners- the head of household and his or her spouse, and allocation of family labor is across: agriculture, non-farm, home production and leisure. The household's leisure is the difference between the total stock of potential labor supply and the sum of hours worked in agriculture, domestic and non-farm activities. Consumption is the sum of income derived from agriculture, non-farm activities and other sources like livestock, transfers etc. Given this, the household utility function is given as:

$$U_{Max} = U(C, N_i; Z) \qquad i = 1, Male, i = 2, Female \qquad (1)$$

where U is the household utility function which is assumed to be strictly concave and possesses continuous second partial derivatives (Abdulai and Delgado, 1999). N_i is the leisure hours for male and female labor, C is the set of consumption of goods and services, and Z is the individual and household characteristics.

Household faces constraints like time, budget, non-negative, and production function constraints.

Household's time constraint is given as:

$$L_i = L_{iA} + L_{iNF} + L_{iD} + N_i \qquad (2)$$

where L_i is the sum of household labor allocated to agricultural (L_{iA}), non-farm (L_{iNF}), home production (L_{iD}) and leisure (N_i)

Household also faces non-negative, production function and budget constraints:

$$L_{iA} \geq 0, \quad L_{iNF} \geq 0, \quad L_{iD} \geq 0 \tag{3}$$

$$Q = Q(L_{iA}, H_i, X, Z, \theta, A, S, V) \tag{4}$$

$$Y_{iA} + Y_{iNF} + Y_{iD} + Y_{iO} - P_X X = P_C C \tag{5}$$

Putting value of Q from equation 4, the equation 5 can be written as:

$$P_C C = PQ(L_{iA}, H_i, X, Z, \theta, A, S, V) - P_X X - W_H H_i + WL_{iNF} + W_D L_{iD} + Y_{iO} \tag{6}$$

where $Y_{iA} / Y_{iNF} / Y_{iD} / Y_{iO}$ represents income from agriculture, non-farm, home production, and other sources respectively for male and female members of household, P_x represents vector of prices of variable inputs, P_c represents vector of prices of purchased goods, P represents vector of Farm output prices, H_i represents amount of hired male and female labor, W_H represents wage paid to hired labor, W represents non-farm wage, W_D represents wages of home production, θ represents production shocks (climatic risks, economic fluctuations), A represents fixed assets of the household (land etc.), S represents vector of social/cultural constraints, V represents village level characteristics such as distance, infrastructure etc., X represents vector of purchased inputs and Q represents quantity of agricultural production.

The Lagrangian of the household's maximization problem is:

$$\int = U(C, N_i; Z) + \lambda (L - L_{iA} - L_{iNF} - L_{iD} - N_i) + \varphi \begin{bmatrix} PQ\ (L_{iA}, H_i, X, Z, \theta, A, S, V) - P_X X \\ -W_H H_i + WL_{iNF} + W_D L_{iD} + Y_{i0} - P_C C \end{bmatrix} \tag{7}$$

where λ is the Lagrangian multiplier associated with the inequality constraints on each type of labor participation (i.e. male and female labor participation), φ is the Lagrangian multiplier associated with income inequality constraint. The Lagrangian function ($\int$) is maximized with respect to L_{iA}, L_{iNF}, L_{iD} H_i, X, λ, φ for maximizing the utility (U) across gender of household members as shown below:

$$\partial \int / \partial L_{iA} = -\lambda + \varphi p \frac{\partial Q}{\partial L_{iA}} = 0 \tag{7.1}$$

$$\partial \int / \partial L_{iNF} = -\lambda + \varphi W = 0 \tag{7.2}$$

$$\partial \int / \partial L_{iD} = -\lambda + \varphi p \frac{\partial Q}{\partial L_{iD}} = 0 \tag{7.3}$$

$$\partial \int / \partial H_i = \varphi p \frac{\partial Q}{\partial H_i} - \varphi W_H = 0 \tag{7.4}$$

$$\partial \int / \partial X = \varphi p \frac{\partial Q}{\partial X} - \varphi p_X = 0 \tag{7.5}$$

$$\partial \int / \partial \lambda = L - L_{iA} - L_{iNF} - L_{iD} - N_i = 0 \tag{7.6}$$

$$\partial \int / \partial \varphi = PQ(L_{iA}, H_i, X, Z, \theta, A, S, V) - P_X X - W_H H_i - W L_{iNF} + W_D L_{iD} + Y_{i0} - P_C C = 0 \tag{7.7}$$

It is important to mention that the model above assumes that the markets are complete. Under this assumption, the production and consumption decisions of the household are separable. Under separability assumption, the value of marginal product of non-farm labor participation by gender is equated to an exogenously determined market wage (Singh et al., 1986). In many low-income countries where market for key factors and products typically is weak or absent in rural areas, usually separability does not exist and mostly farm households are both producers and consumers of agricultural goods.

If commodity and resource markets are incomplete and on farm and off-farm labor are imperfect substitute, thus shadow prices exist. De Janvry et al. (1991) showed that under non-separability, labor is allocated such that the marginal product of labor is equal to an endogenously determined shadow wage (w^*). Shadow prices will be the function of preferences and technology of household members if the household is both a producer and consumer of commodity. Thus, we introduce market failure in the model as a market labor constraint: $L_{iNF} \leq M$, where M is the maximum number of hours a farmer can work in the labor market. This type of failure is important particularly for the existing situations of Pakistan.

Given this development, maximization of Langrangian with respect to $N_i, H_i, L_{iA}, L_{iNF}, L_{iD}$, yields the following first order conditions for the optimal choices of the household;

$$\frac{\partial U / \partial N_i}{\partial U / \partial C} = w_i^* \tag{8}$$

$$\frac{\partial Y_{iA}}{\partial H_i} = W_H \tag{9}$$

$$W_i = \frac{\partial Q}{\partial L_{iA}} = \frac{\partial Q}{\partial L_{iNF}} = \frac{\partial Q}{\partial L_{iD}} = w_i^* \quad \text{if } L_{iNF} < M \tag{10}$$

$$W_i > \frac{\partial Q}{\partial L_{iA}} = \frac{\partial Q}{\partial L_{iNF}} = \frac{\partial Q}{\partial L_{iD}} = w_i^* \quad \text{if } L_{iNF} = M \tag{11}$$

The equilibrium condition (8) for household utility maximization implies that household will equate the marginal rate of substitution between consumption and leisure of family labor of type i and the "shadow wage rate" w_i^* of labor type i. Condition (9) states that hired labor will be utilized up to the point where the marginal product of hired labor of each gender is equal to the wage paid to hired labor. Also shadow wage is same as market wage (10), if labor market is complete and non-farm labor constraint is not binding. Shadow wage will be less than the non-farm wage (11), if labor market is incomplete and non-farm labor constraint is binding.

By using the shadow wage, the non-linear budget constraint can be replaced by an artificial linear constraint. The household maximization problem of equation (1) under the linear budget constraint can then be re-written as:

$$U_{Max} = U(C, N_i; Z) \qquad i = 1, Male, i = 2, Female \tag{12}$$

Subject to

$$P_C C + w_i^* N_i = Y_i^* \tag{13}$$

Where shadow income (Y^*) is written as:

$$Y_i^* = PQ(L_{iA}, H_i, X, Z, \theta, A, S, V) - P_X X - W_H H_i + w_i^* L_i(Z) + Y_{io} \tag{14}$$

Structural demand function for leisure and corresponding structural labor supply function are given as:

$$N_i^* = N_i(w_i^*, Y^*; Z) \tag{15}$$

$$T_i^* = T_i(w_i^*, Y^*; Z) \tag{16}$$

where T_i^* is the total hours of work of family members of gender i in agricultural, non-farm and other activities.

$$T_i^* = L_i - N_i^* = L_{iD}^* + L_{iA}^* + L_{iNF}^* \quad if\ L_{iNF}^* > 0 \tag{17}$$

$$T_i^* = L_i - N_i^* = L_{iD}^* + L_{iA}^* \quad if\ L_{iNF}^* = 0 \tag{18}$$

3.3 Data Description

Data for this study was collected between September 2010 and January 2011 through a cross-sectional survey of rural households in the Punjab province of Pakistan. Punjab province is the country's most populous region, constitutes 56 percent of Pakistan's total population. Due to its largest rural society, this province was selected for data collection. There is no large-scale redistribution of agricultural land and asymmetry exists in land ownership. As a result most rural areas are dominated by a small set of land-owning families which has always contributed the most to the national economy of Pakistan. Agriculture share of Pakistan's GDP has historically ranged from 51.8 to 54.7 percent. It is especially dominant in the service and agriculture sectors of the Pakistan economy. Its contribution ranges from 52.1 to 64.5 percent in the service sector and 56.1 to 61.5 percent in the agriculture sector. It is also major manpower contributor because it has the largest pool of professionals and highly skilled manpower (Pakistan encyclopedia, 2009). It has three broad agro-climatic zones named as lower, central and upper. Two districts from each zone were selected for survey. A stratified random sample of a total of 341 households was selected in each of six districts to ensure representation of all categories of households, which potentially influence the extent and nature of livelihood diversification.

Using a structured questionnaire, the households in the sample area were interviewed eliciting information on farm and non-farm activities as well as personal, demographic and locational characteristics. Information on agricultural activities includes farm size, crop output, price of output, expenditure on variable inputs, family and hired labor, capital assets, own consumption, sale of produce. Information on livestock activities includes the number of animals and poultry birds. Detailed time allocated to farm, non-farm, livestock and domestic work of family and hired labor differentiated by gender was fully obtained.

Table 3.1 includes the definitions and sample statistics of variables used in the analysis for male and female respondents. Total value of output is computed as the sum of value of all crops grown, income from the sale of animal byproducts and twenty percent of the value of the household's herd- an approach similar to work of Huffman (1976); Jacoby (1993); and Abdulai and Regmi (2000). The value of each crop is estimated by using village level median prices of the prices that farmers indicate their crops would currently fetch on the market. This avoids the problem of using the same set of prices for all farm.[1]The land variable is the total cropped area in acres during survey year, whether owned, rented or sharecropped. Detailed information on the variable physical inputs such as fertilizer, seed, and pesticide was also obtained. The use of values in place of quantities in the production function can lead to biased estimates if input price variation is substantial. Yet, taking this route seems preferable to ignoring these inputs altogether and suffering an omitted variables problem. Number of farm equipments, dummy variable for whether or not livestock is reared and locational dummies for the six districts of Punjab Pakistan, are also included in the production function.

The study is concerning to the household-headship and level of education of household head since the head of the household is considered to be the person mainly responsible for the decision-making of the household. The level of education may indicate productivity potential for both farm and non-farm sector (Behrman and Wolf, 1984). Age is used as a measure of experience that increases the marginal value of time in each activity.

The farm labor is divided into four categories as seen in Table 3.2: family male labor; family female labor; hired male labor; hired female labor. The use of family labor is high (62%) as compared to hired labor (38%) in the sample.

[1] As argued by Bardhan (1979), if farmers face the same prices and the true production possibility frontier is concave, rather than linear, crop composition cannot be allowed to vary across farms, since farmers are assumed to have the same technology. However, if crop composition is variable in the sample, movements along a given production possibility frontier will be construed as shifts in the value of output.

Table 3.1: Definition and descriptive statistics of the variables used in production

Variable	Definition of variables	Mean	S.d
Dependent variables			
OutPutValue	Total output value in Rupees	1654011	6598264
Explanatory variables			
TCultiLand	Total cultivated land in acres	19.93	41.35
FertiCost	Expenditures on fertilizer(rs)	6584.33	8288.42
SeedCost	Expenditures on seed(rs)	7202.84	9626.00
PestCost	Expenditures on pesticide(rs)	3901.95	4325.17
Equipments	Number of farm equipments	4.34	4.56
HrsFmale	Total hours of family male labor worked on farm	97.25	135.94
HrsFfemale	Total hours of family female labor worked on farm	43.36	95.79
HrsHmale	Total hours of hired male labor worked on farm	139.20	184.20
HrsHfemale	Total hours of hired female labor worked on farm	82.06	104.77
HrsChildlab	Total hours of farm child labor (family and hired)	9.54	24.78
Head	1if Head of HH is male,0 otherwise	0.74	0.44
HeadEdu	Years of education of HH head	2.12	1.18
AgeHead	Age of education of HH head (years)	48.47	11.54
Livstk	1 if HH has livestock, 0 otherwise	0.83	0.38
Location1	1 if HH resides in Lahore district, 0 otherwise	0.15	0.36
Location2	1 if HH resides in Sahiwal district, 0 otherwise	0.20	0.40
Location3	1 if HH resides in M.Garh district, 0 otherwise	0.30	0.46
Location4	1 if HH resides in Layyah district, 0 otherwise	0.02	0.13
Location5	1 if HH resides in Sialkot district, 0 otherwise	0.25	0.43
Location6	1 if HH resides in Khushab district,0 otherwise	0.08	0.27
Instruments			
M0CasWa	Average village daily wage rate of male	272.23	74.21
F0CasWa	Average village daily wage rate of female	156.95	76.64
Dis0vill	Distance of village from city in km	18.05	12.69
Road	1 if village has road, 0 otherwise	0.67	0.47
Water0supp	1 if village has water supply, 0 otherwise	0.85	0.35
Electricity	1 if village has electricity, 0 otherwise	0.99	0.09
HHSizOvr14	No. of adult household members	4.99	2.76
AdultFarm	No. of adults working on farm	1.83	1.62
Ch0L05	No. Of children under age of 5 years	1.01	1.41
Child14	No.Of children between age 6-14 years	6.25	6.46

[a] wages are noted in Rupees (2010).

3.4 Empirical Approach

The estimation in the present study proceeds in two steps. The first step is to estimate the marginal productivity of family male and female labor through production function analysis. The estimated marginal productivity of family male and female labor (shadow wage) and shadow income are then used in the second stage to estimate the male and female labor supply functions.[2]

3.4.1 Estimation of Shadow Wages and Shadow Income

3.4.1.1 Production Function Analysis

The estimation of technological relationship between output and input that lies at the very heart of economic analysis is usually carried out by production function with family male and female labor hours and hired male and female labor hours specified as heterogeneous inputs. However, a typical example of production function in literature is Cobb-Douglas and Translog production functions. Despite the well known limitation, the Cobb-Douglas production form is used in this study because more flexible functional forms such as the translog production function was initially estimated which yielded results that were inconclusive. Specifically, most of the coefficients of the inputs were not statistically significant, while some of the coefficients turned out to be negative, contrary to prior expectation.

The Cobb-Douglas production form has the advantage of being easily interpreted in economic term and has achieved widespread empirical support from data of various industries, including agriculture and for various countries (See also Heady and Dillon, 1961).

Thus a typical Cobb-Douglas production function is specified as:

$$\ln Y_i = \sum_j \alpha_j \ln X_{ij} + \sum_k \beta k \; D_{ik} + \varepsilon_i \qquad (19)$$

Where Y_i represents the total value of agricultural output of farm household i. X_{ij} is the quantity of input j used by farmer i, D_k is the location dummies that represents some locational-specific characteristics such as topography and temperature, which effect output but not observable to an econometrician. α and β are input intensity parameters that represent

[2] The approach of Jacoby (1993); Abduali and Regmi (2000) are followed in this study.

the elasticities of output with respect to the individual inputs. ε_i is the error term summarizing the effects of omitted variables.

The variable inputs in the vector X_{ij} includes cropped area, value of fertilizer, value of seed, value of pesticide, number of farm equipments, hours of family male labor, hours of family female labor, hours of hired male labor, hours of hired female labor, hours of total child labor (family and hired), dummy variable representing the presence of livestock for farm household, gender of household head which assumes that household head ,whether male or female, is the primary decision maker on the family farm, age and education level of household head as a proxies of management inputs. In the regression all the explanatory variables are in logarithmic except dummies for household headship, livestock and vector of age and education level of household head. The variables measured in monetary terms such as value of output, fertilizer, seed and pesticide were divided by village-specific price indexes used as measures of the price of the composite agricultural commodity consumed and produced.

To keep the estimation manageable in the presence of zero values in most of the variable inputs, the logarithmic transformation was carried out by adding one to the inputs $(i.e., \ln X_{ij} = \ln(X_{ij} + 1))$.

3.4.1.2 Shadow Wage Estimation

We follow the approach of Jacoby (1993) and Skoufias (1994), laterally applied as standard approach in the literature to estimate the shadow wage and the labor supply function under market failures (Lambert and Magnac 1994; Sonoda and Maruyama 1999; Abdulai and Regmin 2000; Seshan 2006). These authors found that the shadow wage is identical to the marginal product of labor (MPL) on the farm regardless of market failures. Based on this concept, we calculated the shadow wage rate of labor (MPL) from the instrumental variable (IV) estimates of Cobb-Douglas production function in Table 3.2, using the expressions:

$$W_m^* = \frac{\hat{Y}}{F_m}\hat{\alpha}_m \qquad \boldsymbol{W_f^* = \frac{\hat{Y}}{F_f}\hat{\alpha}_f} \qquad (20)$$

Where $\hat{Y}$ is the predicted value of output based on the estimated coefficients α_j. The fitted output $\hat{Y}$ is used instead of real output Y since farmers make decisions when they do not know the random shocks and real output. F_m and F_f are the total hours of adult male and female

labor respectively. We obtained negative marginal product for some observations and have subsequently set these values equal to 1.[3]

3.4.1.3 Shadow Income Estimation

The estimates of the shadow income Y_i^* of the household is derived from the expression

$$Y_i^* = \hat{Y} + \prod + Y_{io} - W_m^* F_m - W_f^* F_f - W_h H_m - W_h H_f - W_L Liv - Fert - Pesti - Seed \quad (20)$$

where $\prod$ is the net return from sales of livestock products and non-farm income; Y_{io} is the unearned income such as rent of land, farm equipments and transfers received by households; W_m^*, W_f^* are shadow wages of male and female, $F_m and F_f$ are hours of adult male and female, W_h , W_L are the average village wage rate of labor and animal services respectively; $Fert, Pesti, Seed$ are expenditures on fertilizer, pesticide and seed respectively.

[3] Jacoby (1993) or Skoufias (1994) also found negative marginal product of labor. They then either dropped these observations or set the value to 1 to avoid negative shadow wages.

Table 3.2: Cobb-Douglas production function (dependent variable: log value of Output)

	OLS	IV [b]
Explanatory Variables	Coefficients	Coefficients
LogTCultiLand	0.46(2.05)	1.13(5.60)
LogFertiCost [a]	0.05(0.06)	1.86(3.34)
LogSeedCost [a]	0.46(0.59)	0.49(1.92)
LogPestCost [a]	-0.08(0.37)	1.03(2.20)
LogEquipments	0.56(1.79)	0.18(0.60)
LogHrsFmale [a]	0.07(0.72)	0.47(2.00)
LogHrsFfemale [a]	-0.09(0.90)	0.28(1.73)
LogHrsHmale a	0.26(1.90)	0.68(1.88)
LogHrsHfemale [a]	-0.13(1.08)	0.19(0.52)
LogHrsChild [a]	0.12(0.99)	0.14(0.35)
Head	1.18(2.42)	2.31(5.33)
HeadEdu	0.00(0.01)	0.02(0.10)
AgeHead	-0.02(1.27)	-0.02(1.06)
livstk	4.30(9.09)	4.40(8.87)
location1	-0.79(1.12)	-0.53(0.69)
location2	-2.27(3.41)	-2.64(3.91)
location3	-0.91(1.44)	-1.02(1.54)
location4	-1.29(0.95)	-1.82(1.32)
location5	0.40(0.63)	0.13(0.19)
constant	3.13(3.20)	3.06(2.70)
Adj R-squared	0.7105	0.6928
Male labor marginal product	2.73	0.89
Female labor marginal product	6.05	1.20
Number of observations	341	341

Note: [a] Variables considered endogenous in the instrumental variable estimation.
[b] Wu-Hausman statistics for the joint exogeneity test is 1.88 against a critical value of F(8, 312)=2.29 which is significant at 10 percent.
Value of t-statistics in parentheses.

3.4.2 Estimation of Own-farm, Non-farm and Agri-wage Labor Supply Functions

The estimated shadow wages and income in the first stage of analysis are used to calculate the labor supply of farm household in three major activities: own farm, non-farm and agri-wage. Thus our analysis is focused on the impacts of wages, income and other exogenous variables on the hours worked in three activities by male and female members. Since all households reported positive hours for male and female labor, we employed OLS technique for the estimation of labor supply function in the study.

For each household, the male and female labor supply variables are computed as the average annual hours spent by working on their own-farm, non-farm, and on the farm of others. Time spent on social ceremonies, religious activities, and other pure consumption activities, such as eating or sleeping are considered as leisure. The average daily worked hours are 8.1 for males and 14.1 for females, indicating that females spend more time in working than males. Particularly, males are more engaged in farm and non-farm activities and females are more involved in domestic and livestock activities. All the females reported positive hours for domestic work and almost 33.14% male spent no time on domestic work.

The empirical specification for the labor supplies of male (P_{im}^{*}) and female (P_{if}^{*}) in three activities $(i = own-farm, non-farm, agri-wage)$ is:

$$\ln P_{im}^{*} = \alpha_{m0} + \alpha_{m} \ln W_{m}^{*} + \alpha_{mf} \ln W_{f}^{*} + \alpha_{my} \ln Y^{*} + \alpha_{mz} Z_{m} + \mu_{m} \qquad (22)$$

$$\ln P_{if}^{*} = \alpha_{f0} + \alpha_{fm} \ln W_{m}^{*} + \alpha_{f} \ln W_{f}^{*} + \alpha_{fy} \ln Y^{*} + \alpha_{fz} Z_{f} + \mu_{f} \qquad (23)$$

where α 's are parameters to be estimated, $W_{m}^{*}, W_{f}^{*}, Y^{*}$ are described above, Z_{i} is the vector of individual and/or household specific characteristics such as age, education level, household composition, etc. affecting taste towards work and μ_{i} is the error term summarizing the effects of unobserved factors. The coefficients α_{m}, α_{f} provide estimates of own-wage elasticities for male and females, respectively. Since these are reflections of the usual opposing substitution and income effects, no prediction can be made about their sign. This is also the case for the coefficients α_{mf}, α_{fm} that provide estimates of cross wage elasticities. The Coefficients α_{my}, α_{fy} provide estimates of the income elasticities of male and female labor, respectively. If leisure is a normal good, higher levels of income would result in fewer hours

of work. Previous studies generally support this hypothesis although estimates have been inelastic (Jacoby, 1993; Skoufias, 1994).

3.4.3 Testing for Separability

Correct modeling of household production decisions require knowledge of whether a specific household is likely to behave according to separability or non-separability decision rules. For this reason, numerous tests of separability have been applied in empirical studies. In this section, the hypothesis of separability in agricultural household models was tested by applying three tests in order to gain further intuition into the efficient functioning of labor markets in rural Pakistan. The first test is based on the Benjamin (1992) test which focuses on the relationship between production decision and preferences of household, the second test is based on Jacoby (1993) test which testes the equality of market wage and shadow wage and the third is Le (2010) generalized test which combined both the Benjamin and the Jacoby tests into one relationship.

3.4.3.1 The Jacoby's Test for a Perfect Market Assumption

The hypothesis of equality between marginal products of labor and the market wages is tested in this section. Under the utility maximization assumption, a test for the equality of marginal products and the observed wages could shed some light on the presence of transaction costs or frictions in the rural labor market.

We therefore tested the hypothesis of equality between wages and estimated marginal productivity of labor by regressing the shadow wages on the observed market wages:

$$W_i^* = \alpha + \beta W_h + \varepsilon_i \qquad (24)$$

Where W_i^* is the estimated shadow wages of labor type $i = (m, f)$, W_h is the market wages of male and female, ε_i is the random term probably including measurement error.

Assuming there are no serious biases involved in the derivation of the marginal productivities of family labor from a Cobb-Douglas production function, the null hypothesis of the absence of any frictions in off-farm employment implies that $\alpha = 0 \; and \; \beta = 1$. This means that the allocation of time between farm and market is made purely on efficiency grounds by individuals in the sub-sample. The theory also implies that ε_i is independent of the taste for work.

3.4.3.2 The Benjamin's Test for Differing Efficiencies

Benjamin (1992) proposed a test that uses the relationship between production decisions and household preferences. This test focuses on the differing efficiencies issue of family and hired labor. The study approximates the shadow wages with the following linear regression:

$$LogL = \beta LogW^{*} + \gamma LogZ + (1-\alpha)\frac{H}{L} + \varepsilon \qquad (25)$$

Where L is the total hired and family labor, W* is the shadow wage, Z is household preferences, $\frac{H}{L}$ is the fraction of hired labor. The objective of perfect substitutability of family and hired labor is to test $(1-\alpha) = 0$.

3.4.3.3 The Le's Generalized Test

Both the Benjamin and Jacoby's tests use only one relationship; either between production decisions and preferences; or between shadow wages and market wages. It means both tests implied half of the information to test the separability and results of both tests are contradictory. This shortcoming was covered by Le's generalized test. He simultaneously studied both relationships in one relation to increase the power of test and to avoid possibility of contradictory results. In the present study we also applied the approach of Le's generalized test to test the separability in agricultural household model in the context of Pakistan.

The following regression is estimated for generalized test

$$LogPQ / L = \beta LogW + \gamma LogZ + \varepsilon \qquad (26)$$

The test for the separability model is whether $\beta = 1 and \gamma = 0$.

3.5 Results and Interpretations

3.5.1 The Production Function Estimates

The first column of the Table 3.2 represents OLS estimates of the coefficients of the production technology of the sample households. The results indicate that variable inputs have positive coefficients, while cropped area, equipments and livestock appears to be significantly important inputs in production function. Of the labor inputs, adult male labor contributes most to the output and contribution of teenagers and children appear to be relatively small.

But in the estimation of production function estimate, labor hours, fertilizer, seed and pesticide used are likely to be endogenous variables so the estimates from OLS could be biased. We address the endogeneity bias in this study by adopting an instrumental variable (IV) approach to estimate the Cobb–Douglas production function. The variables used as identifying instruments in the estimation are: male and female daily field wage; distance of village from city; dummies for the presence of road, water supply and electricity; adult household size; number of adults working on farm; and number of children less than 5 years and between 6-14 years as instruments. The value of the Wu–Hausman statistic as presented in Table 3.3 suggests that the instruments can be considered exogenous in the estimation.

The results of IV approach, in the second column of the Table 3.2, indicate that most of the inputs have significant positive effects on agricultural output. Livestock and land appears to be important inputs in the production process. We also found that fertilizer, seed and pesticide inputs lead to higher farm output in the study.

