



Research Article

Agriculture Labour Supply in Irrigated Plains of Punjab Options for Small Rural Household

Arshad Mahmood Malik^{1*}, Nigah Hussain¹ and Nasim Akhter²

¹Department of Economics, PMAS-Arid Agriculture University Rawalpindi, Pakistan; ²Department of Economics, MUST, Mirpur, AJK, Pakistan.

Abstract | Due to modernization in agriculture sector, agricultural labour migration from on-farm to off-farm work and from rural to urban areas is becoming common practice. Punjab Labor Policy 2018, addresses agriculture labor on the lines of industrial labor to improve its supply. This study is designed to ascertain the factors effecting agricultural labour supply of irrigated area of Khushab District of Punjab. Primary data of three villages was collected having different cropping patterns and irrigation systems of the study area. Multivariate model was developed to ascertain the various socio-economic factors i.e., off-farm work, farm size, farming experience and family size, on changing dynamics of agriculture labour. Results indicated that socio-economic factors significantly affect the agriculture labour dynamics in irrigated areas. Off-farm work has inverse relationship with agriculture labour supply indicating inter-sectoral labor migration, while family size, farm size and farming experience has direct relationship with agriculture labour supply. It is therefore suggested that government may focus on fixing minimum ceiling limit on ancestral land transfer and more emphasis will be given on capacity building of farmers for improving agriculture labor supply in rural agriculture labor market.

Received | April 29, 2019; **Accepted** | April 12, 2022; **Published** | September 21, 2022

***Correspondence** | Arshad Mahmood Malik, Department of Economics, PMAS-Arid Agriculture University Rawalpindi, Pakistan; **Email:** arshadmm@uaar.edu.pk

Citation | Malik, A.M., N. Hussain and N. Akhter. 2022. Agriculture labour supply in irrigated plains of Punjab options for small rural household. *Sarhad Journal of Agriculture*, 38(4): 1246-1253.

DOI | <https://dx.doi.org/10.17582/journal.sja/2022/38.4.1246.1253>

Keywords | Farm labour, Punjab, Modernization, Off-farm work, Farm size



Copyright: 2022 by the authors. Licensee ResearchersLinks Ltd, England, UK.

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Introduction

Agriculture sector has a main role in the Economy of Pakistan as 18.5 percent of GDP comes from the agriculture sector and 38.5 percent of labor force is engaged with this sector (GoP, 2019). The population of Pakistan is 211.17 million with population density of 265 per km² (GoP, 2020). Pakistan agriculture sector is a main source of foreign exchange and

promotes growth in other sectors. According to the 6th Population and Housing Census 2017, the annual population growth rate of Pakistan is 2.4 percent. The demand for food items is increased due to this rapid growth of population (GoP, 2017). The Punjab is the main province of Pakistan which contributes a dominant portion in the agricultural GDP by contributing almost 60 percent to total agricultural production of the country.

Punjab has the largest population of 110.0 million among all the provinces of Pakistan and 69.61 million populations are living in rural areas (GoP, 2017) which comprised of major part of agriculture labor. The livelihood of rural communities directly or indirectly depends on agriculture. The demand for agricultural labour is decreasing due of mechanisation in the sector which ultimately give rise to rural unemployment. The agricultural labour force starts migration from rural areas to urban areas for their livelihood (Bezu and Holden, 2014). This is increasing pressure on urban unemployment and population density which have positive relationship with crime rate in Punjab (Kassem *et al.*, 2019). Various factors identified for rural labor supply were education along with economic and social capital index (Faridi and Basit, 2011).

Khushab district has diversified landscape with highest level of land use in Punjab (Iftikhar and Mahmood, 2017). The district is comprised of irrigated plains, mountainous area, Thal desert, saline arid plains and river bank. Waterlogging in irrigated plains is an increasing problem in the area. A drainage system development project addressed the issue and benefit the local economy by lower the ground water table (Niazi *et al.*, 2008).

Migration has strong effects on the economy and the development of the country, including changes in labour market opportunities, family structures, education, health and environment management, security systems and governance (Eshetu and Beshir, 2017). Labor mobility reduces spatial disparities like unemployment, new business development and income (van Dijk and Edzes, 2016). The demand for agricultural labour has decreased due to modernization of agriculture including the increase in cropping intensity, shift in cropping pattern, wider adoption of biochemical and mechanical technologies (Lawrence, 1970). The agriculture labour is replaced by tractors, pesticides, weedicides and modern technology (Devi *et al.*, 2013). Pesticide use is also reported as occupational hazard (Marcelino *et al.*, 2019). In past bullocks were used for tillage, seed bed preparation and other mechanization processes. Bullocks were driven by human labour and a large number of labours were employed as bullock's drivers. In modern agriculture, tractors take the place of bullocks. This is because tractors and bullocks compete for the same type of agricultural operation. For example, seed bed

preparations, harvesting and transportation can be done either with tractor or bullock. Thus more use of mechanical power mean less use of human labour in the form of bullock drivers (Ali and Parikh, 1992).

Mechanisation like tractor has adversely affected the demand for agricultural labour. Modernization in agronomic and plant protection practices in the form of pesticides, weedicides, hoeing and spraying machine reduces the demand of agriculture labour. In conservative agricultural practices, weeding and hoeing was done manually by pulling weeds and hoeing by hands. In modern agriculture, farmers perform agronomic practices like weeding and hoeing with the help of weedicides and spraying machine and hoeing machines as a component of mechanisation (Amare and Endalew, 2016). Due to mechanisation, hiring of casual labor reduced to 8 percent (Caunedo and Kala, 2021) which resulted in unemployment (Soliman, 1992). In traditional agriculture harvesting was done manually and 100-150 labour hours were required for harvesting one hectare of rice crops (Alizadeh and Allameh, 2013). But in modern agriculture up to 85% of saving in labor is possible through mechanised harvesting techniques (Khandai *et al.*, 2021). The work of weeks is done in hours with the help of machinery in modern agriculture (Phyo *et al.*, 2016).

This decreases the demand for agriculture labour. Hence agriculture labour moves from on-farm works to off-farm works. Harvesting through machinery has become common. Mechanization displaces farm workers and act as a substitute for farm workers in the case of agriculture labour shortages. The most antagonistic form of mechanization is typically the adoption of harvest technologies for high-valued crops such as fruits and vegetables because of the large amount of agricultural labour involved (Schmitz and Moss, 2015). Another factor which diverts agricultural labour force from on-farm to off-farm sector is education. An educated person earns more from off-farm sector than the on-farm employment. One additional year of schooling for all adult males raises household income by 8.9 percent. One fifth of this additional income is achieved by relocating labour away from farming and towards non-farm work. An educated household earn more income from non-farm work then the farm work (Fafchamps and Quisumbing, 1999).

Due to Rural-Urban migration, the agriculture labour decreases in rural areas. Rural-Urban migration leads to the shortage of agricultural labour in the rural areas. No abundant labour is available for the agricultural practices and hence the agriculture production decreases (Zimmerer, 1993; Black, 1993). Even youth absence in agriculture labor has negative effects of agriculture production (Angba, 2003)

Social security and its access to agriculture sector is difficult in Pakistan as 70 percent of the population is working in informal sector (GoP, 2020). Informal economy expansion is mainly attributed to growth of real wages and employment (Guisinger and Irfan, 1980).

Those migrant households, whose family size is larger, increase their agriculture production. Because modernized agriculture needs a huge capital which is provided by the migrants and migrant households invest this income on the inputs used for the agriculture practices and hence the production increases. The rural-urban migration impacts on agriculture reveals that income generated from migrants can compensate for the decrease in labour input and provide resources in the form of capital for farm improvement and land productivity (Durand *et al.*, 1996; Stark, 1980; Taylor, 1999).