All the labor inputs have significant positive impact on the output except the hired female labor and child labor which do not significantly different from zero. The family male labor has a greater impact on output than family female labor, probably due to the fact that the activities such as ploughing, irrigation etc., which are undertaken by men, contribute more at the margin to output than activities such as weeding, picking and transplanting in which females are largely engaged. This finding is in line with the result of Jacoby (1992) and Abdulai and Regmi (2000), but is in contrast to the results reported by Skoufias (1994); Udry et al. (1995); and Thapa (2003).

The gender of household head has a positive and significant impact on agricultural output, indicating discrimination in the access to resources on gender basis. This support the findings of Thapa (2008) who indicated that male headed households have relatively better access to resources, particularly in access to new varieties of seeds, inorganic fertilizers, agricultural extension services, and farm credit. The coefficient of age is negative though not significant indicating that young farmers use new technologies to increase production as compared to old farmers. Education of household head has positive effect on agricultural output, confirming the widely accepted role of human capital towards improving farmer's efficiency (Abdulai and Huffman, 2000; Abdulai and Regmin 2000; Barrett et al., 2008).

3.5.2 The Labor Supply Functions Estimates

The variables in W_m^*, W_f^*, Y^* are correlated with μ_i so labor supply functions are estimated by using instrumental variable approach to obtain consistent estimates. The complete set of instruments used are: individual characteristics such as age and age squared, level of education; non-labor income; saving; own land; zonal dummies; and all the instruments that are given in Table 3.2. Thus, in the first-stage, the shadow wage rates and shadow income are regressed on instrumental variables. In the second stage, the predicted values from these regressions are used to estimate the labor supply function employing OLS. The value of the Wu–Hausman statistic given in Table 3.4 suggests that the instruments can be considered exogenous in the estimation.

Estimation of the labor supply functions requires deleting some variables that are used in the first stage regression to allow for the identification of models and variables left out, therefore serve as identifying instruments. Male and female daily field wages; distance of village from city; dummies for the presence of road, water supply and electricity; number of adults working on farm and non-labor income served as identifying instruments. The Wald test statistics χ^2_{10} for the joint significance of these variables for male and female shadow wage equations are 27.20 and 35.20 respectively which are significant at 1 % level as against a critical value of $\chi^2_{(10,0.01)} = 23.21$. The corresponding figure for the shadow income equation is 235.40, also against a critical value of $\chi^2_{(10,0.01)} = 23.21$. The joint significance of these variables in the first stage regressions suggests that the instruments do enter in the first stage estimation and are therefore appropriate instruments (Staiger and Stock, 1997).

In order to account for any potential heteroskedasticity induced by the two-stage procedure of using estimated shadow wages and income as well as for heteroskedasticity possibly present across households, the Breusch–Pagan test was employed. The computed Breusch–Pagan test values χ^2_{16} 85.63, 262.10, 291.42 for males and 562.12, 424.11, 179.85 for females in own farm, nonfarm and agri-wage work respectively, are above the critical value of 32.00 at the 1% level, suggesting the presence of heteroskedasticity. In order to account for the heteroskedasticity, the t-statistics reported are based on the standard errors calculated from White's (White, 1980) formula that accounts for nonparametric forms of heteroskedasticity.

To test the exogeneity of the set of instruments, the value of Wu–Hausman statistics given in the Table 3.3 suggests that the instruments can be considered exogenous in the labor supply functions. The joint hypothesis that all non-intercept coefficients in the labor supply models are zero, are tested with the Wald statistics. The sample values of the Wald statistics are 10.89, 5.69, 4.78 for male and 4.26, 4.19, 2.84 for female labor supply functions in three sectors, with a critical value $F(16,324)=2.75$, thus rejecting the null hypothesis which is significant at 1 % level.

Table 3.3 also displays parameter estimates of the male and female labor supply functions. Starting with the estimates for males, the uncompensated own-wage effect is negative in the case of own-farm and agri-wage work, suggesting a backward sloping labor supply. It means that the income effect dominates the substitution effect. Similarly, Rosenzweig (1980) noticed negative own wage effect of male household labor supply. In the case of non-farm work, own wage effect is positive, suggesting upward sloping labor supply. The negative own-wage elasticity for female confirmed the findings of Skoufias (1994) and are in contrast to Killinsgworth and Heckman (1986); Jacoby (1993); and Abdulai and Regmi (2000).

The cross male wage effect on the non-farm and agri-wage labor supply of females is negative and significant in the case of non-farm, indicating that female labor supply is quite sensitive to any change in the male wage. This is presumably due in part to the reallocation of time by females from income generating to non income generating personal matters such as funerals and weddings. It suggests that male and female leisure are gross substitutes in terms of utility and indicates that studies that restrict such cross-wage effects to be zero may result in specification errors. The cross female wage effect on the labor supply of male is positive, but not significant, indicating that males are not much sensitive to reduce their labor supply even when females earn more from income generating activities.

The coefficient of shadow income is significant and negative for both males and females in all three sectors, indicating that both male and female leisure are normal goods. This finding is in line with the results obtained by Jacoby (1993) for Peru; Skoufias (1994) for India; and Abduali and Regime (2000) for Nepal.

Household composition and characteristics seem to matter as well on the labor supply of both male and female. The presence of working age men and women in the household which is an indicator of non-nuclearity of household, tends to increase the labor supply of both male

and female in own-farm and non-farm. These results are in contrast to the study of Barrett et al. (2008) and are in line with the study of Abdauli and Regime (2000) in the case of male labor supply. The presence of young children (<5 years) in the household impedes the labor supply of female in own-farm and non-farm sector, particularly significant effect in the case of non-farm work. So caring for young children appears to be compatible with farm and non-farm work in rural areas of Pakistan. This result is in line with the findings of Rosenzweig (1980); Evenson et al. (1980); Sahn and Alderman (1988); Skoufias (1994); and Abduali and Delgado (1999). With regard to the age of household-head which also represents experience, we found that labor supply in the agriculture sector increases with experience and decreases in non-farm sector, although the effect is not statistically significantly different from zero for both groups of households.

Turning to the variables of interest in this article viz the education level of household members; family caste; village infrastructure, we found that investment in human capital significantly decreases the labor supply of household on own-farm and agri-wage activities. This reflects the lack of response of agricultural wages to human capital in South Asia as noted by Kurosaki and Khan (2006); Ito and Kurosaki (2009) and disgrace of working as an agricultural laborer in rural areas (Ito and Kurosaki, 2009). Once villagers are educated, they are reluctant to perform manual agricultural work for themselves and especially for others. The positive coefficient of education in non-farm work indicates that individual who has more schooling, spend a great proportion of his working hours in non-farm work. Thus, education was found to be a better positioned to mobilize capital through high returning non-farm work. High return work often requires a specific level of schooling and therefore individuals who have attained less than that are excluded from particular better-paid activities (Abdulai and Delagado, 1999; Davis, 2003). Most activities in non-farm work like service sector or running a small business require a certain level of education or skill and serve as important criteria regarding the allocation of scarce non-farm employment (Bucherrieder, 2005). In other words illiteracy serves as an entry barrier into high returning activities. Thus, education improves individual's ability to allocate resources in response to changing economic conditions. It is a powerful source that leads labor out of agriculture and shifts it into high returning non-farm sector (Timmer, 1988).

Looking at the role of family castes (with the middle castes as the reference group), we found that male labor supply from upper castes decreases in own-farm and agri-wage activities and increases in non-farm sector. Caste is traditionally hereditary social grouping

which has great influence in Pakistan. This class stratification is closely related to income inequalities and distribution of land ownership. Indeed, the caste system is clearly constraining efforts of members of lower castes to improve living conditions. Males from upper castes are more resourceful person so they employ hired labor or lease their land to tenants in order to release themselves from manual agricultural work. We found that female labor supply decreases in non-farm and agri-wage work as we move up to the caste category. There are cultural and social barriers that prevent women from entering and remaining in the labor force. They are not allowed to go outside for work and confined to only household duties which are considered honorable for them. These findings show that caste plays a pivotal role in minimizing the liberty of female. Labor supply increases for agri-wage work for lower castes males and females. This is probably due to the fact that lower castes do face difficulty in non-farm employment in the sense they face high transaction costs associated with entry into labor market. These results are consistent with the findings of Ito and Kurosaki (2009); and Ito (2009) for India.

Presence of small scale industry (factory or mill) as indicator of village infrastructure is associated with higher amount of non-farm labor, indicating that males and females are significantly less geographically mobile. Good state of infrastructure reduces transaction cost and increases efficiency with which rural labor and financial markets channel inputs into high yielding activities by declining cost of information and transport.

Table 3.3: Instrumental variable estimates of male and labor supply functions using shadow wages and income (dependent variable: log average annual hours of male and female in own-farm, non-farm and agri-wage work)

Variables	Own-Farm		Non-Farm		Agri-Wage	
	Male	Female	Male	Female	Male	Female
Log male swage	-1.184(3.24)	0.097(0.27)	0.583(0.59)	-1.568(1.93)	-1.404(1.93)	-0.345(1.02)
Log fem swage	0.059(0.19)	-1.106(3.57)	0.397(0.43)	-0.769(1.00)	0.911(1.41)	0.404(1.51)
Log s income	-0.916(3.77)	-2.072(5.62)	-1.244(1.63)	-0.979(1.52)	-1.788(2.81)	-0.708(2.50)
No. ofadults>14	0.106(1.67)	0.014(1.70)	0.500 (2.53)	0.314(1.86)	-0.009(0.05)	-0.086(1.12)
No. of child<5	0.057(0.61)	-0.013(0.10)	0.418(1.61)	-0.368(1.86)	0.581(2.07)	0.012(0.10)
No of Child 5-14	-0.020(0.94)	0.037(1.77)	-0.006(0.12)	0.009(0.17)	-0.045(0.75)	0.010(0.45)
Age of Head	0.007(0.63)	0.012(0.86)	-0.028(0.82)	-0.000(0.00)	0.019(0.57)	0.033(1.59)
Location1	-0.657(1.35)	0.589(0.59)	5.009(2.72)	6.071(3.44)	3.572(2.47)	0.094(0.15)
Location2	-0.799(1.67)	-1.202(2.24)	1.802(1.37)	2.236(2.44)	1.018(0.93)	-0.129(0.21)
Location3	-1.251(2.99)	-1.114(2.25)	1.114(1.04)	2.286(3.27)	-1.632(1.87)	-0.437(0.80)
Location4	0.524(0.71)	1.051(1.41)	-0.089(0.05)	1.880 (1.32)	-3.131(2.16)	0.049(0.07)
Location5	-0.156(0.34)	0.496(0.98)	0.228(0.22)	1.063(1.74)	0.232(0.25)	0.961(1.63)
Education	-0.127(1.69)	-0.058(1.86)	1.098(3.18)	0.099(0.69)	-0.229(1.82)	-0.041(2.62)
Upper caste	-0.640(2.52)	0.648(1.79)	1.255(1.69)	-1.85(1.95)	-0.709(1.89)	-0.209(1.87)
Lower caste	-0.718(1.94)	0.337(0.91)	0.425(0.44)	-1.569(1.50)	2.939(2.35)	1.809(2.32)
Factory/mil	-0.405(1.67)	-0.095(0.25)	1.763(2.19)	1.386(1.90)	-0.268(0.48)	-0.028(0.07)
cons	13.268(4.80)	25.038(5.97)	13.647(1.58)	-10.190(1.43)	22.175(3.14)	11.034(3.09)
Adj R-squared	0.2637	0.1161	0.1776	0.1005	0.1543	0.0770
Wu-Hausman [a]	13.13	5.62	1.86	4.01	1.42	0.45
Breusch-Pagan [b]	85.63	562.13	262.10	424.11	291.42	179.85
Wald-Statistics[c]	10.89	4.26	5.69	4.19	4.78	2.84

[a] Wu-Hausman test for exogeneity of the set of instruments against a critical value of F(3,286)=32.00 at α= 0.01.

[b] Breusch–Pagan test for homoskedasticity(critical value=32.00 at 1%).

[c] Wald statistics for the joint significance of the non-intercept exogenous variables against a critical value of F(16,324)=2.75at 1% significance level.

Value of t-statistics in parentheses.

3.5.3 The Separability Test's Estimates

3.5.3.1 The Benjamin's Test Estimates

The results of estimation of Benjamin test by OLS and instrumental variable estimation are presented in Table 3.4. Column 1 shows the results of OLS estimation. Coefficients on the number of adult male and fraction of hired labor are significant while the coefficient on the number of adult females is not. Column 2 reports the results of instrumental variable estimation. In this specification, the coefficients on all three labor variables are significant, strongly rejecting the separation hypothesis. Compared with OLS, the results show that the coefficients on the number of adult male, adult female and fraction of hired labor increase in absolute values.

Table 3.4: The Benjamin test (dependent variable: log farm labor)

	OLS	IV
Explanatory Variables	Coefficients	Coefficients
Log Wage	-0.372(28.24)	-0.184(3.79)
Log Land	0.123(3.31)	-0.004(0.06)
Log Fertilizer Cost	0.083(0.62)	-0.273(1.11)
Log Sowing Cost	0.164(1.25)	0.768(3.21)
Log Pesticide Cost	-0.092(2.04)	-0.052(0.63)
Log Equipments	-0.089(1.75)	-0.011(0.09)
Adult Male	0.045(2.16)	-0.072(1.78)
Adult Female	0.011(0.42)	0.076(1.67)
Log Fraction of Hired Labor	-0.082(2.84)	-0.099(1.82)
Livestock	0.703(8.14)	-0.151(1.05)
Age of HH head	-0.003(0.97)	0.001(0.22)
Education of HH head	0.008(0.36)	-0.017(0.40)
Location1	0.066(0.57)	0.258(1.22)
Location2	-0.223(2.02)	-0.141(0.66)
Location3	-0.006(0.06)	-0.039(0.20)
Location4	-0.276(1.22)	-0.278(0.63)
Location5	0.086(0.82)	-0.032(0.16)
Constant	1.721(10.21)	1.302(4.17)

Value of t-statistics in parentheses.

3.5.3.2 The Jacoby's Test Estimates

The result of Jacoby's test is presented in Table 3.5. In order to account for the potential presence of measurement error in the reported individual wage rates, instrumental variable estimation is also reported in Table 3.5. The value of F-Statistics for both the OLS and IV strategies rejected the assumption of perfect market in this sample of Pakistani farmers. It showed that market imperfections are responsible for the inequality between marginal product and market wage. This finding supported the conclusion of Jacoby (1993); Skoufias (1994); Abdulai and Regmi (2000); and Le (2009).

Table 3.5: Tests of the equality of estimated marginal products and market wages received by market participants [a] (dependent variable: shadow wage)

	$\hat{\alpha}$	$\hat{\beta}$	R^2	*F-test* [b]
Males (n=337)				
OLS	-2.32(-17.07)	0.15(3.44)	0.0341	11.84
IV	-1.17(-2.68)	-0.41(-1.96)	0.0114	3.85
Females (n=341)				
OLS	-1.58(-14.99)	0.29(4.39)	0.0544	19.28
IV	-1.85(-11.92)	0.60(3.83)	0.0420	14.68

[a] Value of t-statistics in parentheses.
[b] Value of F-statistics under null hypothesis Ho : $\hat{\alpha} = 0$ and $\hat{\beta} = 1$ .The 5% critical value is 3.

3.5.3.3 The Le's Generalized Test Estimates

The results of Le (2010) test are presented in Table 3.6. Column 1 reports the OLS estimates. The coefficient of wage is significantly different from 1 but coefficients of preference shifters are not significant. The results of instrumental variable are in the 2nd column, with the same instruments that are used in Jacoby's test. The coefficient of wage is significantly different from 1 and coefficients of preference shifters are significant. All tests strongly rejected the separability hypothesis, indicating the dependence of production and consumption decisions of rural households in Pakistan.

Table 3.6: The Le's generalized test (dependent variable: log (value of output/farm labor))

	OLS	IV
Explanatory Variables	Coefficients	Coefficients
Log Wage	0.461(5.93)	0.276(1.68)
Log Land	0.266(1.21)	0.412(1.79)
Log Fertilizer Cost	-0.165(0.21)	0.327(0.40)
Log Sowing Cost	0.596(0.77)	- 0.189(0.23)
Log Pesticide Cost	0.087(0.33)	0.026(0.09)
Log Equipments	-0.716(2.37)	0.690(1.67)
Adult Male	0.065(0.53)	0.233(1.70)
Adult Female	-0.132(0.89)	-0.201(1.31)
Log Fraction of Hired Labor	-0.218(1.28)	0.223(1.70)
Livestock	3.378(6.62)	4.482(9.23)
Age of HH head	-0.011(0.68)	-0.015(0.93)
Education of HH head	0.064(0.45)	0.099(0.68)
Location1	-0.487(0.71)	-0.831(1.15)
Location2	-1.878(2.87)	-2.033(2.84)
Location3	-0.872(1.41)	-0.888(1.31)
Location4	-0.953(0.71)	-1.139(0.76)
Location5	0.307(0.49)	0.417(0.62)
Constant	1.52(1.52)	2.036(1.93)

Value of t-statistics in parentheses.

3.6 Concluding Remarks

Shadow wages and shadow income are important variables for estimating the labor supply of rural household of developing countries, particularly where wage data is not available and markets are imperfect or weak. This article estimated own-farm, non-farm and agri-wage labor supply of rural households under the assumption of non-separability between the production and consumption decisions of households. Estimate proceeded in two steps. At first step the marginal productivity of family male and female labor is estimated through production function analysis. The estimated shadow wage and shadow income are then used

in the second stage to estimate the male and female labor supply functions. We analyzed how the household adjusts its decision on labor supply in response to change in economic conditions. A better understanding of how male and female members of household allocate their time between own-farm, non-farm, agri-wage sector in response to changes in economic conditions may be crucial for designing policy for the welfare of individuals. Results indicate that education can be a powerful source for rural Pakistani households that lead labor out of agriculture and shift into high returning non-farm sector. Caste plays an important role in overthrowing the autonomy of female. Socially backward castes have higher constraints to enter in non-farm sector in the sense they face higher transaction costs. The proximity of physical infrastructure, like factory or small scale industry in village can enables households to engage in high returning activities.

We applied three tests for separation hypothesis to the sample of Pakistani rural households, one test is based on the Benjamin (1992) test which focused on the relationship between production decision and preferences of household, the second test is based on Jacoby (1993) test which tested the equality of market wage and shadow wage and the third one is Le (2010) generalized test which combined both the Benjamin test and the Jacoby test into one relationship. Our analysis provides strong evidence against the perfect labor market hypothesis in Pakistan. This stands in contrast to Benjamin (1992) but agree with other empirical work (Jacoby, 1993; Skoufias, 1994; Abdulai and Regmi, 2000; Le, 2010).

3.7 References

Abdulai, A. and CroleRees, A. (2001). Determinants of income diversification among rural households in Southern Mali, *Food Policy* 26, 437–452.

Abdulai, A. and Delgado, C. L. (1999). Determinants of time spent in non-farm employment by farmers in Northern Ghana, *American Journal of Agricultural Economics* 81,117–130.

Abdulai, A. and Huffman, W. E. (2000). Structural adjustment and efficiency of rice farmers in Northern Ghana, *Economic Development and Cultural Change* 48, 503–520.

Abdulai, A. and Regmi, P. P. (2000). Estimating labor supply of farm households under nonseparability: Empirical evidence from Nepal, *American Journal of Agricultural Economics* 22, 309–320.

Atta, N. (2000). Involvement of rural females in decision making process in Faisalabad, M.Sc. Rural Sociology Thesis, University of Agriculture, Faisalabad, Pakistan.

Bardhan, P. and Udry, C. (1999). *Development Microeconomics*. Oxford University Press, Oxford.

Bardhan, P. K. (1979). Wages and employment in a poor agrarian economy: a theoretical and empirical analysis, *Journal of Political Economics* 87, 479–500.

Barnum, H. N. and Squire, L. (1979). An econometric application of the theory of the farm-households, *Journal of Development Economics* 6, 79–102.

Barrett, C., Sherlund, S. and Adesina, A. (2008). Shadow wages, allocative inefficiency, and labor supply in smallholder agriculture, *Agricultural Economics* 38, 21–34.

Behrman, J. R. and Wolf, B. L. (1984). Labor force participation and earnings determinants for women in the special conditions of developing countries, *Journal of Development Economics* 15, 259–288.

Benjamin, D. (1992). Household composition, labour market, and labour demand: testing for separation in household models, *Econometrica* 60, 287–322.

Buchenrieder, G. (2005). Non-farm rural employment – review of issues, evidence and policies, *Quarterly Journal of International Agriculture* 44, 3–18.

Carney, J. (1992). Peasant women and economic transformation in the Gambia, *Development and Change* 23, 67–90.

Chaudhry, I. S. and Rahman, S. (2009). The impact of gender inequality in education on rural poverty in Pakistan: An empirical analysis, *European Journal of Economics, Finance and Administrative Sciences* 15, 174–188.

Davis, J. R. (2003). The rural non-farm economy, livelihoods and their diversification: Issues and options. NRI Report No. 2753. Natural Resources Institute.

De Janvry, A., Fafchamps, M. and Sadoulet, E. (1991). Peasant household behavior with missing markets: some paradoxes explained, *The Economic Journal* 101, 1400–1417.

Elahi, A. (2006). Compendium on gender statistics in Pakistan. Federal Bureau of Statistics, Statistics Division, Government of Pakistan.

ESCAP. (1997). Women in Pakistan: A Country Profile. United Nations, New York.

Evenson, R. E., Popkin, B. M. and King-Quizon, E. (1980). Nutrition, Work, and Demographic Behavior in Rural Philippine Households: A Synopsis of Several Laguna Household Studies. In: Binswanger H P, Evenson R E, Florencio C A, White B N F (eds) *Rural Household Studies in Asia*. Singapore University Press, Singapore.

Fafchamps, M. and Quisumbing, A. R. (1999). Human capital, productivity and labor allocation in rural Pakistan, *The Journal of Human Resources* 34, 369–406.

FAO. (2009). Gender, Equity and Rural Employment Division. Rome: Food and Agriculture Organization of the United Nations.

Francis, E. (1998). Gender and rural livelihoods in Kenya, *Journal of Development Studies* 35, 72–95.

Heady, E. O. and Dillon, J. L. (1961). *Agricultural Production Functions*. Ames: The Lowa State University Press.

Heltberg, R. (1998). Rural market imperfections and the farm size-productivity relationship: Evidence from Pakistan, *Journal of Development Economics* 26, 1807–1826.

Heltberg, R., Arndt, C. and Sekhar, N. U. (2000). Fuel wood consumption and forest degradation: A household model for domestic energy substitution in rural India, *Land Economics* 76, 213–32.

Huffman, W. E. (1976). The productive value of human time in US agriculture, *American Journal of Agricultural Economics* 58, 672–683.

ICA-ILO. (2001). Gender Issues in Cooperatives: An ICA-ILO Perspective.

Ito, T. (2009). Caste discrimination and transaction costs in the labor market: Evidence from rural North India, *Journal of Development Economics* 88, 292–300.

Ito, T. and Kurosaki, T. (2009). Weather risk, wages in kind, and the off-farm labor supply of agriculltural households in a developing country, *American Journal of Agricultural Economics* 91, 697–710.

Jacoby, H. G. (1992). Productivity of men and women and the sexual division of labor in peasant agriculture of the Peruvian Sierra, *Journal of Development Economics* 37, 265–287.

Jacoby, H. G. (1993). Shadow wages and peasant family labor supply: An econometric application to the Peruvian Sierra, *Review of Economics Studies* 6, 903–21.

Jamali, k. (2009). The role of rural women in agriculture and it's allied fields: A case study of Pakistan, *European Journal of Social Sciences* 7, 71–77.

Kabeer, N. and Tran, T. V. A. (2000). Leaving the rice fields but not the countryside: Gender livelihood diversification and pro-poor growth in rural Vietnam. Occasional Paper 13, 01-52. United Nations Research Institute for Social Development (UNRISD), Geneva, Switzerland.

Killingsworth, M. and Heckman, J. (1986). *Female Labor Supply: A Survey*. In: Ashenfelter O, Layard R. (eds*)* Handbook of Labor Economics. North-Holland Publishing Co, New York.

Kurosaki, T. and Khan, H. (2006). Human capital, productivity, and stratification in rural Pakistan, *Review of Development Economics* 10, 116–134.

Lambert, S. and Magnac, T. (1994). Measurement of implicit prices of family labor in agriculture: An application to Cote d'Ivoire. 1n: Caillavet G, Lifran (eds) *Agricultural Household Modeling and Family Economic,* PP. 9-24. Elsevier Press, Amsterdam.

Le, K. (2009). Shadow wages and shadow income in farmer's labor supply functions, *American journal of Agricultural Economics* 91, 685–696.

Le, K. (2010). Separation hypothesis tests in the agricultural household model, *American Journal of Agricultural Economics* 92, 1420–1431.

Linde-Rahr, M. (2001). Rural shadow Wages, labor supply and agricultural production under imperfect markets: Empirical evidence from Viet Nam. American Agricultural Economics Association. Annual meeting Chicago, IL, August 5-8, 2001.

Mackenzie, F. (1990). Gender and land rights in Murang'a district, Kenya, *Journal of Peasant Studies* 7, 609–643.

Mies, M. (1987). Indian women in subsistence and agricultural labour, *Vistaar, New Delhi*.

Mollel, N. M. and Mtenga, N. A. (2001). Gender roles in the household and farming systems of techenzema, Morogoro-Tanzania, *South African Journal of Agricultural Extension* 29, 73–88.

Mumtaz, K. (1993). Gender Issues in Agriculture and Rural Development Policy in Asia. FAO Study. Part 111. PP. 87.

Nazir, S. (2009). The International Day of Rural Women: Reaching Out to the Rural Women of Pakistan. United Methodist Women.

Pakistan Encyclopedia. (2009). http://en.wikipedia.org/wiki/Pakistan.

Qadri, S. M. A. and M. K. Jehan. (1982). Women in Agriculture Sector in Sindh, Studies on rural women in Sindh, Women's Division Cabinet Secretariat, Government of Pakistan, Islamabad.

Rasheed, S. (2004). Women participation in decision making process regarding agricultural business and family matters: A case study in Tehsil Gojra, M.Sc Rural Sociology Thesis, University of Agriculture, Faisalabad, Pakistan.

Rosenzweig, M. R. (1980). Neoclassical theory and the optimizing peasant: An econometric analysis of market family labor supply in a developing country, *Quarterly Journal of Economics* 94, 31–55.

Saghir, A., Zakaria, M., Hassan, Y. and Javed, A. (2005). Gender participation in crop production activities, *Journal of Agriculture and Social Sciences* 1, 343–345.