Farming community having higher education have higher opportunity cost and ultimately less inclined to agriculture. The earning pattern or wage in non-farm sector is weekly or monthly basis whereas in farm sector it is mostly annually or biannually. Non-farm workers have to spend less time on job while farm workers spend more time on farm works. There are more opportunities of employment in industrial sectors for educated people (Tocco *et al.*, 2012). Agricultural unskilled labor is leaving agriculture due to its inclination in modernization. Unskilled labor with poor education cannot operate the modern machinery or agricultural tools, causing them to leave the profession or learn technical education. Lack of agricultural technical education becomes the reason to leave agriculture (Tocco *et al.*, 2012).

Irrigated areas has more cropping intensity compared with arid areas due to availability of irrigation water, thus creating more opportunity for engagement of rural labor. Mechanisation is also replacing labor, causing labour migration from farm to non-farm activities

in Punjab. No doubt modernization of agriculture is important for the prosperity of the country but it is also obligatory to provide employment to the labour force of the country. The present study was designed to explore the factors affecting rural agriculture labor supply in irrigated area of Khushab, located in Punjab province.

Materials and Methods

The study area comprised of Khushab district of Punjab, which has diverse geography with irrigated plains, river area, mountains and Thal desert. Thal desert is also part of the district and the river Jhelum runs alongside making it highly fertile for agriculture. Crop yield is improving in Khushab due to drainage system improvement (Niazi *et al.*, 2008).

A comprehensive questionnaire is prepared after consultation with all stake holders. Data was collected from three randomly selected union councils of district Khushab spread across three agro-climatic areas of the district using multistage sampling technique. One village was selected randomly from each union council (Table 1). A well planned questionnaire was used for collection of data. Data was collected in June 2019 from 150 respondents and entered in excel and then shifted to Statistical package for Social Sciences (SPSS) version 21.0 for model formation and analysis.

Table 1: Population and sample size of each selected village from District Khushab.

Name of village	Tehsil	Population of village (heads)	Number of respondents selected
Kurpalka	Khushab	5,311	50
Tilokar	Khushab	3,183	50
Gunjial	Quaidabad	5,875	50

Empirical model

Multivariate regression model was applied to determine the effect of socioeconomic factors on agriculture labour supply. The dependent variable of the model was supply of agriculture labor in the farming systems of the area (Anim, 2011). Different factors having importance in rural economy like farm size, family size, off-farm market demand and farming experience were included in the model. Ordinary Least Square (OLS) technique was applied for drawing of results.

$$ALs = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \epsilon$$

Where;

ALs= Agriculture Labour supply in the agriculture market; X1= Work activities; X2= farm size of the household; X3= farming experience of the target farmers; X4= Family Size of the household; ε= Error term; β1, β2, β3 and β4 are the coefficients of the independent variables.

Results and Discussion

The farming community of the area was characterised on the basis of different work activities, their farming experience and family size. The work activities carried out by rural communities include farm activities, business, government employment, private employment and mix of these activities. The majority of rural communities in irrigated areas of Khushab were involved in farming business (37%). Other major activities include business (19%) and government employment (18%) or their mix activities bundle (14%) (Table 2).

Table 2: Respondents characterisation of Khushab district.

	Unit	Category	Fre- quency	%
Work activities	Number	Farm worker	56	37
	Number	Business	28	19
	Number	Govt. Employ	27	18
	Number	Private Employ	6	4
	Number	Business and Govt. Employ	21	14
	Number	Govt. and Private employ	2	1
Experi- ence	Number	Business, Govt. Employ and Private Employ	10	7
	(Years)	6-20	44	29
	(Years)	21-35	52	35
	(Years)	36-50	33	22
	(Years)	51-65	15	10
Family size	(Years)	66-80	6	4
	Number	1-5	39	26
	Number	6-10	83	55
	Number	11-15	20	13
	Number	15-20	8	5

The experience represents the entrepreneurship ability of the farming business. Mostly farmers are experienced in farming activities. The data revealed

that generally young family members are involved in farming business (64%) under the age of 35 years (Table 2). The 81% of the farmers have family size below 10 family members.

Average farm labor supply on the basis of their work activities per household was found to be 1.15±1.41 which indicate every household tendency towards other off farm business activities. The average farm size in Khushab is 19.93±10.01 acres while subsistence holding in Pakistan is identified as 12.5 acres (Saqib et al., 2016). This indicate more probability of farm household labor demand and farm production potential. Average family size was found to be 7.58±3.61 (Table 3) while average family size per household in Pakistan is 6.5 (Peerzado et al., 2019). Higher family size indicates high potential of farm labor supply in the studied area.

Table 3: Descriptive statistics of parameters of the model.

Parameters	Mean	Standard deviation	Mini- mum	Maxi- mum
Work activities (Number)	1.15	1.41	0.00	6.00
Farm size (Acre)	19.93	10.01	6.00	45.00
Farming experience (Year)	31.19	17.67	6.00	77.00
Family size (Members)	7.58	3.61	2.00	20.00

Farm labor supply determine the productivity imperatives of farmer economy in irrigated areas of Punjab. The results of the model revealed that all variables have significant effect on agriculture labor supply in rural areas. Farm size, experience and family size has positive relation with agriculture labor supply while off-farm activities has inverse relationship with agriculture labor supply in rural irrigated Khushab (Table 4).

Table 4: Parameter estimates of the factors effecting labor supply in agri. Markets.

	Coeffi- cients	Standard error	t Stat	P value
Intercept	1.038	0.360	2.882	0.004
Off-farm work (Year)	-0.156	0.061	-2.558	0.011
Farm size (Acre)	0.031	0.007	4.151	0.000
Experience (Years)	0.014	0.007	1.969	0.051
Family size (Number)	0.186	0.034	5.521	0.000

Farm size significantly and positively related to adopting off farm activities and business in Sindh province (Ahmad et al., 2020).

Off-farm work and agricultural labour supply

Off farm activities are increasing in rural areas and international organisations (ILO) were promoting decent activities in rural sector economy (ILO, 2019). Off farm activities income effect also stimulates production of agriculture commodities (Ma *et al.*, 2018) but farmer may use off-farm earnings for consumption purposes instead of investment in agriculture production (Woldeyohanes *et al.*, 2017). Off-farm employment improved due to decrease in agriculture labour force (Robinson *et al.*, 1982). In present study, results revealed inverse and significant ($P < 0.05$) relationship of off-farm activities with agriculture labor supply. As per results of the Farm labor supply model, the coefficients value of off-farm work is -0.156 which indicates that 0.15 units decrease in agriculture labour supply after 1-unit increase in off-farm activities. This is mainly attributed due to its elastic nature (Tocco *et al.*, 2012). Increase in off-farm work opportunity is one of the main factors contributing to decrease in agricultural labour of the farm households (Anim, 2011). An increase in off-farm income affects the consumption pattern and the farm households tried to adjust their standard of living to upward level. Thus, such a situation might lead the farm families to adopt off-farm jobs. According to Mehrotra *et al.* (2014) there was shrinkage in the demand of agricultural labor due to increasing in modernization of agriculture and growing capital intensity in the urban areas. The incomes of households in urban areas increases due to more educational institutions which negatively effects demand of agriculture labor (Mehrotra *et al.*, 2014). The farm income is the primary reason of the engagement of rural labor to off farm employment (Loughrey and Hennessy, 2016).