Sahn, D. E. and Alderman, H. (1988). The effects of human capital on wages and the determinants of labor supply in a developing country, *Journal of Development Economics* 29, 157–83.

Sen, A. (2001). Improving Gender Equality in Pakistan: Small Steps to Date, Large Strides Ahead. The new Republic.

Seshan, G. (2006). The impact of trade liberalization on household welfare in a developing country. Working paper, University of Virginia.

Singh, I., Squire, L. and Strauss, J. (1986). The basic model: theory, empirical results and policy conclusions. In: Singh I, Squire L, Strauss J (eds) *Agricultural Households Models*. Johns Hopkins University Press, Baltimore.

Skoufias, E. (1994). Using shadow wages to estimate labor supply of agriculture households, *American Journal of Agricultural Economics* 76, 215–227.

Sonoda, T. and Maruyama, Y. (1999). Effect of the internal wage on output supply: A structural estimation for Japanese rice farmers, *American Journal of Agricultural Economics* 81, 131–43.

Staiger, D. and Stock, J. H. (1997). Instrumental variables regression with weak instruments, *Econometrica* 65, 557–86.

Stark, O. (1991). *The Migration of Labor*. Blackwell, Cambridge, MA.

Taylor, J. E. and Martin, P. L. (2001). Human Capital: Migration and Rural Population Change. In: Rausser G, Gardner B (eds.). *Handbook of Agricultural Economics*. Elsevier, New York.

Thapa, S. (2003). Estimation of the agricultural household labour supply: A case from Mardi qatershed area, Kaski, Nepal, M.Sc. Development and Resource Economics Thesis, Department Economics and Social Science, Agricultural University of Norway.

Thapa, S. (2008). Gender differentials in agricultural productivity: Evidence from Nepalese household data. MPRA Paper No. 13722, 16-15.

Timmer, P. (1988). The Agricultural Transformation. In: Chenery, H, Srinivasan T N (eds) *The Handbook of Development Economics* 1. North Holland Press, Amsterdam.

Tockle, J. G. and Huffman, W. E. (1991). Local economic conditions and wage labor decisions of farm and rural non-farm couples, *American Journal of Agricultural Economics* 73, 652–70.

Udry, C., Hoddinott, J., Alderman, H. and Haddad, L. (1995). Gender differentials in farm productivity: Implications for household efficiency and agricultural policy, *Food Policy* 20, 407–423.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and direct test for heteroskedasticity, *Econometrica* 48, 817–83.

Chapter 4

Non-farm employment and household welfare: A gender based analysis of rural households in Pakistan

This paper was presented at the second conference of the Italian Association of Agricultural and Applied Economics (AIEAA) in Parma, Italy, June 6th -7th, 2013.

Abstract

This article examines the impact of non-farm work on household welfare, differentiated by female, for rural households in the Punjab province of Pakistan. We employ an endogenous switching regression approach that accounts for selection bias due to observable and unobservable factors to examine the factors that influence the household's decision to participate in non-farm work and the impact of participation on household welfare. Given that we find no substantial selection bias on unobservable factors, we also use PSM approach to check the robustness of our results from the ESR estimates. Separate estimates are also provided for male and female to address gender heterogeneity. The empirical results reveal that participation in non-farm work significantly increases the per head expenditures and reduces the household poverty level. This confirms the potential role of non-farm work in improving rural household welfare and poverty alleviation in rural areas of developing countries.

Keywords: non-farm work, household welfare, impact assessment, endogenous switching regression, propensity score matching, Pakistan

4.1 Introduction

In developing countries, most of the poor live in rural areas and majority of it engage in agricultural related activities. The agricultural sector plays a primal role in providing employment opportunities. This sector, however, has been contending with a number of factors, for example, the small size of landholdings, insufficient capital and investment incentives, the inadequate farm infrastructure, limited markets, and stagnant prices of agricultural products, which have limited its further potential for generating new jobs in rural areas. So there is need to focus on other sector of rural economy, not just on agriculture. The development of various non-farm activities has been generally recognized to have a potential in raising employment opportunities and stimulating the growth of rural economies. The important share of income is derived from non-farm activities. Haggblade et al. (2010), for instance, report that non-farm income contributed 35-50 percent of rural household income across the developing world.

Given the significance of the non-farm in contributing to household welfare, many studies have explained the determinants of participation in non-farm work (e.g., Abdulai and Delgado, 1998; Ellis, 2000; Abdulai and CroleRees, 2001; Barrett et al., 2001). These studies generally highlight the entry barriers to participation in non-farm work and policy measures to promote non-farm activities in the rural area. However, very few have analyzed the impact of participation in non-farm work on household welfare (e.g., Lanjouw, 2001; Chang and Mishra, 2008; Owusu et al, 2011). The studies that have examined the welfare impacts either analyzed correlations rather than causal effects (e.g., Lanjouw, 2001) or did not account for selectivity bias that may occur as a result of unobservable factors (Owusu et al., 2011). From an econometric standpoint, analyzing the welfare impact of non-farm work may be affected by unobserved factors such as the innate technical abilities, the types of social networks households belong to, as well as transaction costs that can be incurred as a result of poor access to markets because of infrastructure constraints. Failure to distinguish between the causal effect of participation and the effect of unobserved heterogeneity could lead to biased estimates and misleading policy implications.

The present study examines the impact of participation in non-farm work on household welfare. It specifically employs endogenous switching regression approach to account for selectivity bias, and to capture the impact of participation on the welfare of participants and non-participants in non-farm work. Thus, the approach allows us to analyze the determinants of participation in non-farm work, as well as the impact of the participation

decision on household welfare. The study utilizes cross-sectional rural household level data collected in 2010 from a randomly selected sample of 341 households in Punjab province of Pakistan. Separate estimates are provided for males and females in order to capture the differential impacts of non-farm work on gender. The knowledge and information generated from the study could be essential in promoting growth in the non-farm sector.

The rest of the paper is organized as follows: In the next section, a description of the data used in the analysis is provided. In section three, overview of the significance of non-farm sector in Pakistan is described. The conceptual framework and estimation strategy are presented in section four. The empirical results are reported in section five, while the final section presents conclusions and implications.

4.2 Significance of Non-farm Sector in Pakistan

Among the South Asian countries, Pakistan is a lower middle income country. Nearly two thirds of the population and 80 percent of the country's poor people are concentrated in the rural parts of the country. Major economic activities in these areas are related directly or indirectly to the agriculture sector, but at present this sector has limited margins for landless poor due to many limiting factors. The major limiting factor in rural areas of Pakistan is the skewed distribution of land ownership. As Anwar et al., (2004) reported that in rural areas of Pakistan, 67 percent households were landless and just 0.1 percent households possessed 1 hectare and above landholdings. Moreover, the fast growing rural labor force cannot be much absorbed in the almost employment overcrowded agriculture sector.

As the result of class stratification, increasing landlessness of small farmers, and population growth, non-farm sector in Pakistan is expanding. This sector in Pakistan, like in many other developing countries, is a heterogeneous sector covering a wide spectrum of activities. Generally, it includes all activities in the rural economy that are not pursued on farms. It is of great importance to rural economies for its productive and employment effects. Almost 45-50 percent of the rural population in Pakistan is directly dependent on non-farm income. Contribution of this sector is also critical to food security, poverty alleviation, farm sector competitiveness and productivity. It offers agricultural services and products to the food and fiber system. These products are critical to the dynamics of agriculture (GOP, 2011).

Despite the critical role of the rural non-farm sector in food security, poverty alleviation, farm sector competitiveness and productivity, this sector has received inadequate attention in the debate in Pakistan (Malik, 2008). There is need to focus on the non-farm

sector while designing poverty alleviation strategies for rural areas of Pakistan where vicious land-labor ratio limit income earnings opportunities in agriculture.

4.3 Data Description

Data for this study was collected between September 2010 and January 2011 through a cross sectional survey of rural households in Punjab province which is the country's most populous region, constitutes 56 percent of Pakistan's total population. Due to its largest rural society, that province was selected for data collection. There was no large-scale redistribution of agricultural land and asymmetry exists in land ownership. As a result most rural areas are dominated by a small set of land-owning families. It has always contributed the most to the national economy of Pakistan. Its share of Pakistan's GDP was 54.7 percent in 2000 and increased to 59 percent in 2010. It is especially dominant in the service and agriculture sectors of the Pakistan economy. Its contribution is ranging from 52.1 to 64.5 percent in the service sector and 56.1 to 61.5 percent in the agriculture sector. It is also major manpower contributor because it has largest pool of professionals and highly skilled manpower (Pakistan encyclopedia, 2012). It has three broad agro-climatic zones named as lower, central and upper. Two districts from each zone were selected for survey. A stratified random sample of a total of 341 households was selected in each of six districts to ensure representation of all categories of households, which potentially influence the extent and nature of livelihood diversification.

Using a structured questionnaire, these households were interviewed eliciting information on farm and non-farm activities as well as personal, demographic and locational characteristics. Information on agriculture activities included farm size, crop output, price of output, expenditure on variable inputs, family and hired labor, capital assets, own consumption, sale of produce, access to credit. Information on livestock activities included number of animals and poultry birds. Detailed information on the consumption expenditure was fully recorded.

The dependent variable used in the study is a dummy variable that takes the value of one, if the household participated in non-farm work, and the value zero, if no participation was recorded. The outcome variables used in this study are per head expenditure and headcount index as an indicator of household poverty status. The consumption expenditure components include expenditures on food, tobacco, clothing, energy, livestock, health, education, social activities (marriages, deaths, etc.), recreation and other household

expenditures over the last year. Headcount index was calculated on the basis of per capita expenditures. Purchasing power parity (PPP) poverty line used in this study is 1.25$ per day per person suggested by World Bank (2008) for Pakistan. Poverty outcome was measured as a binary variable. Since gender plays an important role in the poverty dynamics in Pakistan, the gender stratification was used in the estimation.

The independent variables used in the estimations were based on past research on determinants of participation in non-farm employment (Abdulai and Delgado, 1999; Barrett et al., 2001; Owusu et al., 2011). These variables include household characteristics such as gender of household head, age to capture experience, and education of the household head to present productivity potential, presence of children, household size, household assets (land, livestock) to indicate wealth, access to credit to capture liquidity constraints, village infrastructure development project (road, factory/mill), distance of household from retail shop to indicate employment opportunities, and location characteristics to capture community fixed effects.

Tables 4.1 and 4.2 present the descriptive statistics of variable used in estimations and difference in the characteristics of participants and non-participants with their t-values for males and females, respectively. The observed mean difference of 0.50 in the effects of treatment for males (0.59) and females (0.09) is statistically significant at 1% level indicating the presence of gender heterogeneous treatment effects. The difference in the rate of participation between males and females reflects the fact that males in the area are more engaged in non-farm activities, while females are predominantly engaged in household activities. There are cultural and social barriers that prevent women from entering and remaining in the labor force. They are not allowed to go outside for work and confined to only household duties are considered honorable for them. Also presented in the Tables 4.1 and 4.2 are differences in means of the variables used in the estimations for both male and female participants, alongside their significance levels. The significance levels suggest that there are some differences between participants and non-participants with respect to household and farm-level characteristics.

With regards to the outcome variables, there appear to be statistically significant differences in per head expenditures and poverty level of household between participants and non-participants. Poverty appeared to be lower and per head expenditures was higher among non-farm participants than non-participants for both male and female. When estimating poverty using monetary measures, one may have a choice between using income or

consumption as the indicator of wellbeing. Most analysts argue that, provided the information on consumption obtained from a household survey is detailed enough, consumption will be a better indicator of poverty measurement than income (Coudouel et al., 2002). Head count index is used as indicator of poverty. It is the share of the population living in household whose consumption is below the poverty line.

We found a significant difference in term of education level of household head. Higher level of education of household head among participants in non-farm work indicates that, education was found to be a better positioned to mobilize capital through high returning non-farm work. In other words illiteracy serves as an entry barrier into high returning and less risky activities. There is also significant difference between the female participants and non-participants with respect to access to credit. 41 % of participants and 24 % of non-participants have access to credit, while the corresponding figures for males were 26 % and 24 % respectively; revealing the fact that limited access to credit for households is an entry barrier to their non-farm work participation.

Household composition and characteristics seem to matter for participants and non-participants. Participants have more working age members as compared to non-participants for both male and female. The presence of young children (<5 years) in the household impede the probability of participation of female. So caring for young children appears to be compatible with non-farm work in rural areas of Pakistan. In particular, there appear to be differences in the ownership of land and livestock. Non-participants have higher acreage of land and more number of livestock than participants.

Table 4.1: Descriptive statistics of variables used in estimation for males

Variable	Description	Participants N=202 (59.24%)		Non-participants N=139 (40.76%)		Diff.in Mean
		Mean	S.d	Mean	S.d	
PerHExp	Per head expenditures (Rupees)	99738.11	289855.2	72494.24	78173.28	27243.86*
Headcount	Head count index	0.35	0 .48	0 .40	0 .49	- 0.04*
AgeHead	Age of the HH head in years	49.63	0.82	46.77	0.95	2.86**
Age2Head	Square of head age	2490.28	1215.56	2286.22	1098.84	204.07*
HeadEdu	Years of education of HH head	2.39	1.24	1.73	0.97	0.66***
HHSizOvr14	No.of HH members < 14 years	5.49	2.72	4.25	2.67	1.23***
Ch0L05	No. of children >5 year of age	1.04	1.45	0.95	1.35	0.09
Child14	No. of children b/w age 6-14 years	6.02	6.78	6.58	5.96	-0.57
Livstk	1 if HH has livestock,0 otherwise	0.78	0.41	0.88	0.32	-0.98**
TLand	Total cultivated land in acres	18.81	42.58	21.54	39.57	-2.74
Credit	1 if HH takes credit, 0 otherwise	0.26	0.44	0.24	0.42	0.03*
DProg	1 if village dev. prog, 0 otherwise	0.22	0.42	-0.47	0.72	0.69
M0CasW	Village cash wages of male (Rs)	266.36	70.75	280.76	78.44	-14.39*
Location1	1 if Lahore district, 0 otherwise	0.14	0.35	0.15	0.36	
Location2	1 if Sahiwal district ,0 otherwise	0.23	0.42	0.14	0.35	
Location3	1 if M.Garh district ,0 otherwise	0.32	0.46	0.26	0.44	
Location4	1 if layyah district, 0 otherwise	0.03	0.17	0.00	0.00	
Location5	1 if Sialkot district,0 otherwise	0.20	0.41	0.32	0.46	
Location6	1 if Khushab district,0 otherwise	0.06	0.23	0.12	0.32	
DRShop	Distance of HH to retail shop (km)	0.72	0.45	0.82	0.39	-0.09**

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.
For poverty calculations Purchasing Power Parity (PPP) US$ 1.25 per person per day is used as poverty line.

Table 4.2: Descriptive statistics of variables used in estimation for females

Variable	Description	Participants		Non-participants		Diff. in Means
		N=32 (9.38%)		N=309 (90.61%)		
		Mean	S.d	Mean	S.d	
PerHExp	Per head expenditures (Rupees)	85552.33	203701.3	64742.62	54142.19	20809.71**
Headcount	Head count index	0.38	0.49	0.41	0.50	-0.03*
AgeHead	Age of the HH head in years	53	8.64	47.99	11.71	5.00**
Age2Head	Square of head age	2455.13	966.93	2402.13	1192.49	52.99*
HeadEdu	Years of education of HH head	2.41	1.41	2.09	1.15	-0.32*
HHSizOvr14	No.of HH members < 14 years	6.75	2.16	4.81	2.76	1.94***
Ch0L05	No. of children > 5 year of age	0.75	0.92	1.03	1.45	-0.28*
Child14	No. of children b/w age 6-14 years	5.13	5.96	6.37	6.51	-1.24
Livstk	1 if HH has livestock,0 otherwise	0.68	0.47	0.84	0.36	-0.15**
TLand	Total cultivated land in acres	10.62	11.92	20.89	43.16	-10.27*
Credit	1 if HH takes credit, 0 otherwise	0.41	0.49	0.24	0.43	0.17**
DProg	1 if village dev. prog, 0 otherwise	0.44	0.51	0.38	0.49	0.06
F0CasW	Village cash wages of female (Rs)	138.59	74.17	158.85	76.75	20.26
Location1	1 if Lahore district, 0 otherwise	0.18	0.39	0.15	0.36	
Location2	1 if Sahiwal district, 0 otherwise	0.15	0.37	0.20	0.40	
Location3	1 if M.Garh district, 0 otherwise	0.41	0.49	0.29	0.45	
Location4	1 if layyah district, 0 otherwise	0.03	0.17	0.02	0.13	
Location5	1 if Sialkot district, 0 otherwise	0.19	0.39	0.26	0.44	
Location6	1 if Khushab district, 0 otherwise	0.03	0.17	0.09	0.29	
DRShop	Distance of HH to retail shop (km)	0.75	0.44	0.76	0.43	-0.01

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.
For poverty calculations Purchasing Power Parity (PPP) US$ 1.25 per person per day is used as poverty line.

Although the comparison in Table 4.1 and 4.2 do reveal some significant differences between participants and non-participants, however mean differences do not account for the effect of other characteristics of rural households and cannot be taken as evidence for the specific effects of participation. Multivariate approaches that account for selection bias arising from the fact that participants and non-participants may be systematically different, are essential in providing sound estimates of the impact of participation on per head expenditure and poverty level of household.

4.4 Conceptual Framework and Estimation Strategy

In this section, we introduce the conceptual framework and estimation method. To derive the relationship between participation in non-farm work and household welfare, we start with a standard time allocation model. Consider a farmer who maximizes utility defined over consumption of goods C and leisure N, and a vector of preference shifters Z (e.g., number of adults and number of children), $U(C,N;Z)$, subject to a budget constraint $C = pY + wm$, where p is the price of farm output (Y). The budget constraint suggests that the farmer earns income from working on his farm (L_F) to receive farm output (Y) and working in the non-farm labor market (L_{NF}) to earn the market wage (w). The sum of the labor supply ($L = L_F + L_{NF}$) and leisure (N) is the total time (T) available, $T = L + N$, where T could be 24 hours a day. The technology of farm production is represented by a twice differentiable, concave production function, $Y(L_F, F, X; Z)$, where F is a vector of fixed factors such as land, X represents variable inputs such as hired labor and fertilizer. The household maximization problem outlined above can be summarized as follows

$$\max U\ (pY(L_F, F, X; Z) + wm,\ T - L; Z) \qquad (1)$$

The first order condition for optimal time allocation for farm, non-farm and leisure activities is given as:

$$\partial U / \partial L_i = W_i \partial U / \partial C - \partial U / \partial L = 0 \qquad (2)$$

Equation (2) can be rearranged to obtain the returns to labor from farm work and non-farm work: $w_i = (\partial U / \partial L) / (\partial U / (\partial Q))$. As shown in Huffman (1991), a positive number of non-farm hours will be observed for an individual i, if the potential market wage (w_i^m) is greater than the reservation wage (w_i^r).[4] The labor supply functions can then be derived as $L_i = L_i(w_i, P_i; Z)$ for cases where farm households allocate their time to the three activities.

Following the empirical literature on non-farm work decisions of farm households, it is assumed that the participation decision of the individual is influence by a comparison

[4] The reservation wage for non-farm work is the marginal value of the individual's time when all of it is allocated to farm and leisure.

between the reservation wage (W_i^r) and the potential market wage (W_i^m) in the non-farm sector. Participation in non-farm activities $(L_i = 1)$ occur if $W_i^m > W_i^r$ and positive number of non-farm hours will not be observed $(L_i = 0)$ if $W_i^m \leq W_i^r$. However, these differential wages are not observable, but we do observe the decision of participation. Given that we do observe participation or non-participation, Huffman and Lange (1989) note that an index function can be specified with an unobserved variable (L_i^*), such that

$$L_i^* = \alpha X_i' + \mu_i$$

$$L_i = 1 \quad if \ L_i^* > 0 \tag{10}$$

$$L_i = 0 \quad if \ L_i^* \leq 0$$

where (X_i') is a vector of individual and household characteristics and (μ_i) is an error term.

In order to estimate the relationship between participation in non-farm work and household per head expenditures and poverty level, we start with a linear function

$$Y_i = \beta Z_i' + \gamma L_i + \varepsilon_i \tag{11}$$

where (Y_i) is per head expenditure and poverty level of household, (L_i) is dummy variable representing participation in non-farm sector, (Z_i') is individual, household and locational characteristics, (ε_i) is random error term.

4.4.1 Empirical Impact Evaluation Challenges

In non-randomized trial, estimation of the impact of non-farm work on the welfare of household is very substantial because there is need of information on the counterfactual situation had they not had participated in non-farm work. In randomized experimental studies, information on counterfactual situation is provided by randomly assigning households to treatment and control status, where the welfare outcome observed on the non-participants are statistically representative of what would have occurred without participation for participants.

Moreover, in non-randomized trials, households are not randomly distributed to the two groups (participants and non-participants), rather participation in non-farm activities may be dependent on the benefits from participation. Therefore, participants and non-participants may

be systematically different. Thus, selection bias occurs if unobserved factors influence both the error term (μ_i) of the participation equation (10) and the error term (ε_i) of the outcome equation (11), thus resulting the correlation of the error terms. The implication of this is that the use of standard regression techniques (ordinary least square (OLS) to estimate the parameters of the equation would result in biased and inconsistent estimates.

Some authors have employed the Heckman selection method or instrumental variable approach (IV) but these two methods are quite restrictive and assume that outcome function would differ only by unobservable factors (constant term) between the participating and non-participating households in the non-farm work. According to Heckman et al., (1997), it is likely that the differences between two individuals with or without exposure to program or technology may be more systematic even after conditioning on unobservable or observable factors. So in this study, we employ endogenous switching regression approach to examine the factors that influence the household's decision to participate in non-farm work and the impact of participation on household welfare measures such as per capita expenditure and poverty levels. As we found no endogenous, therefore we also employed the propensity matching approach to further examine the impact of participation on household welfare, and to also check the robustness of our findings from the endogenous switching regression model.

4.4.2 Endogenous Switching Regression Model

We specify the binary decision choice of household to participate in non-farm work conditioned on observed covariates as:

$$L_i^* = \alpha X_i' + \mu_i$$

$$L_i = 1 \quad if \ L_i^* > 0 \qquad (12)$$

$$L_i = 0 \quad if \ L_i^* \leq 0$$

To account for selection biases we adopt an endogenous switching regression model of welfare outcomes, (i.e. per head expenditure and poverty level) where households face two regimes (1) to participate, and (2) not to participate defined as follows:

$$Y_{1i} = \beta_1 Z_i' + \gamma_1 L_{1i} + \varepsilon_{1i} \qquad (13a)$$

$$Y_{2i} = \beta_2 Z_i' + \gamma_2 L_{2i} + \varepsilon_{2i} \qquad (13b)$$

where Y_i is per head expenditure and poverty level of participant and non-participant household (regimes 1 and 2), Z_i represent a vector of exogenous variables representing individual, household and village level information which thought to influence outcome function. γ_1 , γ_2 are parameters to be estimated and ε_1 , ε_2 are error terms.

Finally, the error terms are assumed to have a trivariate normal distribution, with zero mean and non-singular covariance matrix expressed as:

$$\operatorname{cov}(\mu_i, \varepsilon_1, \varepsilon_2) = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{1\mu} \\ \sigma_{12} & \sigma_2^2 & \sigma_{2\mu} \\ \sigma_{1\mu} & \sigma_{2\mu} & \sigma^2 \end{bmatrix} \tag{14}$$

where $\sigma_1^2 = \operatorname{var}(\varepsilon_1); \sigma_2^2 = \operatorname{var}(\varepsilon_2); \sigma^2 = \operatorname{var}(\mu_1); \sigma_{12} = \operatorname{cov}(\varepsilon_1, \varepsilon_2); \sigma_{1\mu} = \operatorname{cov}(\varepsilon_1, \mu_i);; \sigma_{2\mu} = \operatorname{cov}(\varepsilon_2, \mu_i);$

σ^2 represents variance of the error term in the selection equation and σ_1^2 , σ_2^2 represent variance of the error term in the outcome equations.

According to Maddala (1983), when there are unobservable factors associated with selection bias, the important implication of the error structure is that because the error term (μ_i) of the selection equation (12) is correlated with the error terms $(\varepsilon_1 , \varepsilon_2)$ of the welfare outcome functions (13a) and (13b), the expected values of ε_{1i} , ε_{2i} conditional on the sample selection are non-zero:

$$E(\varepsilon_{1i} | L_i = 1) = E(\varepsilon_{1i} | \mu_i > -X_i'\alpha) = \sigma_{1\mu}\left[\frac{\phi(X_i'\alpha/\sigma)}{\Phi(X_i'\alpha/\sigma)}\right] \equiv \alpha_{1\mu}\lambda_1 \tag{15a}$$

$$E(\varepsilon_{2i} | L_i = 0) = E(\varepsilon_{2i} | \mu_i \leq -X_i'\alpha) = \sigma_{2\mu}\left[\frac{-\phi(X_i'\alpha/\sigma)}{1-\Phi(X_i'\alpha/\sigma)}\right] \equiv \alpha_{2\mu}\lambda_2 \tag{15b}$$

where ϕ and Φ are the probability density and cumulative distribution functions of the standard normal distribution, respectively. The ratio of ϕ and Φ evaluated at $\alpha X_i'$,represented by λ_1 and λ_2 in equations (15a) and (15b) is referred to as the inverse mills ratio (IMR) which denotes selection bias terms.

Previous studies have used a two-stage method to estimate the endogenous switching model. (e.g Lee, 1978; Feder et al., 1990; Fuglie and Bosch, 1995; Freemanet al., 1998). In the first stage, a probit model of the criterion equation is estimated and the inverse Mills ratios

λ_1 and λ_2 are derived according to definitions in equations (15a) and (15b). In the second stage, these predicted variables are added to the appropriate equation in (13a) and (13b) respectively to yield following sets of equations:

$$Y_{1i} = \beta_1 Z_i' + \alpha_{1\mu}\lambda_1 + \gamma_1 L_{1i} + \upsilon_1 \quad (16a)$$

$$Y_{2i} = \beta_2 Z_i' + \alpha_{2\mu}\lambda_2 + \gamma_2 L_{2i} + \upsilon_2 \quad (16b)$$

The coefficients of the variables λ_1 and λ_2 provide estimates of the covariance terms $\alpha_{1\mu}$ and $\alpha_{2\mu}$, respectively. Since the variables λ_1 and λ_2 have been estimated, however, the residuals υ_1 and υ_2 cannot be used to calculate the standard errors of the two-stage estimates. While Lee (1978) suggested a procedure to derive consistent standard errors most especially for the two stage approach, Maddala (1983) argue that such procedure require potentially cumbersome and complicated process which most studies using the earlier two stage approach failed to implement. Thus, in the present study, a single stage approach where Full-Information Maximum Likelihood (FIML) method proposed by Lokshin and Sajaia (2004) using the movestay command in the statistical software STATA is employed for the empirical analysis. The FIML simultaneously fit the selection (i.e., equation 12) and outcomes (i.e., equation 13a and 13b) equations in order to yield consistent standard errors, thus, making λ_1 and λ_2 in equations 16a and 16b, respectively homoskedastic.