Farm size and agricultural labour supply

Farm size has positive relationship with agriculture labour supply (0.031) (Table 3). A unit increase in farm size will improve agricultural labour by 0.03 units. When the size of farm increases the farm income improved ultimately enhancing the farm labor requirement (Hanson and Spitze, 1974; Anim, 2011) and inverse relationship with productivity (Sheng *et al.*, 2019). The smaller farm size leads to food insecurity (Agidew and Singh, 2018) Most of the members of farmer families work at farm to fulfil the demand of agriculture labor. Farm size has inverse relationship to shift agriculture labor (farm household labor) from farm to off-farm employment (Serra *et*

al., 2005).

Farming experience and agricultural labour supply

More experience explores more opportunity for job (Mishra and Goodwin, 1997). Agriculture labor supply model indicated the positive and weak relationship of farming experience (0.014) with agriculture labor supply. This revealed a unit increase in farming experience in irrigated areas of Khushab leads to improvement of 0.014 units in agricultural labour supply. The ancestral farming communities engaged in farming from generations and are not willing to leave agriculture in irrigated areas due to vast farming experience and their land as important physical asset. More farming experience leads to higher yield than the inexperience and or less experience farmers. They remain in agriculture sector and do not like to engage with off-farm employment as efficient farmers do not want to work in non-agriculture (Goodwin and Mishra, 2004). An additional year of farming experience possess 0.99% probability of farm succession (Daniele *et al.*, 2015).

Family size and agriculture labour supply

Family size has direct and significant relationship with agriculture labour supply (Table 3). Results revealed that a unit increase in family size will increase 0.185 units in agriculture labour supply. According to Baluch *et al.* (1997) family size was found to be directly related to the non-agriculture labour supply and the opportunities for farm work. Family with more number of members had a bigger pool of labour available for both on-farm and off-farm work.

Conclusions and Recommendations

Agriculture is a back bone of rural economy being responsible of food supply to the local communities and world at large. Labor migration can inversely effect its performance and poses threat to food security of the country. This study investigated farm labor supply and its core areas like farm size, rural family size and farmer experience. It was explored that off farm work is adversely affecting the agriculture labor supply in irrigated Khushab. Family farm and off-farm business engagements determine the household economics and its sustainable development. The size of farm/ land holding is also an important element of economic activities. The land holding above subsistence holding in irrigated Khushab indicate prospects of better household economics and future expansion of farm

business and its sustainability. Family size has direct relationship with farm labor supply. Average family size is bigger in irrigated Khushab indicating more labor supply for future business expansion. Farming experience indicate the entrepreneurial ability of the farming community. More farming experience in irrigated regions indicate more business prospects and ability to mitigate sustainable farm challenges like climate change. It also adds value to the agriculture labor supply in the irrigated areas, thus contributing to local and regional agriculture markets.

For improving farm size, Government has to develop some legislation for fixation of minimum ceiling of land holding to avoid further division of ancestral land. For improving farming experience and converting them to entrepreneurship, capacity building program may be started through extension workers which will improve farm labor supply as well as productivity. More public sector investment in farming entrepreneurship will increase level of business activity in the area thus producing surplus for local and global markets.

Novelty Statement

The study presents the useful policy implications by highlighting factors affecting agriculture labor supply in irrigated plains of Punjab.

Author's Contribution

Arshad Mahmood Malik: Conceived idea, write up, and supervision overall work.

Nigah Hussain: Conduct research, data collection, write up.

Nasim Akhtar: Expert opinion, edited the manuscript.

Conflict of interest

The authors have declared no conflict of interest.