The FIML's log likelihood Function for switching regression model employed in this study proposed by Lokshin and Sajaia (2004) is described below:

$$\ln L_i = \sum_{i=1}^{N} \left\{ \begin{array}{l} L_i w_i \left[\ln F\left(\dfrac{(X_i'\alpha + \rho_{1\mu}(Y_{1i} - Z_{1i}'\beta/\alpha_1}{\sqrt{1-\rho_{1\mu}^2}}\right) + \ln(f((Y_{1i} - Z_{1i}'\beta/\alpha_1)\right] \\ + (1-L_i) w_i \left[\dfrac{\ln(1 - F(X_i'\alpha + \rho_{2\mu}(Y_{2i} - Z_{2i}\beta)/\gamma_2)}{\sqrt{1-\rho_{2\mu}^2}}\right) \\ + \ln(f((Y_{2i} - Z_{2i}\beta)/\gamma_2)\right] \end{array} \right\} \quad (17)$$

The signs of the correlation coefficients $\rho_{1\mu}$ and $\rho_{2\mu}$ have economic interpretations (Fuglie and Bosch 1995). If $\rho_{1\mu}$ and $\rho_{2\mu}$ have alternate signs, then individuals participate in non-farm work on the basis of their comparative advantage: those who participated have above average returns from participation and those who choose not to participate have above-

average returns from non-participation. On the other hand, if the coefficients have the same sign, it indicates hierarchical sorting: participants have above-average returns whether they participate or not, but they are better off participating, whereas non-participants have below-average returns in either case, but they are better off not participating.

The ATT of non-farm participation can be calculated as

$$ATT = E(Y_{1i} - Y_{2i} | L_i = 1) = Z_i'(\beta_1 - \beta_2) + (\sigma_{1\mu} - \sigma_{2\mu})\lambda_1 \quad (18)$$

In equation 18, $E(Y_{1i} | L_i = 1) = Z_i'\beta_1 - \sigma_{1\mu}\lambda_1$ represents the expected outcome for households who participated, had they chose to participate in non-farm; $E(Y_{2i} | L_i = 1) = Z_i'\beta_2 - \sigma_{2\mu}\lambda_1$ represents the expected outcome for households who participated, had it been they chose not to participate in non-farm.

4.4.3 Propensity Score Matching

To examine the causal effect of non-farm participation on household per head expenditure and poverty level, propensity score matching technique was also used. The basic idea behind the propensity score is that we may reduce the bias if we compare outcomes of treated and control groups which are as similar as possible. It constructs a statistical comparison group by matching every individual observation of participants with an observation with similar characteristics from the group of non-participants. Thus, create the conditions of an experiment in which participants and non-participants are randomly assigned, allowing for the identification of a causal link between the non-farm participants and outcome variables.

The propensity score is the conditional probability of assigning a treatment, given pre-treatment characteristics (Rosenbaum and Rubin, 1983), written as:

$$P(X_i) = \Pr(L_i = 1 | X_i) = E(L_i | X_i) \quad (19)$$

Where $L = \{0,1\}$ is the indicator of exposure to treatment (non-farm participation) and *X* is the vector of pre-treatment characteristics.

The parameter of interest is the Average Treatment Effect on the Treated (ATT), which can be estimated as:

$$\begin{aligned} ATT &= E\left\{E\left[Y_i^1 - Y_i^0 | L_i = 1, P(X_i)\right]\right\} \\ &= E\left\{E\left[Y_i^1 | L_i = 1, P(X_i)\right] - E\left[Y_i^0 | L_i = 0, P(X_i)\right] | L_i = 1\right\} \end{aligned} \quad (20)$$

Where Y_i^1 and Y_i^0 are the potential outcome in two counterfactual situations. The propensity score is predicted with probit model. The predicted propensity score is then used to estimate treatment effect.

Conceptually the ATT requires a mean for the unobservable counterfactual, $E\left[Y_i^0 | L_i = 1\right]$ so for the observable quantities in equation (20) to identify the ATT relies on three key conditions introduced into the literature by Rosenbaum and Rubin (1983). First is the "unconfoundedness" $(Y_i^0, Y_i^1 \perp L_i | X_i)$ where $\perp$ denotes independence. According to this, potential outcomes are independent of participation, conditional on the observable covariates, X_i. Given observable covariates, participating group is treated as random and any systematic differences in actual outcomes between participants and non-participants individuals with the same value of the covariates is attributed to the participation in non-farm work.

Second is the "common support" where all participated households have a counterpart in the non-participating group for each X_i for which we seek to make a comparison. This condition would appear to create a dimensionality problem when many covariates are matched on; for example, if X_i contains k covariates which are all dichotomous the number of possible matches will be 2^k. However, the propensity score reduces the dimensionality of the matching problem because it is possible to match on $P(X_i)$ which is scalar, rather than on the vector of observable variables X_i. This use of $P(X_i)$ is valid so long as the "balancing" property $(prob(X_i | L_i = 1, P(X_i) = P) = prob(X_i | L_i = 0, P(X_i) = P))$ holds (Rosenbaum and Rubin, 1983). In other words, conditional on the propensity score, the means of the covariates should be identical across the treatment and control groups if the balancing property holds.

Since the propensity score is a continuous variable it is unlikely that there are two observations with exactly the same value of $P(X_i)$, so further refinement is needed to estimate equation (20). Various matching estimators have been suggested in the literature. Although all matching estimators normally yield same results but the choice of a matching approach could become important in small sample (Heckman et al., 1997). The most commonly used are nearest neighbor matching (NNM), kernel based matching (KBM), stratified matching, radius matching and Mahalanobis matching methods. The NNM, Radius and KBM methods are employed in this study.

The most straightforward matching estimator is nearest neighbor (NN) matching which matches each participant with its closest neighbor with similar observed characteristics. It can be done either with replacement or without replacement. Matching with replacement results in bias reduction since each treatment group can be matched to the nearest comparison group as a result of a reduction in the propensity score distance (Smith and Todd, 2005).

Kernel matching (KM) is non-parametric matching estimators that use weighted averages of all individuals in the control group to construct the counterfactual outcome. Kernel matching tends to use more non-participants for each participant, thereby reducing the variance but possibly increasing the bias. To avoid the risk of bad matches by choosing the closest neighbors that are far away, calipers are implemented. This involves imposing a tolerance on the maximum distance in the propensity score allowed. When applying KM one has to choose the kernel function and the bandwidth parameter. The kernel function appears to be relatively unimportant in practice (DiNardo and Tobias, 2001). As noted by Pagan and Ullah (1999) that more important is the choice of the bandwidth parameter with the following trade-off arising: High bandwidth-values yield a smoother estimated density function, therefore leading to a better fit and a decreasing variance between the estimated and the true underlying density function. On the other hand, underlying features may be smoothed away by a large bandwidth leading to a biased estimate. The bandwidth choice is therefore a compromise between a small variance and an unbiased estimate of the true density function.

In radius matching, each treated unit is matched only with the control unit whose propensity score falls in a predefined neighborhood of the propensity score of the treated unit. The benefit of this approach is that it uses only the number of comparison unit available within a predefined radius; thereby allowing for use of extra units when good matches are available and fewer when they are not. One possible drawback is the difficulty of knowing a priori what radius is reasonable (Dehija and Wahba, 2002).

The matching quality depends on the ability of the matching procedure to balance the relevant covariates. The standardized bias approach proposed by Rosenbaum and Rubin (1985) is used to quantify the bias between treated and control groups. Sianesi (2004) has also proposed a comparison of the pseudo-R^2 and p-values of the likelihood ratio test of the joint significance of all the regressors obtained from the probit analysis before and after matching the samples. To ensure that there are no systematic differences in the distribution of the covariates between both groups, the pseudo-R^2 should be fairly low after matching and the

joint significance of covariates should be rejected. Sensitivity analysis was also undertaken to check if the influence of an unmeasured variable on the selection process is so strong to undermine the matching procedure. Since it is not possible to estimate the selection bias in practice with non-randomized data, we employed the bounding approach suggested by Rosenbaum (2002) to examine the influence of unmeasured variable on the selection process. The aim of this approach is to determine how strongly an unmeasured variable must influence the selection process to undermine the implication of the matching process.

4.5 Empirical Results and Discussion

In order to analyze the driving forces behind rural household's decision to participate in non-farm work, we employed endogenous switching regression that can control for both observable and unobservable selection bias. FIML estimates of the endogenous switching regression model for male and female participants are reported in Tables 4.3-4.6. The third column of Tables 4.3-4.6 presents the estimated coefficients of the selection equation (12) on non-farm work participating or not whereas the fourth and fifth column present per head expenditures and poverty level of household. The empirical results for the probability of non-farm participation are generally in agreement with prediction from the analytical model. Age variable is positive and statistically significant in both specifications for male and females, which represents general experience that increases the marginal value of time in each activity. The results suggest that an increase in age of household head increases the probability of both male and female participation in non-farm work. In both specifications, number of years of schooling of household head significantly increases the participation decision since most of the activities in non-farm work require a certain level of education. Thus education of household members, represented by the household head's level of education, is a powerful source that leads labor out of agriculture and shifts it into high returning non-farm sector (Timmer, 1988). Therefore, households without well educated heads are consequently excluded from non-farm activities.

Household composition and characteristics seem to matter as well on the probability of participation for both male and female. The coefficient of the adult household size is positive and significant, suggesting that the presence of working age men and women in the household which is an indicator of non-nuclearity of household, tends to increase the probability of participation of both male and female in non-farm work. These results are in contrast to the study of Barrett et al. (2008) and in line with the study of Abdauli and Regime (2000) in the case of male labor supply. The presence of children in the household had no significant effect

on the probability of participation of both male and female in non-farm work, confirmed to the findings of other studies that showed that non-farm work and child care are not necessarily competing activities in rural areas of developing countries (Rosenzweig, 1980; Sahn and Alderman, 1988; Skoufias, 1994; Abdulai and Delgado, 1999).

Males and females belonging to households endowed with valuable physical capital like farm land or livestock are less likely to participate in non-farm activities. As noted by Weiss (1997) that increase in farm size reduces the probability of participation in off-farm labor market. Perhaps they often capitalize their valuable assets in order to smooth consumption in times of income shortfalls (Fafchamps et al., 1998; Abdulai and CroleRees, 2001; Corral and Reardon, 2001; Lanjouw et al., 2001; Dercon, 2002; Barrett et al., 2005; Verpoorten, 2009). Consequently, valuable agricultural assets can be regarded as some kind of entry barriers, since well endowed households are able to run their farm properly and are not dependent on non-farm activities to generate more income or to spread risk. In the absence of valuable endowments, however, households seem to be forced into non-farm employment since farming would not be successful due to low quality of assets. Since endowment with valuable assets also represents the household's wealth, these findings also support the theory of decreasing risk aversion. Households endowed with valuable physical capital are less risk-averse and therefore less likely to participate in non-farm employment. The presence of a development project in study area enhances the probability of participation for both male and female in non-farm earning activities. In both specifications, access to credit decreases the likelihood of non-farm participation for both male and female but this variable is not significantly different from zero.

Table 4.3: Full information maximum likelihood estimates of the endogenous switching regression

Dependent variable: non-farm participation of male and per head expenditure				
Variables	Description	FIML Endogenous Switching Regression		
		Participation (1/0)	Participation=1 (participants)	Participation=0 (non-participants)
AgeHead	Age of HH head (years)	0.044(0.02)*	1486.615(1032.52)	10850.41(5859.70)*
Age2Head	Square of head age	-0.001(0.00)	- 9.553(9.68)	-113.069(62.17)*
HeadEdu	Years of education of HH head	0.089(0.02)***	2006.029(1212.06)*	15799.03(5925.29)***
HHSiz14	No.of HH members < 14 years	0.101(0.03)***	477.980(1639.10)	-2552.426(10025.73)
Ch0L05	No. of child > 5 years	-0.018(0.06)	- 11172.18(3115.13)***	-13555.96(19111.12)
Child14	No. of child b/w 6-14 years	-0.016(0.03)	- 2648.617(692.17)***	-8396.397(3770.76)**
Livstk	1 if HH has livestock,0 otherwise	-0.496(0.24)**	29170.37(11271.17)***	111341.70(56806.98)**
CultLand	Total cultivated land in acres	-0.007(0.01)	629.072(351.20)*	5390.478(3056.95)*
Credit	1 if HH takes credit, 0 otherwise	-0.126(0.18)	-12316.09(9926.92)*	23771.70(61787.72)
DProg	1 if village dev. prog, 0 otherwise	0.008(0.00)*	11913.81(11815.76)	249.831(665.87)
M0CasW	Village cash wages of male (Rs)	-0.001(0.00)	116.95(93.42)	-170.992(259.22)
Location1	1 if Lahore district, 0 otherwise	0.166(0.29)	- 12266.68(17977.18)	61118.18(64830.65)
Location2	1 if Sahiwal district , 0 otherwise	0.503(0.31)	- 15005.54(12192.1)	76184.78(71324.03)
Location3	1 if M.Garh district , 0 otherwise	0.190(0.30)	- 11033.16(14055.02)	16619.42(57644.97)
Location4	1 if Layyah district, 0 otherwise	6.446(0.74)***	- 2614.478(31276.57)	25803(35664.1)
Location5	1 if Sialkot district, 0 otherwise	0.132(0.33)	6467.268(20673.71)	29066.35(57972.38)
DRShop	Distance of HH to retail shop (km)	-0.324(0.15)**		
Constant		-1.056(0.81)	-9608.821(40579.14)	-899.378(148525.60)
σ_{ei}			70679.45(1.95) ***	262235(13.64)***
ρ_j			-0.336(0.30)	0.758(0.53)

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.
σ_{ei} denotes the square root of the variance of the error terms in the outcome equations, ρ_j denotes correlation coefficient b/w the error term of selection equation and error term of outcome equation.

Table 4.4: Full information maximum likelihood estimates of the endogenous switching regression.

Dependent variable: non-farm participation of female and per head expenditure				
Variables	Description	FIML Endogenous Switching Regression		
		Participation (1/0)	Participation=1 (participants)	Participation=0 (non-participants)
AgeHead	Age of HH head (years)	0.057(0.03)**	710.811(657.06)	8864.94(4527.70)**
Age2Head	Square of head age	-0.052(0.03)**	-325.627(708.21)	-10041.23(5216.64)*
HeadEdu	Years of edu. of HH head	0.063(0.02)***	3233.42(879.11)***	2962.276(2825.53)
HHSizOv14	No.of HH members <14 years	0.115(0.03)***	1123.871(1966.81)	-8814.77(6239.28)
Ch0L05	No. of child > 5 year of age	-0. 051(0.06)	-6185.097(3179.638)*	-29598.36(13595.25)**
Child14	No. of child b/w age 6-14 years	-0.001(0.01)	-2050.238(692.40)***	-3227.91(1804.83)*
Livstk	1 if HH has livestock,0 otherwise	-0.423(0.23)*	26923.76(10608.73)***	-10451.13(26556.61)
CultLand	Total cultivated land in acres	-0.004(0.00)	216.820(189.01)	3417.42(2015.69)*
Credit	1 if HH takes credit, 0 otherwise	-0.024(0.18)	-15084.88(9266.77)	45493.47(43596.3)
Dprog	1 if village dev. prog, 0 otherwise	0.013(0.01)**	21355.13(13433.69)	532.333(463.14)
F0CasW	Village cash wages of female (Rs)	-0.001(0.00)	188.854(111.14)*	-88.223(152.82)
Location1	1 if Lahore district, 0 otherwise	1.458(0.41)***	16096. 98(14509.69)	14043.9(34611.43)
Location2	1 if Sahiwal district, 0 otherwise	1.830(0.40)***	18832.9 (14331.83)	-20906.85(36205.26)
Location3	1 if M.Garh district, 0 otherwise	1.558(0.40)***	22716.35(13875.92)	-14001.92(34369.65)
Location4	1 if Layyah district, 0 otherwise	2.093(0.78)***	8100.969(30827.24)	112396.8(61361.67)*
Location5	1 if Sialkot district, 0 otherwise	0.014(0.46)	47265.47(27991.48)*	3048.95(23646.26)
DRShop	Distance of HH to retail shop (km)	-0.586(0.21)***		
Constant		-2.832(0.85)***	-38401.17(44267.32)	-70368.19(99072.37)
σ_{ei}			58999.02(7766.79)***	201434.5(70.54)***
ρ_j			-0.009(0.43)	0.001(0.13)

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.
σ_{ei} denotes the square root of the variance of the error terms in the outcome equations, ρ_j denotes correlation coefficient b/w the error term of selection equation and error term of outcome equation.

Table 4.5: Full information maximum likelihood estimates of the endogenous switching regression.

Dependent variable: non-farm participation of male and headcount				
Variables	Description	FIML Endogenous Switching Regression		
		Participation (1/0)	Participation=1 (participants)	Participation=0 (non-participants)
AgeHead	Age of HH head (years)	0.045(0.02)*	-0.005(0.01)	-0.044(0.01)***
Age2Head	Square of head age	-0.000(0.00)	-7.77e-06(0.00)	0.001(0.00)***
HeadEdu	Years of edu. of HH head	0.082(0.02)***	-0.030(0.01)***	-0.022(0.01)**
HHSizOv14	No.of HH members < 14 years	0.1077(0.03)***	-0.035(0.02)*	0.026(0.02)
Ch0L05	No. of chil under > year of age	-0.014(0.07)	0.068(0.03)***	0.080(0.03)***
Child14	No. of child between age 6-14 years	-0.011(0.01)	0.009(0.01)*	0.017(0.01)*
Livstk	1 if HH has livestock,0 otherwise	-0. 598(0.23)***	-0.186(0.09)***	-0.161(0.13)
CultLand	Total cultivated land in acres	-0.003(0.00)	-0.002(0.00)**	-0.002(0.00)*
Credit	1 if HH takes credit, 0 otherwise	-0.126(0.18)	0.052(0.07)	0.061(0.09)
DProg	1 if village dev. prog, 0otherwise	0.013(0.01)*	-0.121(0.07)*	0.003(0.00)**
M0CasW	Village cash wages of male(Rs)	-0.000(0.00)	0.001(0.00)	0.001(0.00)
Location1	1 if Lahore district, 0 otherwise	0.180(0.32)	0.288(0.12)***	0.251(0.12)**
Location2	1 if Sahiwal district ,0 otherwise	0.564(0.31)*	0.207(0.13)	0.443(0.13)***
Location3	1 if M.Garh district ,0 otherwise	0.212(0.31)	0.214(0.11)**	0.303(0.09)***
Location4	1 if Layyah district, 0 otherwise	6.521(0.98)***	0.133(0.25)	0.986(0.72)
Location5	1 if Sialkot district,0 otherwise	0 .093(0.35)	0.021(0.13)	0.020(0.32)***
DRShop	Distance of HH to retail shop (km)	-0 .370(0.21)*		
Constant		-1.204(0.79)	0.758(0.43)*	1.102(0.32)***
σ_{ei}			0.418(0.03)***	0.378(0.02)***
ρ_j			-0.229(0.50)	0.081(0.48)

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.
σ_{ei} denotes the square root of the variance of the error terms in the outcome equations, ρ_j denotes correlation coefficient b/w the error term of selection equation and error term of outcome equation.

Table 4.6: Full information maximum likelihood estimates of the endogenous switching regression.

Dependent variable: non-farm participation of female and headcount				
		FIML Endogenous Switching Regression		
Variables	Description	Participation (1/0)	Participation=1 (participants)	Participation=0 (non-participants)
AgeHead	Age of HH head (years)	0.054(0.03)**	-0.008(0.01)	-0.031(0.01)***
Age2Head	Square of head age	-0.050(0.02)**	0.003(0.01)	0.026(0.01)***
HeadEdu	Years of edu. of HH head	0.063(0.02)***	-0.032(0.01)***	-0.018(0.01)**
HHSizOve14	No.of HH members < 14 years	0.114(0.03)***	-0.042(0.02)**	0.021(0.01)**
Ch0L05	No. of child > 5 year of age	-0.055(0.06)	0.072(0.03)**	0.085(0.02)***
Child14	No. of child b/w 6-14 years	-0.000(0.01)	0.006(0.01)	0.007(0.01)*
Livstk	1 if HH has livestock,0 otherwise	-0.431(0.23)*	-0.286(0.10)***	-0.143(0.09)
CultLand	Total cultivated land in acres	-0.004(0.00)	-0.002(0.00)*	-0.002(0.00)***
Credit	1 if HH takes credit, 0 otherwise	-0.017(0.18)	0.096(0.08)	0.014(0.08)
DProg	1 if village dev. prog, 0 otherwise	0.012(0.01)*	-0.114(0.09)	0.003(0.00)***
F0CasW	Village cash wages of female (Rs)	-0.001(0.00)	0.000(0.00)	0.000(0.00)
Location1	1 if Lahore district, 0 otherwise	1.441(0.41)***	0.104(0.34)	0.331(0.12)**
Location2	1 if Sahiwal district, 0 otherwise	1.800(0.40)***	0.076(0.37)	0.588(0.13)***
Location3	1 if M.Garh district, 0 otherwise	1.541(0.40)***	0.034(0.35)	0.341(0.10)***
Location4	1 if Layyah district, 0 otherwise	2.057(0.76)***	-0.081(0.46)	0.210(0.13)
Location5	1 if Sialkot district, 0 otherwise	-0.015(0.47)	0.050(0.32)	0.148(0.09)*
DRShop	Distance of HH to retail shop (km)	-0.608(0.22)***		
Constant		-2.720(0.89)***	1.270(0.65)*	1.091(0.26)***
σ_{ei}			0.431(0.03)***	0.385(0.02)***
ρ_j			-0.287(0.39)	0.199(0.22)

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.

σ_{ei} denotes the square root of the variance of the error terms in the outcome equations, ρ_j denotes correlation coefficient b/w the error term of selection equation and error term of outcome equation.

The results of the second part of FIML endogenous switching regression model are presented in last two columns of Tables 4.3-4.6. Identification of the model requires that there should be at least one variable in the participation equation that does not appear in the per head expenditures and poverty equations. In both specifications, distance of household from retail market variable is used as identifying instrument.

The non-significance of covariance terms $\rho_{1\mu}$ in the case of per head expenditures and poverty, in the lower panel of Tables 4.3-4.6, shows the absence of endogenous switching in both cases. Also results show that the covariance terms $(\rho_{1\mu}, \rho_{2\mu})$ have alternate signs with $\rho_{1\mu} < 0$ and $\rho_{2\mu} > 0$, which indicates that non-farm participation is based on its comparative advantage. The non-significance of $\rho_{2\mu}$ indicates that in the absence of non-farm work participation, there would be no significant difference in average behavior of male and female in the two groups, caused by unobserved effects.

The results in Tables 4.3-4.6 indicate that education of household head exerts a positive effect on per head expenditure for both non-farm participants and non-participants households, but its effect is not significant in the case of female. On the other hand, the negative and significant coefficient of the variable for schooling suggests that education seems to be a key factor to reduce poverty of both participant and non-participant households. These results indicate that education enhances the welfare of household by increasing the efficiencies of individual activities. As noted by El-Osta (2011) that schooling has significant impact on higher rural household earnings.

Family composition appears to be an important factor in explaining per head expenditure and poverty level differences among participants and non-participants for both male and female. Adult household size tends to have a positive effect on per head expenditures for both male and female participants, and negative effect on per head expenditure for non-participants households, although it does not significantly influence for both cases. In the case of poverty level, adult household size tends to decrease the poverty level of male and female participants and increases the poverty level for non-participants male and female. Presence of children (> 5 years & between 6-14 years) tends to decrease the per head expenditure, while it enhance the poverty level of non-farm work participants and non-participants for both male and female.

Households, endowed with sufficient natural capital (e.g. land) and physical capital (e.g. livestock) are found to influence outcome, although at varying levels. The ownership of livestock has positive impact on per head expenditure of household, albeit its effect is inconclusive for non-participant females. In the case of poverty, livestock has positive and significant effect on poverty reduction for male and female participants but no significant impact for both male and female non-participants. Similarly farm size increases the per head expenditure for both participants and non-participants. The coefficient of farm size is negative and statistically significant for both participants and non-participants in the case of poverty.

Table 4.7: Impact of non-farm participation on per head expenditures and poverty level of household---- ESR results

	Outcome Variables	Outcome mean		ATT	t-Statistics
		Participants	non-participants		
Male	Per head expenditure	90560.12	55202.69	35357.43	1.92*
	Head count	1.235	1.504	-0.26	4.37***
Female	Per head expenditure	123000.81	79850.55	43150.26	6.42***
	Head count	1.206	1.501	-0.30	3.56***

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.

Table 4.7 presents the results of the impact of non-farm participation of male and female on per head expenditure and poverty by using endogenous switching regression method. We find that participation in non-farm work significantly increases consumption expenditures and reduces the poverty status of rural households. Non-farm participation increases per head expenditures by about 35357.43 and 43150.26 point compared to non-participants for male and female respectively. The ATT estimates of 0.26 and 0.30 for poverty reduction suggests that household participation in non-farm work decreases probability of poverty by 0.26 and 0.30 point for male and female respectively, suggesting that non-farm work has significant impact on poverty reduction among rural households in Pakistan. Overall, the estimates show that although the participation rate of females was lower but their participation contributes more to improve welfare and reduce poverty as compared to their male counterparts. Thus, non-farm work appears to be more crucial in the case of female in improving the welfare and reducing the poverty status of farm household.

As we find no endogenous switch so in order to check robustness of our ESR findings and for comparability purposes, we used propensity score matching (PSM) to determine the impact of non-farm on household welfare. A probit model has been employed to predict the probability of participation in non-farm work. The estimated propensity scores for male and female participation are given in Table 4.A.1 and 4.A.2 in the appendix. As the propensity score only serves as a device to balance the observed distribution of covariates across the participant and non-participant groups (Lee, 2008) so, the detailed interpretation of the propensity score estimates is not undertaken here. However, the results indicate that most of the variables included in the estimations have the expected signs.