References

- Agidew, A.M.A., and K.N. Singh. 2018. Determinants of food insecurity in the rural farm households in South Wollo Zone of Ethiopia: The case of the Teleyayen sub-watershed. *Agric. Food Econ.*, 6(1): 1-23. <https://doi.org/10.1186/s40100-018-0106-4>
- Ahmad, M.I., L. Oxley and H. Ma. 2020. What

makes farmers exit farming: A case study of Sindh Province, Pakistan. *Sustainability*, 12(8): 3160. <https://doi.org/10.3390/su12083160>

- Ali, F., and A. Parikh. 1992. Relationships among labor, bullock, and tractor inputs in Pakistan agriculture. *Am. J. Agric. Econ.*, 74(2): 371-377. <https://doi.org/10.2307/1242491>
- Alizadeh, M.R., and A. Allameh. 2013. Evaluating rice losses in various harvesting practices. *Int. Res. J. Appl. Basic Sci.*, 4(4): 894-901.
- Amare, D., and W. Endalew. 2016. Agricultural mechanization: Assessment of mechanization impact experiences on the rural population and the implications for Ethiopian smallholders. *Eng. Appl. Sci.*, 1(2): 39-48.
- Angba, A.O., 2003. Effect of rural-urban migration of youths on agricultural labour supply in Umuahia North Local Government Area of Abia State, Nigeria. *J. Agric. Soc. Res.*, 3(2): 77-83. <https://doi.org/10.4314/jasr.v3i2.2796>
- Anim, F.D., 2011. Factors affecting rural household farm labour supply in farming communities of South Africa. *J. Hum. Ecol.*, 34(1): 23-28. <https://doi.org/10.1080/09709274.2011.11906365>
- Baluch, M.U.H., M. Wasif and M.W. Siddiqui. 1997. Off-farm employment and income of farm families in rural Punjab. *Pak. Econ. Soc. Rev.*, pp. 197-221.
- Bezu, S., and S. Holden. 2014. Are rural youth in Ethiopia abandoning agriculture? *World Dev.*, 64: 259-272. <https://doi.org/10.1016/j.worlddev.2014.06.013>
- Black, R., 1993. Migration, return, and agricultural development in the Serra Do Alvao, Northern Portugal. *Econ. Dev. Cult. Change*, 41(3): 563-585. <https://doi.org/10.1086/452032>
- Caunedo, J., and N. Kala. 2021. Mechanizing agriculture impacts on labor and productivity. <https://doi.org/10.3386/w29061>
- Chaudhry, M.G., and Z. Hussain. 1986. Mechanization and agricultural development in Pakistan. *Pak. Dev. Rev.*, 25(4): 431-449. <https://doi.org/10.30541/v25i4pp.431-449>
- Daniele, C., D. Bertoni, F. Tesser, and D.G. Frisio. 2015. What factors encourage intra family farm succession in mountain areas? Evidence from an Alpine Valley in Italy. *Mountain Res. Dev.*, 35(2): 152-160. Retrieved July 13, 2020, from www.jstor.org/stable/mounresedeve.35.2.152, <https://doi.org/10.1659/MRD-JOUR->

NAL-D-14-00107.1

- Devi, Y.L., J. Singh, K. Vatta and S. Kumar. 2013. Dynamics of labour demand and its determinants in Punjab agriculture. *Agric. Econ. Res. Rev.*, 26(2): 123-124. <https://doi.org/10.1177/019791839603000202>
- Durand, J., E.A. Parrado and D.S. Massey. 1996. Migradollars and development: A reconsideration of the Mexican case. *Int. Migrat. Rev.*, 30(2): 423-444.
- Saqib, S., M.M. Ahmad, S. Panezai and U. Ali. 2016. Factors influencing farmers' adoption of agricultural credit as a risk management strategy: The case of Pakistan. *Int. J. Disaster Risk Reduct.*, 17; 67-76. <https://doi.org/10.1016/j.ijdr.2016.03.008>
- Eshetu, F., and M. Beshir. 2017. Dynamics and determinants of rural-urban migration in Southern Ethiopia. *J. Dev. Agric. Econ.*, 9(12): 328-340. <https://doi.org/10.5897/JDAE2017.0850>
- Fafchamps, M., and A.R. Quisumbing. 1999. Human capital, productivity, and labor allocation in rural Pakistan. *J. Hum. Resour.*, pp. 369-406. <https://doi.org/10.2307/146350>
- Faridi, M.Z., and A.B. Basit. 2011. Factors determining rural labour supply: A micro analysis. *Pak. Econ. Soc. Rev.*, pp. 91-108.
- Foulkes, M.J., M. Reynolds and R. Sylvester-Bradley. 2009. Genetic improvement of grain crops: Yield potential. In: Sadras, V.O., Calderini, D., eds. *Crop physiology applications for genetic improvement and agronomy*. The Netherlands: Elsevier. <https://doi.org/10.1016/B978-0-12-374431-9.00015-3>
- Goodwin, B., and A. Mishra. 2004. Farming efficiency and the determinants of multiple job holding by farm operators. *Am. J. Agric. Econ.*, 86(3): 722-729. <https://doi.org/10.1111/j.0002-9092.2004.00614.x>
- GoP, 2017. Census 2017. Population and Housing Census of Pakistan. Government of Pakistan.
- GoP, 2019. Pakistan Economic Survey 2018-19, Islamabad: Ministry of Finance, Government of Pakistan.
- GoP, 2020. Pakistan Economic Survey 2019-20, Islamabad: Ministry of Finance, Government of Pakistan.
- Guisinger, S., and M. Irfan. 1980. Pakistan's informal sector. *J. Dev. Stud.*, 16(4): 412-426. <https://doi.org/10.1080/00220388008421769>
- Hanson, R., and R. Spitze. 1974. Farm size characteristics affecting off-farm earnings of illinois farmers. *Illinois Agric. Econ.*, 14(1): 26-30. <https://doi.org/10.2307/1348983>
- Iftikhar, S., and H.Z. Mahmood. 2017. Spatial distribution of agricultural resources and food security: A case of Punjab Pakistan. *Cogent Food Agric.*, 3(1): 1357265. <https://doi.org/10.1080/23311932.2017.1357265>
- ILO, 2019. Economic diversification of the rural economy, portfolio of policy guidance notes on the promotion of decent work in the rural economy, 9789220308028 (web PDF) [ISBN] View online.
- Kassem, M., A. Ali and M. Audi. 2019. Unemployment rate, population density and crime rate in Punjab, Pakistan: An empirical analysis.
- Khandai, S., N. Gupta, S. Baishya, K. Singh and V. Kumar. 2021. Opportunity of mechanized harvesting methods of cereal crops in India: A review. *Int. J. Curr. Microbiol. App. Sci.*, 10(01): 3137-3145. <https://doi.org/10.20546/ijemas.2021.1001.365>
- Lawrence, R., 1970. Some economic aspects of mechanization in Pakistan. AID, Islamabad.
- Loughrey, J., and T. Hennessy. 2016. Farm income variability and off-farm employment in Ireland. *Agric. Finance Rev.*, <https://doi.org/10.1108/AFR-10-2015-0043>
- Ma, W., A. Abdulai and C. Ma. 2018. The effects of off farm work on fertilizer and pesticide expenditures in China. *Rev. Dev. Econ.*, 22(2): 573-591. <https://doi.org/10.1111/rode.12354>
- Marcelino, A.F., C.C. Wachtel and N.D.C. Ghisi. 2019. Are our farm workers in danger? Genetic damage in farmers exposed to pesticides. *Int. J. Environ. Res. Publ. Health*, 16(3): 358. <https://doi.org/10.3390/ijerph16030358>
- Mehrotra, S., J. Parida, S. Sinha and A. Gandhi. 2014. Explaining employment trends in the Indian economy: 1993-94 to 2011-12. *Econ. Polit. Weekly*, pp. 49-57.
- Mishra, A., and B. Goodwin. 1997. Farm income variability and the supply of off-farm labor. *Am. J. Agric. Econ.*, 79(3): 880-887. <https://doi.org/10.2307/1244429>
- Niazi, M.F.K., A.R. Ghumman and W. Wolters. 2008. Evaluation of impact of Khushab sub surface pipe drainage project in Pakistan. *Irrig. Drain. Syst.*, 22(1): 35-45. <https://doi.org/10.2307/1244429>