The effect of non-farm work on per head expenditure and poverty status of the households is estimated with the nearest neighbor matching (NNM), radius matching, and kernel-based matching (KBM) methods. The empirical results of average treatment effect (ATT) are given in Tables 4.8, while the indicators of matching quality are provided in Table 4.9 for both male and female. Before turning to the causal effects of non-farm participation of household, we briefly discuss the quality of the matching process. After estimating the propensity scores for the participants and non-participants group we check the common support condition.[5]

A visual inspection of the density distributions of the estimated propensity scores for the two groups (Figure 4.1 in appendix) indicates that the common support condition is imposed and the balancing property was satisfied in all the estimates regression models. The bottom half of the graph shows the propensity scores distribution for the non-participants and the upper half refers to that of participants. The densities of the scores are on the y-axis.

[5] In this study, the common support region is implemented, following the example of Leuven and Sianesi (2003), discarding observation from the participants group, whose propensity score is higher than the maximum or less than the minimum propensity score of non-participants

Table 4.8: Average treatment effects and sensitivity analysis for male and female----PSM results

	Matching	Outcome variable	No. of neighbors/ Kernel type	Caliper	ATT	Critical level of hidden bias	No. of treated	No. of controlled
Male	NNM	Per head expenditures	4	0.0011	29678.95**(2.15)	1.4-1.5	196	139
		Headcount	1	0.04	-0.14*(1.79)	1.4-1.5	196	139
	Radius	Per head expenditures	-	0.0011	29678.95**(2.15)	1.4-1.5	196	139
		Headcount	-	0.0015	-0.16*(1.84)	1.3-1.4	196	139
	Kernel	Per head expenditures	tricube	0.0011	27765.51**(2.00)	1.4-1.5	196	139
		Headcount	tricube	0.0011	-0.21**(2.06)	1.5-1.6	196	139
Female	NNM	Per head expenditures	1	-	25452.68**(2.15)	1.4-1.5	32	308
		Headcount	3	-	-0.27**(2.57)	2-2.1	32	308
	Radius	Per head expenditures	-	0.0003	36996.14*(1.82)	1.3-1.4	32	308
		Headcount	-	0.19	-0.17*(1.96)	1.2-1.3	32	308
	Kernel	Per head expenditures	normal	0.0001	32738.56*(1.69)	1.5-1.6	32	308
		Headcount	biweight	0.01	-0.23**(2.03)	1.4-1.5	32	308

Note: t-statistics are in parentheses.
Significance of t-statistics of mean difference is at the *10%, **5% and ***1% level.

The matching for all three approaches in Table 4.8 generally indicate that non-farm work of male and female exerts a positive and significant impact on per head expenditure and a negative and significant impact on poverty status of household. Specifically, the NNM, Radius and KBM casual effect of participation on per head expenditures range between 27765.51 and 29678.95 for male; 25452.68 and 36996.14 for female. The magnitude of coefficient suggests that the average treatment effect of participation in non-farm work increases the individual's welfare by 27765.51 - 29678.95 for male and 25452.68 - 36996.14 for female. Non-farm participation of male and female also had significant impact on reducing poverty. The estimated impact of participation on poverty reduction as measured by head count index is estimated to range between -0.14 and -0.21 for male; -0.17 and -0.27 for female, suggesting that poverty is lower for participant by 0.14-0.21 for male and 0.17-0.27 for female.

A comparison of the ATT estimates from the endogenous switching regression and the PSM approach reveals that the estimates from the PSM are slightly lower, suggesting that the PSM may be underestimating the ATT. It is widely accepted that in the presence of hidden bias, PSM normally underestimates the average treatment effects, since matching only controls for observable characteristics.

Also presented in Table 4.8, the critical levels of gamma (Γ), at which the causal inference of significant participation effect may be questioned. Given that sensitivity analysis for insignificant effects is not meaningful, Rosenbaum bounds were calculated only for treatment effects that are significantly different from zero (Hujer et al., 2004). For example, the value of 1.50 for male participation implies that if households that have the same X-vector differ in their odds of participation by a factor of 50%, the significance of the participation on per head expenditure may be questionable. The lowest critical value of Γ is 1.20, whereas the largest critical value is 2.10. We can therefore conclude that even large amounts of unobserved heterogeneity would not alter the inference about the estimated effects, suggesting that the findings are generally insensitive to hidden bias.

Table 4.9: Indicators of matching quality before and after matching----PSM results

Matching		Outcome variable	Pseudo-R2		p-Value*		Median absolute bias		% bias reduction
			(unmatched)	(matched)	(unmatched)	(matched)	(unmatched)	(matched)	
Male	NNM	Per head expenditures	0.112	0.054	0.000	0.888	14.3	6.1	57.34
		Headcount	0.112	0.010	0.000	0.997	14.3	3.3	76.92
	Radius	Per head expenditures	0.112	0.054	0.000	0.888	14.3	6.1	57.34
		Headcount	0.112	0.029	0.000	0.982	14.3	5.1	64.34
	KBM	Per head expenditures	0.112	0.049	0.000	0.929	14.3	6.3	55.94
		Headcount	0.112	0.049	0.000	0.929	14.3	6.3	55.94
Female	NNM	Per head expenditures	0.299	0.197	0.000	0.189	26.9	12.2	54.6
		Headcount	0.299	0.081	0.000	0.995	26.9	7.7	71.43
	Radius	Per head expenditures	0.299	0.176	0.000	0.186	26.9	16.9	37.17
		Headcount	0.299	0.082	0.000	0.995	26.9	6.4	76.34
	KBM	Per head expenditures	0.299	0.157	0.000	0.26	26.9	13.3	50.56
		Headcount	0.299	0.143	0.000	0.947	26.9	15.5	59.09

Note:* p-Value of likelihood ratio test $(pr > \chi^2)$.

The fourth and fifth columns in Table 4.9 present the pseudo-R^2 from the propensity score estimation and from the re-estimation of the propensity score after matching on the matched samples for both male and female. The likelihood-ratio test of the joint significance of all the regressors in the probit model of propensity score estimation before and after matching and their corresponding p-values are presented in the sixth and seventh columns of the Table 4.9 for both male and female. The corresponding *p*-values of the likelihood-ratio test show that the joint significance of regressors on treatment status could always be rejected after matching. It was, however, never rejected before matching. The relatively low pseudo-R^2 after matching and the p-values of the likelihood-ratio test of joint significance of the regressors imply that there is no systematic difference in the distribution of covariates between participants and non-participants after matching.

However, as indicated earlier, the main purpose of the propensity score estimation is not to obtain a precise prediction of selection into treatment but rather to balance the distributions of relevant variables in both groups. The balancing powers of the estimations are ascertained by considering the reduction in the median absolute standardized bias between the matched and the unmatched models. These median absolute standardized bias before and after matching are shown in the eighth and ninth columns of Table 4.9 for male and female, and the tenth column reports the total bias reduction obtained by the matching procedure. The estimates show substantial bias reductions for both male and female. Rosenbaum and Rubin (1985) suggested that a remaining standardized bias of 20% would be advisable.

4.6 Concluding Remarks

This study evaluates the impact of non-farm work on consumption expenditure and poverty status in rural Pakistan. The study utilizes cross-sectional rural household level data collected in 2010 from a randomly selected sample of 341 households in Punjab province of Pakistan. The causal impact of non-farm work participation is estimated by utilizing switching regression and propensity score matching methods to assess robustness of the results. This helps in estimating the true welfare effect of non-farm work by controlling selection problem that normally occurs when observable and unobservable factors influence both on participation in non-farm work and outcomes such as per head expenditures and poverty status of household. The study provides separate estimates for males and females to address gender heterogeneity. The estimates show that although the participation rate of females was lower but their participation contributes more to improve welfare and reduce poverty as compared to their male counterparts.

Both the switching regression and propensity score matching results suggest that participants of non-farm work have significantly higher consumption expenditure and lower poverty than non-participants even after controlling for all confounding factors. The results from this study generally confirm the potential direct role of non-farm sector in improving rural household welfare and alleviating poverty in rural areas of developing countries.

The policy makers should be worried about substantial evidence of the inability of the poor to overcome existing economic and social entry barriers of non-farm activities. Particularly, women face more entry barriers to participation in non-farm work, so policy measures should target them to lower these barriers. Increased and stable household income through non-farm participation in turn smoothes consumption and reduces poverty. Government poverty reduction strategies should address the poor people, especially females to encourage them to engage in non-farm work in order to reduce poverty.

4.7 References

Abdulai, A. and CroleRees, A. (2001). Determinants of income diversification among rural households in Southern Mali, *Food Policy* 26, 437–452.

Abdulai, A. and Delgado, C. L. (1999). Determinants of time spent in non-farm employment by farmers in Northern Ghana, *American Journal of Agricultural Economics* 81, 117–130.

Abdulai, A. and Regmi, P. P. (2000). Estimating labor supply of farm households under nonseparability: Empirical evidence from Nepal, *American Journal of Agricultural Economics* 22, 309–320.

Anwar, T., Qureshi, S. K. and Ali, H. (2004). Landlessness and rural poverty in Pakistan, *The Pakistan Development Review* 43, 855–874.

Barrett, C. B., Reardon, T. and Webb, P. (2001). Non-farm income diversification and household livelihood strategies in rural Africa: Concepts, dynamics and policy implications, *Food Policy* 26, 315–331.

Barrett, C. B., Bezuneh, M., Clay, D. and Reardon, T. (2005). Heterogeneous constraints, incentives and income diversification strategies in rural Africa, *Quarterly Journal of International Agriculture* 44, 37–62.

Barrett, C., Sherlund, S. and Adesina, A. (2008). Shadow Wages, allocative inefficiency, and labor supply in smallholder agriculture, *Agricultural Economics* 38, 21–34.

Chang, H. H. and Mishra, A. (2008). Impact of off-farm labor supply on food expenditures of farm households. *Food Policy* 33, 657-664.

Corral, L. and Reardon, T. (2001). Rural non-farm incomes in Nicaragua, *World Development* 29, 427–442.

Coudouel, A., Hentschel, J. and Wodon, Q. (2002). Poverty measurement and analysis, In Klugman J, editor, A sourcebook for poverty reduction strategies, Volume 1: Core techniques and cross-cutting issues. Washington, D.C. The World Bank.

Dehejia, R. H. and Wahba, S. (2002). Propensity score matching methods for non-experimental causal studies, *The Review of Economics and Statistics* 84, 151–161.

Dercon, S. (2002). Income risk, coping strategies and safety nets, *The World Bank Research Observer* 17, 141–166.

DiNardo, J. and Tobias, J. (2001). Nonparametric density and regression estimation, *Journal of Economic Perspectives* 15, 11–28.

El-Osta, H. (2011). The impact of human capital on farm operator household income, *Agricultural and Resource Economics Review* 40, 95–115.

Ellis, F. (2000). *Rural Livelihoods and Diversity in Developing Countries*. Oxford University Press.

Fafchamps, M., Udry, C. and Czukas, K. (1998). Drought and saving in West Africa: Are livestock a buffer stock?, *Journal of Development Economics* 55, 273–305.

Feder, G., Lau. L. J., Lin, J. Y. and Luo, X. (1990). The relationship between credit and productivity in Chinese agriculture: A micro-economic model of disequilibrium, *American Journal of Agricultural Economics* 72, 1151–1157.

Freeman, H. A,. Ehui, S. K. and Jabbar, M. A. (1998). Credit constraints and smallholder dairy production in the East African high lands: Application of a switching regression model, *Agricultural Economics* 19, 33–44.

Fuglie, K. O. and Bosch, D. J. (1995). Implications of soil nitrogen testing: A switching regression analysis, *American Journal of Agricultural Economics* 77, 891–900.

Government of Pakistan. (2011). Economic Survey 2010-11, Finance Division, GOP, Islamabad, Pakistan.

Haggblade, S., Hazell, P. and Reardon, T. (2010). The rural nonfarm economy: Prospects for growth and poverty reduction, *World Development* 38, 1429–1441.

Heckman, J., Ichiwura, H. and Todd, P. E. (1997). Matching as an econometric evaluation estimator: Evidence from evaluating a job training program, *Review of Economic studies* 64, 605–654.

Huffman, W. E. (1991). Agricultural household models: Survey and critique, in Hallberg, M.C., Findeis, J. L., Lass, D. A (ed.) Multiple Job-Holding among Farm Families. Iowa State University Press, Ames, pp. 79–111.

Huffman, W. E. and Lange, M. (1989). Off-farm work decisions of husbands and wives, *Review of Economics and Statistics* 71, 471–480.

Hujer, R., Caliendo, M. and Thomsen, S. L. (2004). New evidence on the job creation schemes in Germany – A matching approach with threefold heterogeneity, *Research in Economics* 58, 257–302.

Lanjouw, P. (2001). Nonfarm employment and poverty in rural El Salvador. *World Development* 29, 529-547.

Lanjouw, J. and Lanjouw, P. (2001). The rural non-farm sector: Issues and evidence from developing countries, *Agricultural Economics* 26, 1–23.

Lanjouw, P., Quizon, J. and Sparrow, R. (2001). Non-agricultural earnings in peri-urban areas of Tanzania: Evidence from household survey data, *Food Policy* 26, 385–403.

Lee, L. F. (1978). Unionism and wage rates: A simulation equation model with qualitative and limited dependent variables, *International Economic Review* 19, 415–433.

Lee, W. (2008). Propensity score matching and variations on the balancing test. In: 3rd conference on policy evaluation, ZEW, 27-28 October, Mannheim, Germany.

Leuven, E. and Sianesi, B. (2003). PSMATCH2: Stata Module to Perform Full Mahalanobis and Propensity Score Matching, Common Support Graphing, and Covariate Imbalance Testing.

Lokshin, M. and Sajaia, Z. (2004). Maximum likelihood estimation of endogenous switching regression models, *Stata Journal* 4, 282–289.

Maddala, G. S. (1983). *Limited Dependent and Qualitative Variables in Econometrics*. Cambridge University Press, New York.

Malik, S. J. (2008). Rethinking development strategy-the importance of the rural non farm economy in growth and poverty reduction in Pakistan, *The Lahore Journal of Economics*, Special Edition, 189–204.

Owusu, V., Abdulai, A. and Rahman, S. (2011). Non-farm work and food security among farm households in Northern Ghana, *Food Policy* 36, 108–118.

Pagan, A. and Ullah, A. (1999). *Nonparametric Econometrics*. Cambridge University Press, Cambridge.

Pakistan Encyclopedia. (2012). http://en.wikipedia.org/wiki/Punjab,_Pakistan

Rosenbaum, P. R. (2002). *Observational Studies*. Springer, New York.

Rosenbaum, P. R. and Rubin, D. (1983). The central role of the propensity score in observational studies for causal effects, *Biometrika* 70, 41–45.

Rosenbaum, P. R. and Rubin, D. (1985). Constructing a control group using multivariate atched sampling methods that incorporate the propensity score, *The American Statistican* 39, 33–38.

Rosenzweig, M. R. (1980). Neoclassical theory and the optimizing peasant: An econometric analysis of market family labor supply in a developing country, *Quarterly Journal of Economics* 94, 31–55.

Sahn, D. E. and Alderman, H. (1988). The effects of human capital on wages and the determinants of labor supply in a developing country, *Journal of Development Economics* 29, 157–83.

Sianesi, B. (2004). Evaluation of the active labor market programmes in Sweden, *The Review of Economics and Statistics* 86, 133–155.

Skoufias, E. (1994). Using shadow wages to estimate labor supply of agriculture households, *American Journal of Agricultural Economics* 76, 215–227.

Smith, J. and Todd, P. (2005). Does matching overcome lalonde's critique of non-experimental estimators?, *Journal of Econometrics* 125, 305–353.

Timmer, P. (1988). The Agricultural Transformation. In: Chenery, H, Srinivasan T N (eds) *The Handbook of Development Economics* 1. North Holland Press, Amsterdam.

Verpoorten, M. (2009). Household coping in war- and peacetime: cattle sales in Rwanda, 1991-2001, *Journal of Development Economics* 88, 67–86.

Weiss, C. R. (1997). Do They Come Back Again? The symmetry and reversibility of off-farm employment, *European Review of Agricultural Economics* 24, 65–84.

Appendix

Table 4.A.1: Probit estimates of propensity score for male's non-farm employment participation.

Variable	Coefficient	Standard error	Z-value
Head	-0.566	0.203	-2.79**
AgeHead	0.006	0.007	0.92
HHSizOvr14	0.127	0.033	3.81***
Ch0L05	-0.004	0.062	-0.06
Child14	-0.006	0.013	-0.45
AvEdMale	0.128	0.053	2.43**
livstk	-0.477	0.224	-2.13**
TCultiLand	-0.001	0.002	-0.27
Dis0vill	-0.000	0.008	-0.03
Credit	-0.29	0.177	-0.16
UppCaste	-0.222	0.179	-1.24
LowCaste	0.015	0.251	0.06
Fac0Mil	-0.127	0.167	-0.76
Location1	0.167	0.332	0.50
Location2	0.738	0.323	2.29**
Location3	0.436	0.369	1.18
Location4	-0.550	1.009	-0.54
Location5	0.212	0.356	0.64
Constant	-0.272	0.559	-0.49
Pseudo-R2	0.1118		
Log likelihood	-201.91614		

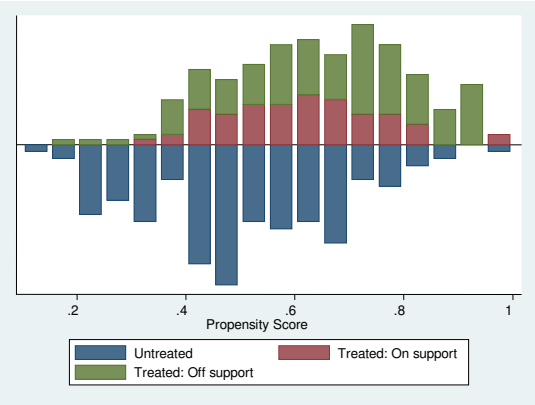
Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.

Table 4.A.2: Probit estimates of propensity score for female's non-farm employment participation.

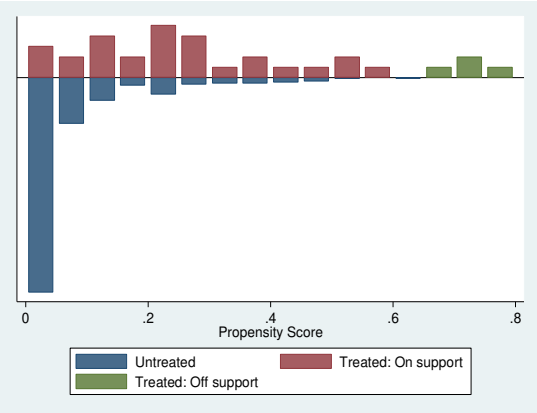
Variable	Coefficient	Standard error	Z-value
Head	-0.350	0.304	-1.15
AgeHead	0.024	0.011	2.09**
HHSizOvr14	0.222	0.054	4.14***
Ch0L05	-0.217	0.113	-1.91*
Child14	-0.003	0.022	-0.14
AvEdFemale	0.042	0.028	1.45
livstk	-0.268	0.318	-0.84
TCultiLand	-0.011	0.008	-1.34
Dis0vill	-0.070	0.023	-3.08***
Credit	0.309	0.257	1.20
UppCaste	0.323	0.317	1.02
LowCaste	0.638	0.407	1.57
Fac0Mil	0.328	0.253	1.30
Location1	0.821	0.766	1.07
Location2	0.835	0.750	1.11
Location3	0.265	0.685	0.39
Location4	-0.550	1.009	-0.54
Location5	0.105	0.691	0.15
Constant	-3.005	1.036	-2.90***
Pseudo-R2	0.2979		
Log likelihood	-74.471862		

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.

Male's non-farm work participation

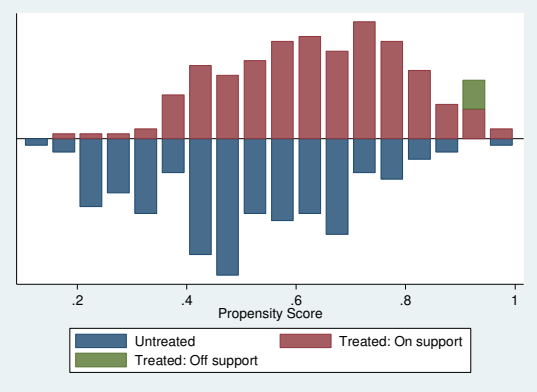


Impact on per head expenditure

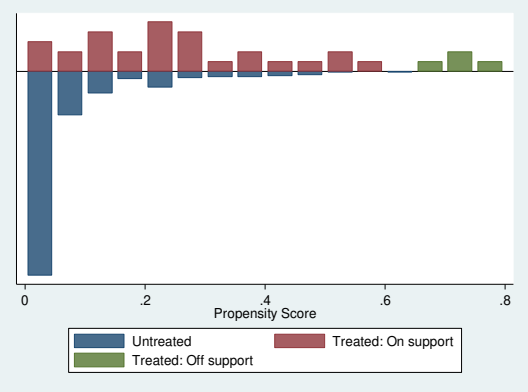


Impact on poverty

Female's non-farm work participation



Impact on per head expenditure



Impact on poverty

Figure 4.1: Propensity score distribution and common support for propensity score estimation

Chapter 5

Non-farm work, land tenancy contracts and investment in soil conservation measures in rural Pakistan

This paper is submitted to the Australian Journal of Agricultural and Resource Economics

Abstract

This paper examines the impacts of participation in non-farm work and land tenancy arrangements on the intensity of investment in soil-improving measures and farm productivity. A multivariate tobit model that accounts for potential endogeneity between the intensity of investment and the non-farm work and tenancy arrangement variables is estimated for 341 rural households in Punjab province of Pakistan. Instrumental variable approach is also used to analyze the impact of tenancy arrangement and non-farm work on farm productivity. The empirical results show that participation in non-farm work and tenure security tend to increase the intensity of investment in long-term soil-improving measures, but decrease chemical fertilizer use intensity. We also find that increases in non-farm work and tenure security exert significant and positive effects on agricultural productivity. Investment in soil conservation measures is also found to significantly increase agricultural productivity.

Keywords: farm productivity, land tenancy arrangements, non-farm work, soil conservation.

5.1 Introduction

Sustainable management of natural resources such as land and water remains a key component of production strategies that aim at encouraging soil conservation and reducing soil losses. As rightly noted by Pretty et al. (2011), soil conservation on its own does not necessarily increase, but conservation methods that capture water and add new system components can result in improved productivity of food crops. Thus, sustainable management of natural resources is a possible route to improved agricultural productivity and increased farm income. Considerable effort has therefore been directed toward identifying and promoting sustainable management farm practices in low-income countries. Although soil type, rainfall and slope of the land largely influence rates of soil loss, farmers' management decisions can exacerbate or mitigate their effects (Lee and Stewart, 1983).

There is now strong evidence that institutions such as land tenancy arrangements tend to influence farmers' decisions to adopt or invest in soil-improving and productivity-enhancing practices (Feder and Onchon, 1987; Deininger and Jin, 2006; Banerjee and Ghatak, 2004; Abdulai et al., 2011). However, studies by Pender and Fafchamps (2006) and Arcand et al. (2007) show that the impact of tenancy arrangement on investment in soil-improving and productivity-enhancing measures is quite weak. The recent literature on tenure security and investment in soil-improving practices suggests three major effects that explain the positive and significant impact of tenure security on investment in soil conservation measures such as organic manure and green manures (Brasselle et al., 2002). First, the 'assurance effect' which is related to the security involved in undertaking long-term land improvement and conservation measures, without any fear of expropriation. The second effect, which is known as 'transaction effect', operates through the trade effect when land is easily convertible to liquid assets as a result of tenure security. Third, secure tenancy improves farmer's access to credit to finance agricultural investments, by using land title as collateral. As shown by Feder and Feeny (1991), in the presence of credit constraints, ownership security results in greater investment by providing access to credit. On the other hand, insecure tenancy arrangement, which is the characteristic of many farmers in less developed countries in most regions of the world, create disincentives for the users to invest resources in land-improving inputs, resulting in productivity declines. Some reports suggest that the absence of secured land tenancy arrangements have contributed to increased degradation of agricultural land (World Bank, 2007; Barnhart, 2010).

Meanwhile a growing body of empirical evidence suggests that participation in non-farm work may be equally important in promoting investments in sustainable management practices and productivity-enhancing inputs (e.g. Barrett et al., 2001; Haggblade et al., 2002; Phimister and Roberts (2006); Pfeiffer et al., 2009; Chang et al., 2011).[6] The underlying intuition of this relationship between non-farm work and investment in soil-improving and productivity-enhancing measures is that in the presence of credit market imperfection, earnings from non-farm work of households that face financial constraints can be used to relax the budget constraint and therefore raise investment in farming activities by providing the required capital (Pfeiffer et al., 2009). The available evidence on the impact of non-farm work on investment in soil-improving and productivity-enhancing inputs, as well as farm productivity also appears to be mixed. For instance, Barrett et al., (2001); Chang et al., (2011) found that participation in non-farm work exerts a positive effect on purchase of farm inputs by relaxing the liquidity constraints faced by farmers. In contrasts, McNally (2002) and Goodwin and Mishra (2004) found that increased participation of household members in non-farm work leads to decrease in the use of family labor and subsequent reduction in farm efficiency.

Most of the studies mentioned above have either examined the role of non-farm work on agricultural investments, or the impact of tenancy arrangement on investment in conservation measures. However, very few have analyzed the link between tenancy arrangements and farm investment through enhanced income possibilities from non-farm work (Feng et al., 2010). The recent study by Feng et al. (2010) examined the impact of land rental market and participation in off-farm employment on land investment, input use, and rice productivity in Northeast Jiangxi Province in China, and found that tenure status of plots did not affect the level of land investments. They also found that off-farm employment does not significantly affect crop yields. They conclude that the negative lost-labor effect of off-farm employment dominates the positive income effect. A shortcoming of the study is the consideration of the household's decision to participate in non-farm work as exogenous, without accounting for potential endogeneity of the variable. This study seeks to contribute to the literature by considering participation in non-farm work and land tenure arrangement as endogenous to investment decisions.

[6] Haggblade et al. (2010), for instance, report that non-farm income contributed 35-50 percent of rural household income across the developing world.

The main objective of this study is to examine how participation in non-farm work and tenancy arrangements affect investment in soil conservation and productivity-enhancing measures in Pakistan. The empirical analysis focuses on the impact of explanatory variables that represent participation in non-farm work, tenancy arrangements, and farm characteristics on agricultural input investment and farm productivity. The study utilizes cross-sectional rural household level data collected in 2010 from a randomly selected sample of 341 households in Punjab province of Pakistan.

Land ownership in Pakistan remains highly concentrated in rural areas due to class stratification, where 67 percent of households are landless and just 0.1 percent households possessed 1 hectare and above landholdings (Anwar et al., 2004). Land lease markets are therefore very active in the country, with large land owners employing hired labor or leasing their land to tenants in order to release themselves and their families from manual labor (Rehman, 1987). The main types of tenancy arrangements are ownership, fixed-rent and sharecropping contracts. The most common type of tenancy is ownership where private individuals have rights to use, rent or sell land. The fixed-rent arrangement involves land owners renting out parcels to tenants, while sharecropping contracts involve arrangements between the landlords and the operators, such that part of the output is given to the landlord as compensation for using the land. As a result of unequal access to land and population growth, non-farm sector has expanded significantly over the last decades. Almost 45-50 percent of the rural population in Pakistan is directly dependent on non-farm income for their livelihood (GOP, 2011).

The rest of the paper is organized as follows: In the next section, the conceptual framework on which the analysis is based is presented. Section 3 outlines the empirical specification. The data used in the analysis is described in section 4. In section 5, the empirical results are discussed. The final section presents the conclusion.

5.2 Conceptual Framework

In many developing countries, where the risks of farming are high and rural credit markets are poorly developed, the non-farm sector provides a vital source of income diversification and access to cash. Thus, earnings from non-farm work can help households to overcome credit and insurance market constraints by providing liquidity that can be used for investment in soil conservation measures and productivity-enhancing inputs (Upton and Haworth, 1987). Similarly, ownership security provides incentive for farmers to engage in investment in soil-

quality, yield-enhancing and resource management practices. However, these investments depend upon the nature of users rights, that is, whether the farmers have permanent rights to use land (e.g., owners) or have temporary rights (e.g., fixed-renters or sharecroppers). Hence, farmers consider these tenancy arrangements when making agricultural investment decisions. As indicated by Abdulai et al. (2011), farmers with short-term fixed-rent contracts have little incentives to invest in longer term soil-improving measures, but are more interested in short-term benefits from their agricultural investments. Tenants therefore tend to invest in the soil-quality up to the point where marginal profits are equal to zero and do not consider the depreciation cost of the soil.

To illustrate the relationship between non-farm work participation, tenancy arrangements and investment in soil-improving and productivity-enhancing activities, we start by specifying a simplified allocation model. To fix things, consider a household that maximizes utility over consumption of goods C and leisure, N, i.e., $U = U(C, N)$. Utility is maximized subject to time, budget, production, liquidity, and non-negativity constraints. We restrict attention to utility functions that are twice differentiable and strictly concave. The time constraint is $T = L_1 + L_2 + N$, where T is total time endowment, L_1 and L_2 are respectively time allocated to farm work and non-farm work, and N is leisure as defined above. The farm technology is specified as $Q = Q(L_f, A, X; Z)$, where Q represents quantity of agricultural production, X captures inputs such as investment in organic manure, farm manure and chemical fertilizer, A is fixed capital like land etc., and Z is the individual, household and location characteristics. In the case of liquidity constraints, expenditures on purchased inputs ($P_x X$) cannot exceed household income from farm (Y_f), non-farm (Y_{nf}), and un-earned (Y_u) sources, given as: $P_x X \leq Y_f + Y_{nf} + Y_u$. The full household budget constraint can be specified as

$$P_C C \leq P_Q Q - P_X X - w_f L_f - K_A(\lambda, \gamma) + w_{nf} L_{nf} + Y_u, \qquad (1)$$

where P_C is the price for the consumption good purchased in the market, P_X is the vector of costs associated with the nonconventional inputs, P_Q, represent vectors of prices of farm output, K_A is cost of land; w_f w_{nf} are the farm and non-farm wages.

The first order conditions associated with maximizing utility subject to these constraints, yield the following optimal choices of the household

$$P\frac{\partial Q}{\partial X} - P_x = (\eta / \rho)P_x \tag{2}$$

$$P\frac{\partial Q}{\partial L_f} = \alpha / \rho = \frac{\partial U / \partial N}{\partial U / \partial C} = w(1 + \eta / \rho) \tag{3}$$

where α is the multiplier for the labor market constraint, which is equal to the marginal utility of leisure, η is the multiplier for liquidity constraint and is equal to the marginal utility of liquidity, and ρ is the marginal utility of full income.

Equation (2) shows that when the liquidity constraint is binding, rather than being equal to zero at the optimum, the marginal profit from purchased inputs is equal to the shadow value of liquidity (η / ρ). Intuitively, increasing demand for the purchased input carries with it an additional cost above and beyond the input price, in terms of the exhaustion of scarce liquidity. Therefore, liquidity-constrained households cannot purchase productivity-enhancing inputs and pursue longer term investment in agriculture. Equation (3) indicates that households will equate the marginal rate of substitution between consumption and leisure of family labor and the shadow wage rate. When the liquidity constraint is binding, the shadow wage will be less than the market wage by a factor of the shadow price of the constraint (η / ρ), with additional labor being allocated to non-farm activities in order to relax the liquidity constraint. If the liquidity constraint is not binding (η=0), the shadow wage would be equal to the market wage, and inputs are used up to the point where their marginal effect on profit vanishes, which is the case of a separable agricultural household model.

The first order condition for optimal time allocation for farm work, non-farm work and leisure is given as

$$\partial U / \partial L_i = W_i \partial U / \partial C - \partial U / \partial L = 0 . \tag{4}$$

Equation (4) can be rearranged to obtain the returns to labor from farm work and non-farm work: $w_i = (\partial U / \partial L) / (\partial U / (\partial Q)$. As shown in Huffman (1991), a positive number of non-farm hours will be observed for an individual i, if the potential market wage (w_i^m) is

greater than the reservation wage (w_i^r).[7] The labor supply functions can then be derived as $L_i = L_i(w_i, P_i; Z)$ for cases where farm households allocate their time to the three activities.

The above derivation of non-farm work can be employed to relate non-farm work to farm input use through duality theory. As shown in Bazaraa (1993) and Phimister and Roberts (2006), by Lagrangean duality theory, at the optimal solution the farm household production problem can be specified as the outcome of a profit-maximization problem given as

$$\pi(P_Q, P_X, \lambda, \gamma, w_f, w_{nf}, Z) = \max_{L,A,X} \left[P_Q Q - w_f L_f - P_X X - K_A(\lambda, \gamma) \right] \quad (5)$$

subject to the technology constraint, $Q = Q(L_f, A, X; Z)$; where $K(\cdot)$ represents the cost of land, reflecting the three different land tenancy arrangements, namely, ownership, fixed-rent contract and sharecropping contract. With these three types of arrangements, the cost of land can be specified as

$$K_A(\lambda, \gamma) = (1 - \lambda)\overline{K}_A + \lambda\gamma P_Q Q \quad (6)$$

where the parameter γ represents an output-sharing rule, with λ equal to zero for fixed-rent tenants and one for sharecroppers. Given this specification, the cost of land for sharecroppers will be $\gamma P_Q Q$. In the case of no sharecropping (owner and fixed-rent tenant), $\lambda = 0$, the cost of the land is given by the constant $\overline{K}_A$.

From equation (5), we can specify the maximized profits as a function of prices, household characteristics, and tenancy arrangements as

$$\pi = \pi(P_Q, P_X, \lambda, \gamma, w_{f,}, w_{nf}, Z) \quad (7)$$

Beginning with any well-specified normalized profit function, direct application of Hotelling's lemma to equation (7), then yields the reduced-form specifications for input demand (land, labor and non-conventional inputs) and farm output functions

$$L = L(P_Q, w_{f,}, w_{nf}, P_x, \lambda, \gamma, Z) \quad (8)$$

$$A = A(P_Q, w_{f,}, w_{nf}, P_x, \lambda, \gamma, Z) \quad (9)$$

[7] The reservation wage for non-farm work is the marginal value of the individual's time when all of it is allocated to farm and leisure.

$$X = X(P_Q, w_{f,}, w_{nf}, P_x, \lambda, \gamma, Z) \quad (10)$$

$$Q = Q(P_Q, w_{f,}, w_{nf}, P_x, \lambda, \gamma, Z) \quad (11)$$

The specifications (8)-(10) show that input and output prices, tenancy arrangements, and non-farm work tend to influence farm profits, demand for inputs, while equation (11) shows how these factors affect farm output. It is significant to mention that in the absence of moral hazard problems, the optimal input use and farm output would not be dependent on the tenancy arrangement. As argued by Jacoby and Mansuri (2008), where landowners fully commit to reward tenants, fixed-rent contracts provide user rights for the duration of the contract, making it possible for tenants to claim monetary compensation for maintaining or improving soil quality. In such cases, tenants are fully incentivized and moral hazard and hold-up problems disappear. Without full commitment, tenants invest only up to the point where the marginal profits in the current period are equal to zero.[8]

On the basis of above theoretical concepts, we formulate two hypotheses about the relationship between tenancy arrangement, non-farm work and agricultural investment. The first hypothesis is that participation in non-farm work exerts a positive effect on investment in longer term soil-improving measures. The second hypothesis is that secure tenancy arrangements lead to higher investment in soil-improving measures.[9]

5.3 Empirical Specification

The main goal of the empirical analysis is to analyze the impact of non-farm work and tenancy arrangements on investment in three soil-improving (conservation measures) and productivity-enhancing activities. A direct way to examine the effects of farm household participation in non-farm work and tenure security on input use would involve estimating a structural farm household model, which can directly capture the optimal production decisions and how they interact with non-farm labor supply (Phimister and Roberts, 2006). However, as shown in Lopez (1984), this requires detailed information on both production and consumption decisions, as well as complex econometric modeling techniques. We therefore employ a reduced-form approach that is less data-intensive, but still includes the production

[8] No commitment usually refers to cases where landowners withhold the benefits of an increase in soil capital.

[9] Tenure security refers to the assurance that an individual can use or hold land for an agreed period of time and cannot be deprived of rights and benefits of using that land.

relationships indicated in the discussions outlined previously. Specifically, we employ the specifications in (8)-(11) for the empirical analysis.

The investment measures we address in the analysis include organic manure (m) and green manure from leguminous crops (g), which are soil conservation measures, as well as chemical fertilizer (f), which is a productivity-enhancing measure, since its productivity effects are limited to the season of application (Jacoby and Mansuri, 2008). In the absence of information on non-farm wages, we can approximate the investment function by using the input demand function in equation (10), and substituting non-farm labor supply for non-farm wages in the following reduced-form specification

$$Y_{in} = \alpha L_{in} + \beta T_{iAn} + \psi Z_{in} + \varepsilon_{in} \qquad n = m, g, f, \tag{12}$$

where Y_{in} represents investment by household i in soil conservation and productivity-enhancing measure n, and L_i captures the household's participation in non-farm work. The vector T_{in} represents tenancy arrangements and includes the variables λ and γ, indicating whether the farm is owner-cultivated, or on sharecropping or fixed-rent contract. The vector Z_{in} is as defined earlier, capturing household and farm-level characteristics. Because of the censored nature of the investment in the soil-improving and productivity-enhancing measures, we employ a tobit specification in the analysis. Suppressing subscripts, this can be expressed as

$$Y_i^* = \alpha L_i + \beta T_{iA} + \psi Z_i + \varepsilon_i \tag{13}$$

$$Y_i = Y_i^* \quad if \; Y_i^* > 0 \tag{14}$$

$$Y_i = 0 \quad if \; Y_i^* \le 0$$

where Y_i^* is a latent variable capturing the expected profits for household i from investing in an activity, while Y_i is observable variable and indicates the level of investment in soil-improving and productivity-enhancing measures, and ε_i is the error tem, which is assumed to be independently and identically distributed, α is a constant, β and ψ are parameters to be estimated. Given that the errors of the individual specification may have nonzero correlation, a multivariate tobit estimation can be employed in the analysis. In particular, because of the substitutability or complementarity between these investment options, and the fact that the

farm lands in the sample are similar across equations, it is most likely that the error terms of these equations will be correlated.

The specification above in equation (12) assumes that the non-farm work and tenancy arrangement variable are exogenous. However, many studies on non-farm work and investment in farm inputs could be jointly determined (Pfeiffer et al., 2009; Kilic et al., 2009). Similarly, studies on the relationship between tenancy arrangements and investment in soil conservation measures suggest that the two variables may be jointly determined (Braselles, 2002). Given that the dependent variable is censored, the usual two-stage approach will not be able to address the endogeneity problem. We therefore employ the approach suggested by Smith and Blundell (1989), by modeling both non-farm work and tenancy arrangement explicitly and then allowing for interactions between these decisions and the investment variables specified in equation (12). The approach involves specifying the first-stage equations for non-farm work and tenancy arrangements as functions of exogenous variables as follows:

$$L_i = Y_i\delta + X_i\xi + \mu_i \tag{15}$$

$$T_i = Y_i\phi + X_i\theta + \varepsilon_i \tag{16}$$

where δ , ξ , θ are parameters to be estimated and μ_i and ε_i are error terms. Both the observed values and the residuals from the regressions are then used in the investment specification as follows

$$Y_i^* = L_i\omega_1 + T_{iA}\omega_2 + Z_i\omega_3 + U_i\omega_4 + \eta_i\omega_5 + \nu_{iA} \tag{17}$$

where L_i and T_i are vectors of the observed variables for non-farm work and tenancy arrangement, respectively; U_i and η_i are the residual terms of non-farm work and tenancy arrangement from equations (12) and (13), and ν_{iA} is the error term. As noted by Smith and Blundell (1989), the tobit estimates of ω_1 and ω_2 in equation (17) are consistent. An interesting feature of the approach is the fact that the usual tobit t-statistics on ω_4 and ω_5 are valid tests of the null hypotheses that the variables are exogenous.

A linear probability model that yield consistent estimates of the parameters is used in the first-stage estimation. Proper identification of the investment specification requires that some of the variables included in the first-stage estimation of non-farm and tenancy

arrangement regressions are excluded from the multivariate tobit estimation. A suitable identification strategy here is to employ variables in the first-stage regressions that strongly influence non-farm work and tenancy arrangement but not investment in soil conservation and productivity-enhancing measures. In the tenancy arrangement equation, we use the distance of the farm from the farmer's residence and a dummy variable indicating whether cultivator resides in the village where the farm is located or not as instruments. In the non-farm equation, we employ migration status of the farmer as an instrument. As pointed out by Pfeiffer et al. (2009) and Kilic et al. (2009), migrant network is correlated with national and international migration and thus with participation in non-farm work, but not directly with agricultural investment decisions.

To examine the impacts of non-farm work and tenancy arrangements on farm output, we use an instrumental variable approach to estimate specification (11). This accounts for the potential endogeneity of intensity of investment with the non-farm work and tenancy arrangement variables. To avoid confounding a potential increase in productivity from increased output with returns to storage, we value output at producer prices at the time of harvest.

5.4 Data Description

We examine the impacts of non-farm work and tenancy arrangements on investment in soil-conservation and productivity-enhancing measures by using farm-level data from a survey conducted between September 2010 and January 2011 in Punjab province of Pakistan. Punjab is the second largest and most populous province of Pakistan, and contributes about 68 percent to annual food grain production in the country. A stratified random sampling approach was employed in collecting information from a total of 341 households from six districts in the province. First, the total number of districts was considered, and a sample of six districts drawn for the survey. Within each district, random samples were drawn to ensure proportional representation of farmers. The six districts considered include Sahiwal, Layyah, Sialkot, Khushab, Muzaffargarh, and Lahore.

The survey asked farmers whether they used any soil conservation and productivity-enhancing inputs such as organic manure, green manure, terraces, strip cropping, and chemical fertilizer in the past few years. The land investments considered in the present study are organic manure and green manure, while the productivity-enhancing input is chemical

fertilizer.[10] As noted by Jacoby and Mansuri (2008), organic manure supply nutrients to soil which remain available over a longer period of time than the nutrients supplied by mineral fertilizer. Thus, intensive use of fertilizer, considered as a static input, may cause soil degradation and hence lead to low crop productivity.[11] Farmers were also asked to indicate the applicable acreage in each case, and the costs of inputs such as organic manure and chemical fertilizer. The data from the survey also contain information about the farm topography, farm operation, non-farm activities, farm finance, and human capital of the household head; such as age at the time of the survey; education, measured in number of years of schooling and experience. Non-farm work includes wage (on and off-farm) and self-employment.

In addition, farmers were requested to provide information on the type of tenancy arrangement under which they operated their farms. The sample of interviewed households consisted of 200 owner-cultivated households, 91 sharecropping and 50 fixed-rental households, without any recorded cases of households with multiple tenancy arrangements. Information was also collected on other farm and non-farm activities, socio-demographic and location characteristics.[12] The households were asked about their perceptions of soil fertility. The variable is captured as a dummy, where one represents good soil fertility and zero poor soil fertility. Farm size is captured by the number of acres under cultivation by the household. The distance of the farm from the home of the cultivator and from the home of the landlord in case it is a rented land was also included in the questionnaire. Information on output and input prices was also collected.

The definitions of the variables used in the analysis are presented in Table 5.1. As indicated previously, the dependent variable in the study is investment in soil-improving and productivity-enhancing measures. The three tenancy arrangement variables used are owner-cultivated, fixed-rent contract, and sharecropping contract. Non-farm employment was represented with a dummy variable taking the value of one if the household participated in the non-farm labor market, and zero otherwise. Other socio-demographic variables include

[10] In our sample, very few farmers engaged in terraces and strip cropping. We therefore did not consider them in the empirical analysis.

[11] Increased application of mineral fertilizer leads to boost the productivity of crops in the short run but with time crop yield decrease if there is no usage of organic or green manure. Manures are long-term soil investments which increase the fertility of the soil by adding organic matter and nutrients.

[12] Non-farm activities include non-farm self-employment, wage-labor, migration, non-labor work, renting of household and farm assets and all other activities other than agriculture.

household size, household assets (cultivated land, livestock, tube well) to indicate wealth, unearned income and access to credit to capture liquidity constraints.

Table 5.1: Descriptive statistics of variables used in the regression models.

Variable	Definition of variables	Mean	S.d
Investment variables			
Organic Manure	Organic manure used per acre (kgs)	280.86	373.67
Green Manure	Leguminous crops grown per acre	0.73	2.37
Fertilizers	Chemical fertilizer applied per acre (Kgs)	324.87	256.09
Non-farm Participation variable			
Parti in Nfarm	1 if HH members participate in non-farm work	0.63	0.48
MigNet	1 if HH member migrated, 0 otherwise	0.29	0.45
DisMarkt	Distance of market from house (km)	14.02	20.01
Tenancy variables			
Owner	1 if land is under owner-cultivated, 0 otherwise	0.59	0.50
Fix-renter	1 if land is under fixed-rent contract, 0 otherwise	0.26	0.44
Sharecropper	1 if land is under sharecropping contract, 0 otherwise	0.15	0.23
Household-level characteristics			
AgeHead	Age of HH head (years)	45.87	13.30
Head	1 if female is the head of HH, 0 otherwise	0.74	0.43
HeadEdu	Years of education of HH head	6.04	5.43
HHSizOvr14	No.of HH members < 14 years	4.32	3.02
Livstk	1 if HH has livestock, 0 otherwise	0.83	0.38
TTwell	Number of tube well	0.66	0.97
NONLAB	Unearned income (Rs)	5.55	15.74
Credit	1 if HH has access to credit, 0 otherwise	0.36	0.48
Exte0ff	1 if HH has contact to extension agent, 0 otherwise	0.21	0.41
Farm-level characteristics			
CultiLand	Total cultivated land in acres	22.83	38.71
SoiFert	1 if land is fertile, 0 otherwise	0.13	0.36
ADisField	Distance of farm from owner's residence (km)	1.99	4.12
Residence	1 if landlord reside in village where farm is located,0 otherwise	0.54	0.43
Family labor	Total hrs of family labor worked on farm last year	140.61	184.37
Hired labor	Total hrs of hired labor worked on farm last year	221.26	270.71
Location dummies			
Location1	1 if HH resides in Lahore district, 0 otherwise	0.15	0.36
Location2	1 if Hh resides in Sahiwal district, 0 otherwise	0.20	0.39
Location3	1 if HH resides in M.Garh district, 0 otherwise	0.30	0.46
Location4	1 if HH resides in Layyah district, 0 otherwise	0.02	0.13
Location5	1 if HH resides in Sialkot district, 0 otherwise	0.25	0.43
Location6	1 if HH resides in Khushab district,0 otherwise	0.08	0.27

To explore the differences in output and input use between the three tenancy arrangements, we present descriptive statistics that point toward differences in the key characteristics for owner-cultivators, fixed-rent and sharecropping tenants in Tables 5.A.1-5.A.3 in the appendix. Also presented in the Tables are differences in the means of the variables, alongside their significance levels. Tables 5.A.1 to 5.A.3 reveal significant differences in application of all the three inputs. Specifically, the mean value of output per acre for owner-cultivators (391135.2) is higher than those of fix-rent tenants (289372) and sharecroppers (153266.54). Higher output points to Marshallian inefficiency. In addition, owner-cultivators are found to apply more organic manure than both tenants. However, fixed-rent tenants appear to invest more in chemical fertilizer than both owner-cultivators and sharecroppers. The average quantity of organic manure used by owner-cultivators was about 338 kg per acre, as compared to 257 kg per acre used by sharecroppers, and this difference is significant at 10% level. Although sharecroppers applied on average 286 kg per acre of organic manure, this is still lower than that of owner-cultivators, but higher than that of fixed-renters. The land used for green manure crops is higher on owner-cultivated plots (0.72) than those under fixed-rent contract (0.44) and sharecropping contract (0.25). The comparisons also reveal that fix-renters use about 387 kg per acre of chemical fertilizer, compared to 343 kg per acre by owner-cultivators and 311 kg per acre by sharecroppers. This support the notion that fixed-rent tenants are more likely to use more productivity-enhancing inputs to obtain short-term yield gains than investing in soil conservation measures with longer term benefits. There are also significant differences in variables such as access to credit, education, and extension services between the three tenancy arrangements.

5.5 Regression Results

The empirical results of the impact of non-farm work and tenancy arrangements on investments in soil-improving and productivity-enhancing inputs, as well as agricultural productivity are presented in this section. The analysis was conducted by using the STATA statistical package. The investment specification was estimated by using a multivariate tobit model, controlling for endogeneity of the non-farm work and tenancy arrangement variables, while the productivity analysis was conducted with an instrumental variable approach. The first-stage estimates of the determinants of non-farm work and tenancy arrangements are first presented, followed by the second-stage investment estimates.

Table 5.2 reports the first-stage estimates of the determinants of participation in non-farm work. The signs of the estimated parameters are consistent with previous studies. A

household head with more schooling had a significantly higher probability of engaging in non-farm activities, suggesting that additional schooling raises an individual's non-farm wage by more than it raises his or her reservation wage for farm or home activities. Age increases the probability of participation in non-farm work which represents general experience that increases the marginal value of time in each activity. Non-labor income tends to increase the probability of participating in non-farm work. Migrant household heads are more likely to participate in non-farm work, compared to non-migrants. Lack of credit access serves as a constraint to non-farm participation.

Table 5.2: Linear probability estimates of determinants of non-farm participation

Variable	non-farm work	Standard errors
AgeHead	0.026***	0.01
Head	0.299	0.23
HeadEdu	0.088***	0.02
HHSizOvr14	0.051	0.03
Livstk	-0.652**	0.31
TCultiLand	0.012***	0.00
Credit	0.444**	0.18
TTwell	0.295**	0.13
NONLAB	0.019***	0.01
SoiFert	0.011***	0.00
DisMarkt	0.009*	0.00
Location1	0.142	0.39
Location2	1.20***	0.37
Location3	0.684**	0.33
Location4	0.930	0.92
Location5	0.644**	0.30
MigNet	0.627**	0.26
Intercept	-1.384**	0.49

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.

The first-stage estimates of the determinants of tenancy arrangement are presented in Table 5.3. The omitted category used as a reference group is the sharecropping variable in the case of tenancy arrangement. The estimates reveal that farm and household characteristics are related to tenancy arrangements. Owner-cultivators are more likely to be males, while fixed-rent tenants are more likely to be females. Landlords living in the same village where plots are located are more likely to be owner-cultivated. Similarly, plots located at further distances from the cultivator's residence are more likely to be on fixed-rent contracts, but less likely to be owner-cultivated. This is probably because landlords prefer to cultivate plots closer to their homes, and to rent out those that are far away because of transportation and monitoring cost. The estimations generally provide robust first-stage results that can be employed in the second-stage multivariate tobit analysis. The variables employed as identifying instruments in the analysis are all statistically significant in the first-stage regressions. The value of the *F*-statistics on the joint significance of instruments (distance, residence) in the tenancy arrangement regression given in Table 5.3 suggests that the instruments can be considered exogenous in the estimation.

Table 5.3: Linear probability estimates of determinants of land tenure arrangements

Variable	Own-cultivated	Standard errors	Fix-rented	Standard errors
AgeHead	0.024***	0.01	-0.031***	0.01
Head	-0.707**	0.26	0.793***	0.30
HeadEdu	0.343***	0.08	-0.399***	0.09
HHSizOvr14	0.009	0.03	0.008	0.04
Livstk	0.026*	0.01	-0.018*	(0.01
TCultiLand	0.009**	0.01	-0.008**	0.00
Credit	0.492**	0.19	0.437**	0.20
TTwell	0.645***	0.16	0.685***	0.16
Exte0ff	0.250*	0.14	0.563**	0.27
SoiFert	0.031***	0.00	0.007*	0.00
Location1	-0.284	0.43	-0.330	0.54
Location2	-0.485	0.41	0.020	0.45
Location3	-0.335	0.37	0.396	0.40
Location4	-0.875	0.69	0.039	0.81
Location5	-0.123	0.36	-0.057	0.41
ADisField	-0.187**	0.08	0.078***	0.02
Residence	0.077***	0.02	-0.839***	0.23
Intercept	-0.257	0.54	-0.015	0.60
F-Statistics (P-values)	18.13[0.00]		10.79[0.00]	

Note: *p*-values in squared brackets. Significance of *t*-statistics of mean difference is at the *10%, **5% and ***1% levels.

Table 5.4 presents the results of the second-stage regression on investment in soil-improving and productivity-enhancing measures. The estimated coefficients and their associated t-statistics are presented in the first panel of the Table, while a number of test statistics are reported in the second panel. Considering the test statistics, the estimated correlation coefficients are all positive and significantly different from zero at the 5% level of significance, suggesting that unobserved variables involved in each investment option are significantly positively related. The likelihood ratio test of the joint significance of the correlation coefficients (ρ_i) rejects the null hypothesis that there is no correlation between the investment specifications, indicating that it is more efficient to use the multivariate tobit model than the separate tobit models. The estimates of residuals ResNF, ResOwn, and ResFix, derived from the first stage regressions of non-farm work and tenancy arrangement are not significantly different from zero, indicating that there is no simultaneity bias and that the coefficients are consistently estimated (Wooldridge, 2002). The value of χ^2 statistics for the joint significance of these residuals for each equation could not reject the null hypothesis that the residuals are jointly equal to zero, confirming the value of the individual t-statistics. These findings confirm the exogeneity of non-farm participation and tenancy arrangement variables.