- [org/10.1007/s10795-007-9030-6](https://doi.org/10.1007/s10795-007-9030-6)
- Peerzado, M.B., H. Magsi and M.J. Sheikh. 2019. Land use conflicts and urban sprawl: Conversion of agriculture lands into urbanization in Hyderabad, Pakistan. *J. Saudi Soc. Agric. Sci.*, 18(4): 423-428. <https://doi.org/10.1016/j.jssas.2018.02.002>
- Phyo, A.S., C. Grünbühel, L. Williams and S.S. Htway. 2016. Changing dynamics in rural Myanmar: Non-farm development, agricultural labor shortages and farm mechanization. In ACIAR Project mid-term research conference. Yezin Agric. Univ. Yezin, Myanmar, Vol. 31.
- Rangi, P.S. and M.S. Sidhu. 2004. New farm technology and changing structure of agricultural labour employment in Punjab. *Man. Dev.*, 26(4): 61-80.
- Robinson, C., P.J. McMahon and J.C. Quiggin. 1982. Labour supply and off farm work by farmers: Theory and estimation. *Aust. J. Agric. Econ.*, 26(1): 23-38. <https://doi.org/10.1111/j.1467-8489.1982.tb00406.x>
- Sabir, M., 2015. Gender inequality in labour force participation: An empirical investigation. *Pak. Dev. Rev.*, 54(4): 551-564. Retrieved July 12, 2020, from www.jstor.org/stable/43831340, <https://doi.org/10.30541/v54i4I-IIpp.551-565>
- Schmitz, A., and C.B. Moss. 2015. Mechanized agriculture: Machine adoption, farm size, and labor displacement. *AgBio Forum*, 18(3): 278-296.
- Serra, T., B.K. Goodwin and A.M. Featherstone. 2005. Agricultural policy reform and off-farm labour decisions. *J. Agric. Econ.*, 56(2): 271-285. <https://doi.org/10.1111/j.1477-9552.2005.00004.x>
- Sheng, Y., J. Ding and J. Huang. 2019. The relationship between farm size and productivity in agriculture: Evidence from maize production in Northern China. *Am. J. Agric. Econ.*, 101(3): 790-806. <https://doi.org/10.1093/ajae/aay104>
- Soliman, I., 1992. Agricultural mechanization and economic efficiency of agricultural production in Egypt (No. 1860-2016-153018).
- Stark, Q., 1980. On the role of urban to rural remittances in rural development. *J. Dev. Stud.*, 16(3). <https://doi.org/10.1080/00220388008421764>
- Taylor, E.J., 1999. The new economics of labour migration and the role of remittances in the migration process. *Int. Migr.*, 37(1): 63-88. <https://doi.org/10.1111/1468-2435.00066>
- Tocco, B., S. Davidova and A. Bailey. 2012. Key issues in agricultural labour markets: A review of major studies and project reports on agriculture and rural labour markets (No. 545-2016-38749).
- van Dijk, J., and A. Edzes. 2016. Towards inclusive and resilient regional labour markets: Challenges for research and policy. *Invest. Reg. J. Reg. Res.*, 36: 169-190.
- Woldeyohanes, T., T. Heckelesi and Y. Surry. 2017. Effect of off farm income on smallholder commercialization: panel evidence from rural households in Ethiopia. *Agric. Econ.*, 48(2): 207-218. <https://doi.org/10.1111/agec.12327>
- Zimmerer, K.S., 1993. Soil erosion and labor shortages in the Andes with special reference to Bolivia, 1953–1991: Implications for conservation with development. *World Dev.*, 21(10): 1659-1675. [https://doi.org/10.1016/0305-750X\(93\)90100-N](https://doi.org/10.1016/0305-750X(93)90100-N)