On the estimated coefficients and their t-statistics, the positive and statistically significant coefficients for the non-farm work variable in the organic manure and green manure specifications show that participation in non-farm work increases the intensity in the application of these inputs. This result is in line with the findings reported by Savadogo et al. (2004) for Burkina Faso and by Oseni and Winters (2009) for Nigeria. As argued by Marenya and Barrett (2007), non-farm income helps in easing liquidity constraints needed to invest in soil-improving inputs. In contrasts, the negative and significant coefficient in the chemical fertilizer specification suggests that fertility intensity declines with participation in non-farm work, a finding that is consistent with the results reported by Phimister and Roberts (2006) for England and Wales and by Kilic et al. (2009) for Albania.

The results for the tenancy arrangement variables reveal positive and significant coefficients for the owner-cultivators variable in the organic manure and green manure specifications, suggesting that the intensity of investments in these farm inputs are higher for owner-cultivators, compared to sharecroppers. This finding is consistent with the results reported by Deininger and Ali (2008) for Uganda, but contrasts with the findings by Quisumbing et al. (2001), who found in their study that investment in sustainable

management practices are unaffected by land tenure regimes in Ghana. The results also show that sharecroppers tend to apply higher levels of chemical fertilizers, relative to owner-cultivators. The intensity of investment in organic manure and green manure is lower for fixed-rent tenants, compared to sharecroppers. Consistent with expectations, fixed-rent tenants tend to apply higher levels of chemical fertilizers than sharecroppers.

A few interesting results also emerge for the farm and household-level variables used in the regressions. Age exerts a negative effect on soil conservation measures but positive effect on the application of mineral fertilizers, indicating that younger farmers are more likely to invest in soil conservation measures than older ones. This may be attributed to the fact that younger farmers cultivate land for longer periods of time, and as such expect to reap the long-term benefits from soil-improving investments. In particular, the coefficient of education is positive for all three types of investments, a finding that is in line with the human capital theory.

The coefficient representing the effect of farm size is positive and statistically significant in the case of organic and green manure but negative and significant for chemical fertilizer. This is probably due to the fact that with increasing plot size, farmers are more likely to adopt soil investment measures because of the higher establishment cost in these types of longer term measures, as compared to investment in fertilizer. This finding is consistent with the results reported by of Shively (1997), who found a positive relationship between farm size and investment in soil conservation in Philippines. Livestock ownership is found to have positive and significant effect on investment in organic and green manure, but negative and significant effect on the application of chemical fertilizer. Livestock ownership may be a necessary, but not sufficient condition for investment in organic manure. This is because the manure market functions quite well in the study area, with farmers buying and selling manure in the market. With regard to plot characteristics, we found that investments in all three types of measures are higher on fertile soils, where the marginal returns to such investments are likely to be much higher. Access to extension services and education also appear to increase the intensity of investments in soil conservation and productivity-enhancing investments. Non-labor income, which also relaxes household liquidity constraints, also tends to increase the intensity of investment.

Table 5.4: Multivariate tobit estimates of extent of investment in soil conservation and productivity-enhancing measures

Variable	Organic Manure	Green Manure	Fertilizer
Participation in non-farm work	762.609*	356.986*	-444.531**
	(451.52)	(202.59)	(198.39)
Own-cultivated	658.964***	417.658***	-307.909*
	(233.66)	(125.41)	(168.03)
Fix-rented	-8.942***	-4.360***	1.772*
	(2.96)	(1.58)	(1.04)
AgeHead	-2.442	-0.028	0.277
	(3.99)	(0.02)	(1.73)
Head	5.184	0.201	37.112
	(91.68)	(0.46)	(39.21)
HeadEdu	9.801***	1.007**	16.752***
	(3.36)	(0.50)	(5.72)
HHSizOvr14	1.334	0.126*	6.029
	(13.87)	(0.07)	(47.13)
livstk	7.291***	1.496**	-0.452*
	(1.56)	(0.63)	(0.26)
TCultiLand	1.885*	0.019*	-3.927**
	(1.13)	(0.01)	(1.82)
Credit	-57.149	-0.573	40.429
	(71.39)	(0.36)	(32.16)
TTwell	8.435	0.496*	1.709
	(5.38)	(0.28)	(24.74)
NONLAB	0.993*	0.031*	1.971*
	(0.571)	(0.02)	(1.13)
SoiFert	4.588*	0.037*	0.929
	(2.61)	(0.01)	(1.059)
Exte0ff	217.135***	0.251	52.480
	(83.66)	(0.41)	(36.80)
ResNF	-0.155	-0.345	0.117
	(0.19)	(0.970)	(0.84)
ResOwn	-0.273	-0.779	-0.104
	(0.33)	(0.66)	(0.16)
ResFix	-0.338	-0.237	-0.709
	(0.43)	(0.66)	(0.56)
Intercept	1633.371***	-0.9160	426.146***
	(319.60)	(1.51)	(120.74)
Number of observations	341	341	341
Cross-equation correlations			
ρ_{12}		0.218***	
		(0.06)	
ρ_{13}		0.137**	
		(0.07)	
ρ_{23}		0.724***	
		(0.06)	
Likelihood ratio test of ρ		12.70	
		(0.00)	
χ^2 -statistics for joint significance of residues	0.68[0.34]	1.29[0.68]	0.83[0.58]
χ^2 - statistics for over identification	0.57[0.39]	0.62[0.42]	0.91[0.63]

Note: standard errors are in parentheses and p-values in squared brackets. Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels. District fixed effects included in the estimation, but not reported here.

The coefficients presented in Table 5.4 indicate the impact of explanatory variables on the intensity of each investment measure, but do not indicate the differences in intensity levels of the investments. We therefore compute marginal effects to show the marginal contribution of each explanatory variable on the intensity of investment in soil-improving and productivity-enhancing practices. The computed marginal effects and their standard errors are presented in Table 5.5. Marginal effects of the regressors are evaluated at their sample means. All the values of marginal effects have the expected signs. The estimates show that participation in non-farm work increases the intensity of investment in organic manure and green manure by 60% and 42%, respectively, while it decreases the investment in chemical fertilizer by 36%. Looking at the tenancy arrangement variables, the results show that being an owner-cultivator increases the probability of investment in organic manure and green manure by 56% and 57%, respectively but, decreases the investment in chemical fertilizer by 39%. On the other hand, being a fixed-renter increases the intensity of investment in chemical fertilizer by almost 54%. These findings are consistent with the notion that secured rights matters for investment in soil-improving and productivity-enhancing measures. Households endowed with valuable physical capital like farm land or livestock are more likely to invest in organic and green manure, as they capitalize their assets to finance longer term investment measures. Non-labor income tends to increase the likelihood of all three types of investment between 10% and 50%.

Table 5.5: Marginal effects on the marginal probability of investment (in %)

Variable	Organic Manure	Green Manure	Fertilizers
Participation in non-farm work	0.603(0.082)	0.418(0.193)	-0.359(0.195)
Own-cultivated	0.559(0.100)	0.568(0.218)	-0.387(0.152)
Fix-rented	-0.694(0.173)	-0.421(0.004)	0.541(0.226)
AgeHead	-0.912(0.653)	-0.168(0.212)	0.856(0.326)
Head	0.295(0.782)	0.164(0.193)	0.109(0.148)
HeadEdu	0.621(0.127)	0.606(0.210)	0.638(0.379)
HHSizOvr14	0.158(0.070)	0.129(0.072)	0.256(0.021)
Livstk	0.558(0.008)	0.479(0.032)	0.322(0.024)
TCultiLand	0.062(0.031)	0.064(0.001)	-0.085(0.031)
Credit	-0.382 (0.377)	-0.336(0.141)	0.351(0.087)
TTwell	0.146(0.091)	0.212(0.043)	0.312 (0.591)
NONLAB	0.103(0.01)	0.194(0.112)	0.504(0.122)
SoiFert	-0.024(0.002)	-0.087(0.011)	-0.044(0.021)
Exte0ff	0.423(0.024)	0.291(0.122)	0.563(0.089)

Note: Standard errors of the estimated marginal effects are presented in parentheses.

The results of the instrumental variable analysis that capture the impact of non-farm work and tenancy arrangement on farm productivity are presented in Table 5.6. We employed value of crop output per acre as dependent variable, given the significant diversity of crops on the farms. Given the potential endogeneity of the non-farm work and tenancy arrangement variables, they were instrumented by first estimating probit regression and then using the predicted values of these variables in the farm productivity estimation. The estimates in Table 5.6 show a positive and significant effect of non-farm work on farm productivity, suggesting that income from non-farm work provides much needed capital for investment in soil-improving measures that eventually increases productivity.

The coefficients for the both own-cultivated and fixed-rent variables are positive and significant, suggesting that productivity is higher on farm under these tenancy arrangements, compared to sharecropping contracts, even after adjusting for other factors. These results further support the Marshallian inefficiency hypothesis which states that sharecroppers are

less efficient than owners and fix-renters, due to the fact that they get only a share of the marginal output at a given level of input use. These results are consistent with the findings by Banerjee et al. (2002) for India and Abdulai et al. (2011) for Ghana, who found positive and significant impacts of tenure security on productivity in their studies. The results also show that physical assets like land, labor, farm equipments and human capital like education tend to increase farm productivity.

Table 5.6: Instrumental variable estimates of determinants of land productivity

Variable	Coefficient	t-value
Participation in non-farm work	0.135**	2.24
Own-cultivated	1.309***	7.61
Fix-rented	1.067***	5.32
Organic Manure	0.050***	4.16
Fertilizers	0.011*	1.72
TCultiLand	0.329*	1.68
Equipments	0.688**	2.30
Family labor	0.164*	1.85
Hired labor	0.422***	3.50
Head	0.840*	1.76
HeadEdu	0.275*	1.70
AgeHead	-0.016	-1.06
HHsizOvr14	0.164	1.49
livstk	3.593***	7.47
location1	-0.0112	-0.02
location2	-1.274*	-1.86
location3	-0.602	-0.96
location4	-1.29	-1.82
location5	0.649	1.10
Constant	6.656***	6.18
R^2	0.2984	
Adjusted R^2	0.2637	
Wald-statistics $\chi^2(19)$	36.61	
F-value	121.29	
Prob>F	0.00	
Number of obsevations	341	

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.
Predicted values of non-farm participation and tenancy arrangement variables are used.

Wald test for the joint significance of the non-intercept exogenous variables against a critical value of $\chi^2_{(19,0.05)} = 30.14$

The instrument used in the non-farm equation is migration status. In tenancy arrangement equations, distance and location are used as instruments.

Although our results show that tenure security have positive impacts on investment in soil-improving measures and agricultural productivity, it is also significant to examine the direct relationship between investment and productivity. We therefore, employed a propensity score matching approach to examine the direct effects of investment in organic manure, green manure, and chemical fertilizer on farm productivity. Table 5.7 presents the average treatment effects (ATT) estimated by nearest neighbor (NNM) and kernel-based methods (KBM). The matching results from both approaches generally indicate that investment in organic manure, green manure, and mineral fertilizer exert a positive impact on farm productivity, indicating that may partly account for the productivity impacts of tenure security.

Table 5.7: Average treatment effect for organic manure, green manure and fertilizer

	Matching	Outcome	ATT	No. of treated	No. of controls	Common support imposed	Balancing property satisfied
Organic Manure	NNM	Output value per acre	254002.08**(2.31)	192	147	Yes	Yes
	KBM		230887.26*(1.97)	192	147	Yes	Yes
Green Manure	NNM	Output value per acre	34130.03**(2.03)	271	68	Yes	Yes
	KBM		27542.06***(2.96)	271	68	Yes	Yes
Fertilizer	NNM	Output value per acre	266991.271**(2.33)	306	29	Yes	Yes
	KBM		234394.563**(2.21)	306	29	Yes	Yes

Note: Numbers in parentheses are t-values.
Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.
ATT is the Average Treatment effect for the Treated.
NNM stands for Nearest Neighbor Matching and KBM stands for Kernel Based Matching.

5.6 Concluding Remarks

Land tenure arrangements in developing countries tend to have significant implications for allocative and farm productivity. The imperfect financial markets in these countries also make non-farm work a source of liquidity to overcome credit and insurance market constraints, and increase investment in soil-improving and productivity-enhancing measures in farming, which is the main source of income and food security for poor households. This study utilized cross-sectional rural household level data collected in 2010 from a randomly selected sample of 341 households in Punjab province of Pakistan to examine the effects of non-farm work and tenancy arrangements on the intensity of investment in soil-improving and productivity-enhancing measures, as well as farm productivity. The empirical results show the significance of controlling for potential endogeneity of investment intensity and variables such as tenancy arrangement and participation in non-farm work when examining the effects of these variables. Our findings add to existing evidence that non-farm work and tenancy arrangements influence investment in longer term soil-improving measures and agricultural productivity.

The evidence from our analysis suggests that participation in non-farm work increases the intensity of investment in soil-improving measures such as organic manure and green manure, but decreases the use of chemical fertilizer. Thus, household participation in non-farm work induces a shift toward investment in soil-improving measures with long-term benefits, and away from static inputs such as chemical fertilizer with short-term benefits. The findings are consistent with the evidence that non-farm income can be used to finance long-term farm investment (Savagado et al., 1994; Oseni and Winters, 2009). We also find evidence that participation in non-farm work exerts positive and significant impact on farm productivity, suggesting that access to non-farm work opportunities can contribute to higher farm household incomes and poverty reduction in rural areas.

The analysis also reveals that land tenancy arrangements influence investment intensity in soil-improving and productivity-enhancing measures. In particular, owner-cultivators invested more in soil-improving measures, but less in chemical fertilizer. On the other hand, fixed-rent tenants invested less in soil-improving measures, but more in chemical fertilizer. These findings confirm the notion that farmers on short-term fixed-rent contracts normally aim for short-term benefits and therefore tend to invest more in static inputs such as chemical fertilizer. However, owner-cultivators, with secured property rights, mostly target longer term benefits from their agricultural investments.

Overall, our findings suggest that the strengthening of tenure security, either through land reforms to improve ownership or improving tenancy contracts through longer tenure durations can have positive impacts on investment in soil-improving measures and agricultural productivity. Moreover, improving the access of rural farm households to non-farm opportunities can have significant investment and productivity effects. In particular, in rural areas with imperfect credit markets, where farm households find it difficult to obtain credit, improving non-farm work opportunities could provide a substitute for credit as a mechanism to facilitate investment in longer term soil-improving measures and increasing agricultural productivity.

5.7 References

Abdulai, A., Owusu, V. and Goetz, R. (2011). Land tenure differences and investment in land improvement measures: Theoretical and empirical analyses, *Journal of Development Economics* 96, 66-78.

Anwar, T., Qureshi, S. K. and Ali, H. (2004). Landlessness and rural poverty in Pakistan, *The Pakistan Development Review* 43, 855–874.

Arcand, J., Ai, C. and Ethier, F. (2007). Moral hazard and Marshallian inefficiency: Evidence from Tunisia, *Journal of Development Economics* 83, 411–445.

Banerjee, A., Gertler, P. and Ghatak, M. (2002). Empowerment and efficiency: Tenancy reform in West Bengal, *Journal of Political Economy* 113, 151–183.

Banerjee, A.V. and Ghatak, M. (2004). Eviction threats and investment incentives, *Journal of Development Economics* 74, 469–488.

Barnhart, J. (2010). Email communication from USAID Pakistan Mission (June 25, 2010), *Rural Development Institute, Seattle*.

Barrett, C. B., Reardon, T. and Webb, P. (2001). Nonfarm income diversification and household livelihood strategies in rural Africa: Concepts, dynamics and policy implications, *Food Policy* 26, 315–331.

Bazaraa, M. S., Sherali, H. D. and Shetty, C. M. (1993). *Nonlinear programming. Theory and algorithms*, 2nd edition. John Wiley and Sons, New York.

Brasselle, A. S., Gaspart, F. and Platteau. J. P. (2002). Land tenure security and investment incentives: Puzzling evidence from Burkina Faso, *Journal of Development Economics* 67, 373–418.

Chang, H., Mishra, A. and Livingston, L. (2011). Agricultural policy and its impact on fuel usage: Empirical evidence from farm household analysis, *Applied Energy* 88, 348–353.

Deininger, K. and Ali, D. A. (2008). Do overlapping land rights reduce agricultural investment? Evidence from Uganda, *American Journal of Agricultural Economics* 90, 869–882.

Deininger, K. and Jin, S. (2006). Tenure security and land-related investment. Evidence from Ethiopia, *European Economic Review* 50, 1245–1277.

Feder, G. and Onchan, T. (1987). Land ownership security and farm investment in Thailand, *American Journal of Agricultural Economics* 69, 311–320.

Feder, G. and Feeny, D. (1991). Land tenure and property rights: Theory and implications for development policy, *World Bank Economic Review* 5, 135–153.

Feng, S., Heerink, N., Ruben, R. and Qu, F. (2010). Land rental market, off-farm employment and agricultural production in Southeast China: A plot-level case study, *China Economic Review* 21, 598–606.

Goodwin, B. K. and Mishra, A. K. (2004). Farming efficiency and the determinants of multiple job holding by farm operators, *American Journal of Agricultural Economics* 86, 722–729.

Government of Pakistan. (2011). Economic Survey 2010-11, Finance Division, GOP, Islamabad, Pakistan.

Haggblade, S., Hazell, P. and Reardon, T. (2002). Strategies for stimulating poverty-alleviating growth in the rural nonfarm economy in developing countries, EPTD scission paper 92.

Haggblade, S., Hazell, P. and Reardon, T. (2010). The Rural nonfarm economy: Prospects for growth and poverty reduction, *World Development* 38, 1429–1441.

Huffman, W. E. (1991). Agricultural household models: survey and critique, in Hallberg, M.C., Findeis, J. L., Lass, D. A (ed.) Multiple Job-Holding among Farm Families. Iowa State University Press, Ames, pp. 79–111.

Jacoby, H.G. and Mansuri, G. (2008). Land tenancy and non-contractible investment in rural Pakistan, *Review of Economic Studies* 75, 763–788.

Kilic, T., Carletto, C., Miluka, J. and Savastano, S. (2009). Rural nonfarm income and its impact on agriculture: Evidence from Albania, *Agricultural Economics* 40, 139–160.

Lee, L.K. and Stewart, W.H. (1983). Landownership and the adoption of minimum tillage, *American Journal of Agricultural Economics* 65, 256–264.

Lopez, R. (1984). Estimating labor supply and production decisions of self-employed producers, *European Economic Review* 24, 61–82.

Marenya, P. P. and Barrett, C. B. (2007). Household-level determinants of adoption of improved natural resources management practices among smallholder farmers in Western Kenya, *Food Policy* 32, 515–536.

McNally, S. (2002). Are other gainful activities on farms good for the environment?, *Journal of Environmental Management* 66, 57–65.

Oseni, G. and Winter, P. (2009). Rural nonfarm activities and agricultural crop production in Nigeria, *Agricultural Economics* 40, 189–201.

Pender, J. and Fafchamps, M. (2006). Land lease markets and agricultural efficiency in Ethiopia, *Journal of African Economies* 15, 251–84.

Pfeiffer, L., Looez-Feldman, A. and Taylor, J. E. (2009). Is off-farm income reforming the farm? Evidence from Mexico, *Agricultural Economics* 40, 125–138.

Phimister, E. and Roberts, d. (2006). The effect of off-farm work on the intensity of agricultural production, *Environmental and Resource Economics* 34, 493–515.

Pretty, J., Toulmin, C. and Williams, S. (2011). Sustainable intensification in African agriculture, *International Journal of Agricultural Sustainability* 9, 5–24.

Quisumbing, A., Aidoo, J. B., Payongayong, E. and Otsuka, K. (2001). Agroforestry management in Ghana, in Otsuka, K., Place, F(ed.) Land Tenure and Natural Resource Management: a Comparative Study of Agrarian Communities in Asia and Africa. John Hopkins University Press, Baltimore, Maryland, pp. 53–96.

Rehman, M. (1987). Women and rural development in Pakistan, *Journal of Rural Studies* 3, 247–243.

Savadogo, K., Reardon, T. and Pietola, K. (1994). Farm productivity in Burkina Faso: Effect of animal traction and nonfarm income, *American Journal of Agricultural Economics* 6, 608–612.

Shively, G. E. (1997). Consumption risk, farm characteristics, and soil conservation adoption among low-income farmers in the Philippines, *Agricultural Economics* 17,165–177.

Smith, R. J. and Blundell, R. W. (1989). An exogeneity test for a simultaneous equation tobit model with an application to labor supply, *Review of Economic Studies* 54, 679–685.

Upton, M. and Haworth, S. (1987). The growth of farms, *European Review of Agricultural Economics* 14, 351–366.

Wooldridge, J. M. (2002). *Econometric Analysis of Cross- section and Panel Data*. MIT Press, Cambridge

World Bank. (2007). Pakistan: Promoting Rural Growth and Poverty Reduction, Report No. 39303-PK. The World Bank, Washington, DC.

Appendix

Table 5.A.1: Difference in investment and other key characteristics by owners and fix-renters status

Variable	Description	Owner	Fix-renter	Diff.	t-values
Organic	Organic manure used per acre(kgs)	338.05	257.69	80.35*	1.77
Green	Leguminous crops grown per acre	0.72	0.44	0.27	0.77
Fertilizer	Chemical fertilizer applied per acre(kgs)	343.24	387.76	-44.52*	1.71
OutValue	Output value per acre in rupees	391135.2	289372	101763.2**	2.03
Head	1 if female is the head of HH,0 otherwise	0.77	0.92	-0.15***	3.06
HeadEdu	Years of education of HH head	2.32	1.96	0.37**	2.43
AgeHead	Age of HH head (years)	49.09	40.00	9.09***	5.47
HHSizOvr14	No.of HH members <14 years	4.03	4.07	-0.05	0.15
Livstk(%)	1 if HH has livestock,0 otherwise	0.89	0.97	-0.08**	2.15
TCultiLand	Total cultivated land in acres	21.46	33.43	-11.98**	2.28
Credit(%)	1 if HH has access to credit, 0 otherwise	0.86	0.45	0.41*	1.73
NONLAB	Unearned income in rupees	5.49	0.95	4.54***	3.16
TTwell	Number of tube well	1.21	0.60	0.61***	4.81
SoiFert(%)	1 if land is fertile, 0 otherwise	0.95	0.65	0.3*	1.81
Exte0ff(%)	1 if HH has contact to extension agent, 0 otherwise	0.25	0.16	0.08*	1.68

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.

Table 5.A.2: Difference in investment and other key characteristics by owners and sharecroppers status

Variable	Description	Owner	Share-cropper	Diff.	t-values
Organic	Organic manure used per acre(kgs)	338.05	286.48	52.00**	2.15
Green	Leguminous crops grown per acre	0.72	0.25	0.47	0.70
Fertilizer	Chemical fertilizer applied per acre(kgs)	343.24	311.60	31.64	0.56
OutValue	Output value per acre in rupees	391135.2	153266.54	237868.66**	2.12
Head	1 if female is the head of HH,0 otherwise	0.77	0.90	-0.12	1.29
HeadEdu	Years of education of HH head	2.32	1.80	0.52*	1.86
AgeHead	Age of household head (years)	49.09	45.00	4.09*	1.87
HHSizOvr14	No.of HH members< 14 years	4.03	3.9	0.13	0.21
livstk(%)	1 if HH has livestock,0 otherwise	0.89	0.8	0.09**	2.01
TCultiLand	Total cultivated land in acres	21.46	14.71	6.74*	1.78
Credit(%)	1 if HH has access to credit, 0 otherwise	0.86	0.25	0.61***	2.73
NONLAB	Unearned income in rupees	5.49	1.78	3.71*	1.96
TTwell	Number of tube well	1.21	0.35	0.86***	2.81
SoiFert(%)	1 if land is fertile, 0 otherwise	0.95	0.76	0.19*	1.69
Exte0ff(%)	1 if HH has contact to extension agent, 0 otherwise	0.25	0.05	0.20**	2.04

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.

Table 5.A.3: Difference in investment and other key characteristics by fix-renter and sharecroppers status

Variable	Description	Fix-renter	Share-cropper	Diff.	t-values
Organic	Organic manure used per acre(kgs)	257.69	286.48	-28.79*	1.68
Green	Leguminous crops grown per acre	0.44	0.25	0.19	0.42
Fertilizer	Chemical fertilizer applied per acre(kgs)	387.76	311.60	76.16*	1.72
OutValue	Output value per acre in rupees	289372	153266.54	136105.46*	1.96
Head	1 if female is the head of HH,0 otherwise	0.92	0.90	0.02	0.34
HeadEdu	Years of education of HH head	1.96	1.80	0.16*	1.76
AgeHead	Age of HH head (years)	40.00	45.00	-5.0**	2.36
HHSizOvr14	No.of HHmembers < 14 years	4.07	3.9	0.17	0.27
livstk(%)	1 if HH has livestock,0 otherwise	0.97	0.8	0.17***	2.86
TCultiLand	Total cultivated land in acres	33.43	14.71	18.72*	1.91
Credit(%)	1 if HH has access to credit, 0 otherwise	0.45	0.25	0.25*	1.69
NONLAB	Unearned income in rupees	0.95	1.78	-0.83	0.69
TTwell	Number of tube well	0.60	0.35	0.25***	3.53
SoiFert(%)	1 if land is fertile, 0 otherwise	0.65	0.76	-0.11*	1.83
Exte0ff(%)	1 if HH has contact to extension agent, 0 otherwise	0.16	0.05	0.11	1.32

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.

Chapter 6

Summary and Conclusions

The analysis conducted in this study aimed at examining the labor supply responses of male and female members of rural household to changes in economic opportunities under the assumption of non-separability; second the factors that influence the household's decision to participate in non-farm work and impact of participation on household welfare; third impact of non-farm work and land rights on the intensity of investment in soil-improving and yield-enhancing measures and farm productivity. The major objective of this study is to examine the welfare activities of households living in rural areas. In the present study effort has been made to investigate three diverse aspects of rural household development and welfare activities. This chapter first gives an overview of the study by summarizing major findings and review of methods applied. The conclusions and policy implications based on the findings are given at the end.

6.1 Study Focus and Review of Methods

Several studies in Pakistan have examined the role of gender in crop activities, fulfilling food demand of household, and inequality in resource access etc. Some studies investigated the linkages between agrarian change and gender relation. A very few studies examined the labor supply of household and tested presence of imperfect labor and factor markets as a by-product but no study has estimated the labor allocation of male and female on different activities (own-farm, non-farm, agri-wage) in Pakistan under the assumption of non-separability.

In this study hypothesis of separability in agricultural household models was tested by applying three tests; first test is based on the Benjamin (1992) test which focused on the relationship between production decision and preferences of the household; second test is based on the Jacoby (1993) test which tested the equality of market wage and shadow wage; and third test is the Le (2010) generalized test which combined both the Benjamin and the Jacoby tests into one relationship.

In the past, few studies have explicitly analyzed household welfare effect of non-farm work participation but these studies did not account the selectivity bias due to unobservable factors. The present study acknowledges the differences in welfare outcome variables

between those farm-households that did and did not participate in non-farm work due to observed and unobserved factors by applying endogenous switching regression approach. The study also employed the propensity matching approach to further examine the impact of participation on household welfare, and to also check the robustness of findings from the endogenous switching regression model.

The study also focused on the impact of non-farm and tenancy arrangements on the intensity of investment in agriculture. Very few studies that have analyzed the link between tenancy arrangements and farm investment through increased income possibilities from non-farm work, considered non-farm work as exogenous. This study considered participation in non-farm work and land tenure arrangement as endogenous to investment decisions.

6.2 Summary of Results and Implications for Policy

6.2.1 Gender based Labor Activity of Farm Households

In developing countries markets are imperfect and wage data is not available so shadow wages and shadow income are important variables for estimating the labor supply of rural household. The study shows that labor supply of both male and female is sensitive to changes in shadow wages and income.

The cross male wage effect on the non-farm and agri-wage labor supply of female is negative, indicating the sensitiveness to change in male wage. This is probably due to reallocation of time by female from income generating to non income generating personal matters. The cross female wage effect on the male labor supply is positive, showing that males are not much sensitive to reduce their labor supply even when females earn more from income generating activities. Education significantly increases the non-farm labor supply of both male and female, while decreases the labor supply of own-farm and agri-wage work, suggesting the potential role of education in shifting labor from agriculture to high return non-farm sector. Thus education improves the ability of individuals to assign resources in response to changing economic conditions. Social caste system plays an important role in allocating the labor in different activities. In upper caste, female labor supply decreases in non-farm and agri-wage work due to cultural and social barriers for mobility. The results reveal that socially backward castes have higher constraints to enter in non-farm sector in the sense they face higher transaction costs. Well developed village infrastructure increases the possibilities to participate in non-farm work.

The functioning of labor market in Pakistan is tested by applying three tests of separability. All these tests strongly reject the separability assumption showing the dependence of production and consumption decisions of rural households in Pakistan. This finding is in line with much of development literature showing the existence of imperfect markets in developing economies. The study emphasizes the importance of labor allocation decisions under different factors for designing policy for the welfare of rural households.

6.2.2 Determinants and Welfare Impacts of Non-farm Work

The study shows that education level of household head, adult household size, and physical infrastructure tend to increase the probability of participation of both male and female in non-farm work. Alternatively, lack of access to land, livestock, and credit tends to decrease the likelihood of participation in non-farm work, for both male and female.

The welfare equation reveals that education increases welfare and reduces poverty of both participant and non-participant by increasing the efficiencies of individual activities. Farm size increases the per head expenditures and reduces the poverty level for both participants and non-participants. Adult household size tends to positively and significantly increase the welfare of participants, but has negative impact on the welfare of non-participants. The findings of this study generally confirm the potential positive role of the non-farm work in improving rural household welfare and alleviating poverty in rural areas of developing countries. The study shows that although the participation rate of female in non-farm work is low but its contribution towards increased welfare is more as compared to male. It highlights strategies for policy makers to reduce barriers for entering into non-farm sector especially for female.

6.2.3 Influence of Non-farm Work and Land Rights on the Intensity of Investment

Non-farm work and secured property rights do matter in household's decision to invest in agriculture. The results show that participation in non-farm work increases the intensity of investment in soil-improving measures such as organic manure and green manure, but decreases the use of chemical fertilizer. This reveals that non-farm income can be used to finance long-term farm investment by overcoming liquidity constraint.

The analysis also shows that land tenancy arrangements influence investment intensity in soil-improving and productivity-enhancing measures. Specifically, owner-cultivators invest more in soil-improving measures, but less in chemical fertilizer. On the other hand, fixed-rent

tenants invest less in soil-improving measures, but more in chemical fertilizer. Our findings also reveal that secured property rights and non-farm work have positive impact on farm productivity. Overall, our findings suggest that strengthening of tenure security and access of rural farm households to non-farm opportunities can have significant investment and productivity effects.

6.3 Policy Implications

The findings summarized above indicate a number of important policy implications. Although it is difficult to derive general policy recommendation due to heterogeneity of non-farm sector in developing countries but as non-farm work has proved to increase welfare and reduce poverty level of household, as well as it provides finance to make investments in the agriculture sector so the policy makers should target to reduce entry barriers of non-farm work, especially for females.

It is the need of time that policymakers and government agencies should introduce projects with the core issue to develop rural areas. Proper attention should be given to expand infrastructure, investment in human capital and small scale industries. Besides these, skill development and resource management programs should be introduced. Government poverty reduction strategies should address the poor people, especially females to encourage them to engage in non-farm work in order to reduce poverty. Strengthening the formal credit and insurance markets can be used to protect rural poor people from income shortfall due to agricultural risk.

As the study shows that secured land rights influence the decision of household to invest in soil-improving and productivity-enhancing measures and farm productivity, so there is a need of revisiting the issue of land tenure security by formulating and implementing land reforms in Pakistan.

Appendices

Appendix A: Questionnaire

Gender based Labor Supply, Income Diversification and Household Welfare: Evidence from Pakistan

Instructions

- The questionnaire contains 6 sections and 17 pages. Please check that the blank questionnaires have no missing pages or sections.
- Please prefer to interview household head, if it not possible then most important member of household.
- First introduce yourself and explain thoroughly the purpose of the survey.
- Please stick to the units in which figures and values are asked.
- Please use codes where provided.
- Please fill out the all details as correctly as possible.
- Please note that the information will be kept secret and will not be disclosed to anyone.

Time interview commenced: ---------- Time interview concluded: ----------

Case No.: ---------- Date: ----------

District: ---------- Tehsil: ----------

Village: ---------- Name of Respondent: ----------

Distance of village from the city: ---------- (km)

1/General information of the respondent

Please write down the basic information about the respondent.

Gender 1=Male 2=Female	**Age** (Years)	**Marital status** 1= Unmarried 2= Married 3= Widow/ Widower 4=Divorced 5=Separated (living separately)	**Head of household** 1=Male 2=Female	**How he/she become head** 1= Inherited 2= Marriage 3= Widow 4= Divorced / Separated 5= Migration 6= Sickness 7= Death 8= Ability	**Relation with Head** 1= Head(self) 2= Spouse 3= Child 4= Parent 5= Other kin 6= Other(specify) ----------

2/ Village level information

2.1: Village Infrastructure

Please mark **(X)** in the yes column if facility is available in the village otherwise in column of No. If facility is not available then write distance at which facility is available.

Items	**Yes**	**No**	**Distance** (Km)	**Items**	**Yes**	**No**	**Distance** (Km)
Mettle road				Electricity			
Brick road(soling)				Commercial bank			
Boy's school				Agri. bank			
Girl's school				Agri -extension office			
Hospital				Agri- research centre			
Veterinary centre				Crop output market			
Dairy centre				Input dealer			
Drinking water supply				Shop for handicrafts			
Sanitation				Factory/Mill			
Transport				Other (Specify)_____			

2.2: Prevailing wages in village

Please write the no. of meal, cash pay and value of wages in kind per unit (day, acre, task, months etc) of male, female and children for different agricultural tasks.

Task	**Unit** 1=Day 2=Acre 3=Task 4=Month 5=Other (specify) _____	**Male** >14 years			**Female**>14 years			**Child** (10-14 years)		
		No. of meals	Cash pay (Rs)	In-kind (Value) (Rs)	No. of meals	Cash pay (Rs)	In-kind (Value) (Rs)	No. of meals	Cash pay (Rs)	In-kind (Value) (Rs)
*Prevailing agri-wages										
Land preparation										
Planting										
Weeding/Hoeing										
Spraying										
Paddy transplanting										
Irrigation										
Harvesting of wheat										
Threshing of wheat										
Picking of cotton										
Digging of potatoes										
Cutting of fodder										
Livestock caring										
Milk sale										
Other (specify)_____										

*is the regular agri-wages prevailing in village and all others are seasonal wages.

3/Household Related information

Please use given codes for the following household related information.

3.1: Family type ---------- 1=Nuclear, 2=Joint

3.2: Caste of family ---------- 1= Top caste, 2=Middle caste, 3=Lower caste

3.3: Inheritance of property ---------- 1=Only son, 2=Only daughter, 3= 2:1 ration to son &daughter
4= Wife, 5=Other kin, 6= Other (specify)

3.4: Household size and education profile

Members	***Level of education**	**Members**	***Level of education**	**Members**	***Level of education**
Respondent		Female 1		Male child 3	
Head		Female 2		Male child 4	
Male 1		Female 3		Female child 1	
Male 2		Female 4		Female child 2	
Male 3		Male child 1		Female child 3	
Male 4		Male child 2		Female child 4	

*1=Illiterate, 2=1-5 years of schooling, 3=6-10 years of schooling, 4=Above 10 years of schooling, 5=University level

3.5: No. of children less than 5 years ----------3.6: No. of handicapped in the family ---------

3.7: Socio-economic characteristics

Please indicate code in front column of socio-economic characteristics.

Soil Fertility 1=Fertile, 2=Better than average, 3=Average 4=Poor than average		**House** 1=Earthen, 2=Cemented	
Land Type 1=Clay, 2=Loam, 3=Clay loam, 4=Sandy loam, 5=Silt loam, 6=Other(_____)		**Rights on house** 1=Owned, 2=Rented, 3= Of landlord	
Power Source 1=Bullocks, 2=Own tractor, 3=Rented tractor, 4=Bullock+ Own tractor, 5=Bullocks+ Rented tractor		**Dwelling for cattle** 1=Katcha, 2=Pakka, 3=Mix	
Irrigation Source 1=Only Rain, 2=Canal, 3=Tube well, 4=Canal+ Tube well, 5=Small dam, 6=Dugwells, 7=Turbines, 8=Other(specify)		**Location of Livestock shed** 1= Connected with house 2=Inside house, 3= Separated	

3.8: Ownership of resources

Please write the no. of things that are owned by male, female or both in the relevant column.

Items	**Male** (No.)	**Female** (No.)	**Combined** (No.)	**Items**	**Male** (No.)	**Female** (No.)	**Combined** (No.)
Land(acre)				Hen			
Fixed deposit (Specify_____				Tractor			
TV				Trolley			
Radio				Tube well			
Mobile				Leveler			
Car				Thresher			
Refrigerator				Cultivator			
Madani				Rotavator			
Washing machine				Plough			
Sewing machine				Ridger			
Motorbike				Drill (rabi, kharif)			
Cows/Buffaloes				Tractor driven drill			
Goats/Sheep				Fodder cutter			
Horses/Donkey				Sprayer			
Oxen				Other(specify_____			

3.9: Farming unit

Tenancy Status_____ 1=Owner, 2=Tenant, 3=Owner-cum-Tenant

Kind of Tenancy_____ 1=Fixed rent, 2=Sharecropping

Total owned land (Acres)		**Area leased/rented** (Acres)		**Area shared** (Acres)		**Total cultivated land** (Acres)		**Averaged istance to field** (km)
Cultivated	Uncultivated	In	Out	In	Out	Irrigated	Un irrigated	

Land rent per year if land was rented in or out---------- (Rs)

Owner share percentage if land shared in or shared out/6 months ----------

Is landlord residing in the same village? ---------- 1=Yes, 2=No

No. of years under the contract ----------

No. of times contract renewed----------

3.10: Farm Employment record of household

Please write down the record of all household members who spent their time in cropping.

Member	**Working** *1=Fulltime *2=Partime	**No. of years spent in farming** (Years)	**Daily hours worked** (Hours)	**Member**	**Working** *1=Fulltime *2=Partime	**No. of years spent in farming** (Years)	**Daily hours worked** (Hours)
Respondent				2			
Head				3			
*Male 1				4			
2				*Child 1			
3				2			
4				3			
*Female1				4			

*Male/Female=15-60 years, *Child =10-14 years.

*Fulltime= only doing farming, * Partime= in additional to farming, doing other job.

3.11: Non-farm employment record

Please fill in the following information regarding non-farm activities.

Person	**Activity name**	**No. of years spent** (Years)	**Location** 1=Village 2=Other village 3=City 4-Other district 5=Other province 6=Other country	**Distance Of work place** (Km)	**Mode of Transportation** 1=Foot 2=Bullock cart 3=Cycle/bike 4=Motorized 5=Mixed (foot+vehicle) 6=Other (specify)--------	**Work hours /day**	**Entry constrains** 1=Family 2=Religious 3=Travelling 4=Pardha 5=Attitude of people 6=Discrimination 7=No one	**Attitude of people at work place** 1=Good 2=Bad 3=Neutral	**Pay/month** (Rs)
Respondent	1 2								
Head	1 2								
Male 1	1 2								
2	1 2								
3	1 2								
4	1 2								
Female1	1 2								
2	1 2								
3	1 2								
4	1 2								
Child 1	1 2								
2	1 2								
3	1 2								
4	1 2								

3.12: Participation in domestic activities

Please write down the daily working hours spent on domestic activities of household members

Activities	No. of hours/day		Activities	No. of hours/day	
	Male	Female		Male	Female
Cooking			Poultry activity		
Childcare			Animal byproducts		
Elder care			FYM collection		
Cleaning			Education/Training		
Washing			Visiting friends		
Fetching water			Watching movie/TV		
Collecting firewood			Listening radio		
Embroidery/Sewing			Sleep/Rest		
Livestock caring			Other(specify)_____		

3.13: Participation in cropping activities

Please write down the number of hours worked by family and hired labor for different cropping activities of three major crops, vegetables and fruits.

Activity	Crop____Wheat					
	Family labor			Hired labor		
	Male (No. of hours)	Female (No. of hours)	Child (No. of hours)	Male (No. of hours)	Female (No. of hours)	Child (No. of hours)
Land preparation						
Sowing						
Irrigation						
Weeding/Hoeing						
Spraying						
Fertilizer application						
Harvesting						
Threshing						
Transport						
Sale						
Processing/storage						

Activity	Crop____Cotton					
	Family labor			Hired labor		
	Male (No. of hours)	Female (No. of hours)	Child (No. of hours)	Male (No. of hours)	Female (No. of hours)	Child (No. of hours)
Land preparation						
Sowing						
Irrigation						
Weeding/Hoeing						
Spraying						
Fertilizer application						
Picking						
Cutting of sticks						
Transport						
Sale						
Activity	**Crop__ Sugarcane/Rice**					
Land preparation/nursery						
Sowing/transplanting						
Irrigation						
Weeding/Hoeing						
Spraying						
Fertilizer application						
Harvesting						
Gur making/Husking						
Transport						
Sale						
Processing/storage						

Activity	Vegetables _____					
	Family labor			Hired labor		
	Male (No. of hours)	Female (No. of hours)	Child (No. of hours)	Male (No. of hours)	Female (No. of hours)	Child (No. of hours)
Land preparation						
Sowing						
Irrigation						
Weeding/Hoeing						
Spraying						
Fertilizer application						
Harvesting						
Sorting/Packing						
Transport						
Sale						
Processing/storage						
Activity	**Fruits _____**					
Caring/trimming						
Irrigation						
Weeding/spraying						
Fertilizer application						
Picking						
Sorting/Packing						
Transport /sale						
Processing/storage						

4/Income record of household

4.1: Income from crops

Crops	**Area** (Acre)	**Yield/ acre** (Maund)	**Price/ unit** (Rs)	**Total cost/ Acre** (Rs)	**Total Quantity sold** (Maund)	**Total Quantity lost** (Maund)	***Reasons of lost** **Use code**	**Quantity Consumed (Maund)**	**Hold on income** 1=Male 2 =Female
Wheat									
Cotton									
Rice									
Sugarcane									
Maize									
Fodder									
Beans									
Tobacco									
Vegetable 1									
2									
3									
Fruits 1									
2									
3									
Other (specify----------									

*1=Weather, 2=Rainfall/drought, 3=Flood, 4=Pest/disease, 5=Animal damage, 6=Financial, 7=Price of output, 8=Transportation, 9= Other (specify)

4.2: Was the food production enough to meet the household requirement? ------- 1=Yes, 2=No

4.3: Were there seasonal food shortage? ------ 1=Yes, 2=No If yes then how many months/year---

4.4: Did you get same price of major crops which was fixed by Govt? ------ 1=Yes, 2=No

4.5: If No then, reason----------

4.6: Did you get inputs at same prices which were fixed by Govt? ------- 1=Yes, 2=No

4.7: If No then, reason----------

4.8: Any insurance of crop failure or help by Govt -------- 1=Yes, 2=No

4.9: Any subsidy by Govt for input purchase --------- 1=Yes, 2=No

4.10: Income from agri-wage employment

Please write down the record of wages (cash, in-kind) of work done on farm of another person during the last year.

Persons	**Work type** *1=skilled *2=unskilled	**Cash wage / month** (Rs)	**Value of wage in-kind/Month** (Rs)	**How many months you worked in last year**	**Hold on income** 1=Male 2=Female
Respondent					
Head					
Male 1					
2					
3					
4					
Female 1					
2					
3					
4					
Children 1					
2					
3					
4					
5					

*1=skilled, is the work in which person has got training of few weeks/ months or have some formal education (8-10 years). *2=unskilled , is the work in which person has not got any training or formal education.

4.11: Income from livestock and Poultry

Items	**Quantity sold last year**			**Quantity consumed last year**			**Price/Unit** (Rs)	**Hold on income** 1=Male 2=Female
	Quantity	Unit 1=Unit 2=Litre 3=Dozen	Frequency 1=Daily 2=Weekly 3=Monthly 4=Annual	Quantity	Unit 1=Unit 2=Litre 3=Dozen	Frequency 1=Daily 2=Weekly 3=Monthly 4=Annual		
Cattle								
Goats/Sheep								
Milk/Cream								
Butter/Ghee								
Meat								
Hides								
Wool								
Eggs								
Broilers								
Layers								
Manure								
Fish								
Honey								
Other(specify) ----------								

Did you hire labor for livestock caring---------- 1=Yes, 2=No , if yes then how many -----

Cash wages/month of one labor (Rs)---------- Value of in-kind wages/month of one labor(Rs) -

4.12: Income from other sources

Items	**Income/ year** (Rs)	**Hold on income** 1=Male 2=Female	**Items**	**Income/ year** (Rs)	**Hold on income** 1=Male 2=Female
Rental income of property			Widow pension		
Rental income of agri-equipments			Social securities (accidental death benefit)		
Income from water sale			Zakat		
Old age pension			Other(specify)_____		

5/Expenditure and saving record of the household

5.1: Household expenditure in the last year

Items	**Expenditure/year** (Rs)	**Items**	**Expenditure/year** (Rs)
Housing (rent/repair)		Medical	
Food items		Education	
Clothing and footwear		Recreation	
Tobacco		Water charges	
Fuel, lighting		Durable goods	
Electricity		Social expenses (Marriages, gifts etc.)	
Transport		Miscellaneous	
Livestock		Personal	
Poultry		Other(specify)----------	

5.2: Is price of food items changed during the year--------1=Yes, 2=No if yes, then next question

5.3: Trend of change---------- 1=1-3 months, 2=4-6 months, 3= 7-9 months, 4=10-12 month

5.4**:** Saving per year (Rs) ----------

6/Access to resources and decision making

6.1: Did you hire agri.equipments during cropping season------- 1=Yes, 2= No

6.2: If No, then reason ---------- 1=Shortage, 2=Costly, 3=No one willing to give, 4=other

6.3: Have you ever borrowed money--------- 1=Yes, 2= No

If yes, then fill in the following table regarding credit information for the previous five years.

Source *1=Formal *2=Informal	**Year**	**Amount** (Rs)	**Length of duration** (No. of Years)	**Interest rate** (%)	**Total no. of Installments**	**Amount of Installment** (Rs)	**Purpose**	**Benefited?** 1=Yes 2=No

*1=Formal (Commercial bank/Agri-bank/Govt institute/NGO). *2=Informal (Friends, Relatives, Farmer group, Money lender).

6.4: If the loan needed collateral?---------- 1=Yes, 2= No , if yes then what type----------

6.5: Time lapse between application and loan disbursement----------months

6.6: Whether you repaid loan in time----------1=Yes, 2= No, if No then reason of it----------

6.7: If you never applied for a loan, what is the main reason? **----------**

1= Amount of loan offered is insufficient
2= Procedures are too complicated
3= Interest rates are too high
4= Guarantee/collateral required is too much
5= Maturity period is too short
6= I did not need
7= I do not believe in paying interest
8= Other (specify) ----------

6.8: What was the main reason your application was rejected? ----------

1= Incomplete documents
2= Complete but not convincing documents
3= Insufficient guarantees/collateral
4= Insufficient initial capital
5= Activity/enterprise was deemed not viable
6= Other (specify) ----------

6.9: Is there any discrimination between male and female for getting loan-------- 1=Yes,2=No

6.10: If you got the loan, did you need more?---------- 1=Yes,2=No

6.11: Access to sources of information

Please write in the relevant box of male and female if they are getting or not information from mentioned sources. If yes indicate the frequency of contact from codes.

Source	**Male** 1=Yes 2= No	***Frequency of contact** (Use code)	**Female** 1=Yes 2= No	***Frequency of contact** (Use code)
Newspaper				
Radio				
TV				
NGO /Govt agent				
Extension services				
Fellow farmers				
Other(specify)				

*1=Daily, 2=Weekly, 3=Fortnightly, 4=Monthly, 5=Thrice a year, 6=Twice a year, 7=Yearly, 8=Other (specify).

6.12: Are you member of any organization ---------- 1=Yes, 2= No if yes then proceed

Name of organization	**No. of meetings/year**	***Services obtained**	**Demerits**

*1= Loan, 2=Purchase of input, 3=Marketing, 4=Extension advice, 5=Training, 6=Other (specify)

6.13: Was there any development program in the village --------- 1=Yes, 2= No if yes then proceed

Name of project	**Sponsored by**	**Target group?**	**Completed** 1=Yes, 2= No	**Benefit?** (Specify)

6.14: Diseases

Is there any household member suffered from chronic disease during the last year_____

1=Yes, 2=No. if yes go to next section

Member 1=Male 2=Female 3=Male child 5=Female child 4=Elder	**Disease name**	**For how long was ill** (No. of Months)	**Who took care** 1=Male 2=Female	**Treated from** 1=Indigenous 2=Religious person 3=Govt hospital 4=Private doctor 5=Charitable(NGO) 6=Other(specify)	**How much money Spent** (Rs)	**Recovered** 1=Yes 2=No

6.15: Role in decision making

Please write from the codes about person who makes decision in different tasks.

Items	***Who make decision** (Use code)	**Items**	***Who make decision** (Use code)
Crop selection		Sale of product	
Credit		Schooling of children	
Seed		Non-farm work of male	
Fertilizer		Non-farm work of female	
Pesticide/Chemical		Income of male	

Hiring of labor		Income of female	
Land purchase/ sale		Income spending	
Milk/Ghee sale		Investment	
Cattle purchase/sale		Other(_____)	

*1=Male, 2=Female,3=Combined (Male+ Female), 4=Son, 5=Daughter, 6=Elder, 7=Other(Specify)

6.16: Do you think that women's participation in different activities is necessary for strengthening income level and general welfare of the household? ---------- 1=Yes, 2=No

6.17**:** Problem/constraints that you face for taking part in non-farm earning activities

1----------

2----------

3----------

4----------

6.18: Suggestions to improve participation in non-farm activities

1----------

2----------

3----------

4----------

Please say many thanks to respondent for his time and information

Appendix B: Curriculum Vitae

Personal Information

Name : Rakhshanda Kousar
Date of Birth : 30-08-1979
Place of Birth : Sahiwal, Pakistan
Nationality : Pakistani

Areas of Scientific Interest

Rural Development, Poverty Alleviation, Gender Growth, Labor Supply, Land Tenancy Rights and Non-Farm Employment.

Academic Qualifications

Oct 2009 – April 2014: **PhD** scholar at the Department of Food Economics and Consumption Studies at the Christian Albrecht University, Kiel- Germany.

2002 – 2004: **M.Sc. (Hons.), Agricultural Economics** at University of Agriculture, Faisalabad, Pakistan.

1998 – 2002: B.Sc. (Hons.), Agriculture at University of Agriculture, Faisalabad, Pakistan.

1995 – 1997: F.Sc. Pre-Medical Govt. Degree College, Sahiwal, Pakistan.

1992 – 1994: Matriculation Govt. Pilot High School, Sahiwal, Pakistan.

2011: Basics in Statistics and Introduction to "R" organized by the Graduate Centre, CAU, Kiel-Germany.

Professional Experience

2005-2009: Lecturer at University of Agriculture Faisalabad sub campus at Dera Ghazi Khan and Depalpur.

Research Projects

Jun2002 – Aug 2002: Research project and report on **"Water Distribution and Productivity on Private Mini Dams in Rainfed Pothwar, Gujar Khan Distt. Rawalpindi"** at National Agriculture Research Centre, Islamabad.

2002 – 2004: Research Project and Thesis on **"Economics of Energy use on Small Farms in the Cotton Zone of Punjab, Pakistan"** at University of Agriculture, Faisalabad.

Internship

Jun2002 – Aug 2002: Internship as a research fellow at **National Agriculture Research Centre** (NARC), Islamabad, Pakistan.

Papers Presented and Conferences attended

"Impacts of Rural Non-Farm Employment on Household Welfare in Pakistan" Paper presented at the 2nd AIEAA Conference "Between Crisis and Development: which Role for the Bio-Economy ?" 6-7 June, 2013 at Parma, Italy.

Hosted "First Pakistan Students Conference in Germany" at University of Kiel on Dec 07, 2013 organized by the Pakistani Students Association Kiel and the Embassy of Pakistan, Berlin.

Upcoming Conferences

"Non-Farm Work, Land Tenancy Contracts and Investment in Soil Conservation Measures in Rural Pakistan" at "Annual World Bank Conference on Land and Poverty" The World Bank - Washington DC, March 24-27, 2014.

"Impact of Non-Farm Work and Land Tenancy Contracts on Soil Conservation Measures" at AES Annual Conference 9-11 April 2014 at Paris-France.