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LINKING SOCIO-ECONOMIC TRAITS WITH THE ADOPTION OF WEED MANAGEMENT PRACTICES (WMP) IN PUNJAB, PAKISTAN

[a]Muhammad Usman, [a]Humaira Hina, [b]Shama Mushtaq, [a]Sadia Aslam, [b]Naima Nawaz, [b]Asima Rasool, [b]Zareen Fatima

[a] *Institute of Agri. Extension, Education and Rural Development, University of Agriculture Faisalabad, Pakistan.*
[b] *Department of Rural Sociology, University of Agriculture Faisalabad, Pakistan.*

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ABSTRACT

Agricultural growth is obligatory for sustainable rural development and meeting the food requirements for the increasing population. Weeds put biotic stress on the crops and cause yield decline eventually. In this study, we explored the effect of socio-economic attributes of the farmers on the adoption of weed management practices (WMP) in four cropping systems (Rice-Wheat, Rice, Potato, Rice-Maize and Rice-Peas) of the Punjab, Province. Face-to-face interviews were conducted with the 356 respondents chosen through a proportionate sampling method from the District Gujranwala of Punjab. Data were analyzed using Statistical Package for Social Sciences and frequency, percentage and regression analysis was applied to the data. Results confirmed that respondents' age, education and income were statistically significant ($P<0.05$) with the adoption of WMP. As for as information sources were concerned, the association was significant in R-P ($P<0.05$) and R-Peas ($P<0.05$) cropping systems. This study endorsed that socio-economic characteristic had a key role in technological adoption. To accelerate the adoption, training programs for the farmers, provision of quality weedicides, subsidized inputs and awareness campaigns are suggested.

Corresponding Author: Naima Nawaz
Email: naimauaf@hotmail.com

INTRODUCTION

For sustainable rural development, food security and economic acceleration, the agriculture sector is considered vital. The agriculture sector contributed 22.7% to the national GDP and employed 37.4% of the labour force of the country. The improvement in the agriculture sector will surely increase farm income, curtail consumer prices, accelerate food supply and above all will generate employment (Government of Pakistan, 2022). Agriculture inside Pakistan is practised under different types of cropping systems. Some of the major cropping systems especially in the Punjab province are cotton-wheat, rice-wheat, maize-potato, rice-potato, cotton-maize, vegetable-wheat, maize-wheat, mixed crops, pulses-wheat etc (Ahmad et al., 2013). Production of major and minor crops in these cropping systems is less than the potential for different reasons like weed infestation. Frisvold et al. (2009) believed that with the adoption of weed management practices the potential yield can be achieved across the different cropping systems.

Weeds are unwanted plants in the field with the potential to cause a significant production drop. Weeds harm plants because they compete for soil nutrients, light, water and space. The spread of weeds and the occurrence of herbicide-resistant weeds is increasing over time. Weeds already have a dominating role in global crop losses (Fried et al., 2017). Vila et al. (2004) were of the

view that due to non-native weeds 42% crop production loss was recorded. On average, a 28% production decline was attributed to weeds (Villa et al., 2021). In another study, Thobatsi (2009) reported a 40-60% decline in crop production due to weeds. Specifically in Pakistan, a 40-50% production decline due to weeds was reported by Hafeez (2011). According to Clements et al. (2000), yield loss due to weeds in Pakistan was 11.5% whereas the total yield loss in the world due to weeds was 9.5%.

Weeds control is indispensable especially when the onus is on the agriculture sector to feed ever increasing population of the world. The current world population is 7.7 billion which is expected to reach over 9 billion by 2050. To feed this mammoth population, world food production will surely need to be increased by 70 to 100% (www.fao.org). Weed control in the UK costs farmers €150 million per year (Williamson, 2002) and $3 billion per year in the United States (Pimentel et al., 2005). In Australia, the overall cost of weed control was estimated at 3.3 billion Australian Dollars annually (Llewellyn et al., 2016). Indian farmers have to spend USD 11 billion each year on weed control (Gharde et al., 2018). Thus, suitable, less laborious, economically viable and environmentally friendly weed control have become complementary (Ali et al., 2005).

Adoption of different weed management techniques is associated with many factors including social, economic, institutional and human factors. Socio-economic factors of the farmers are much important in the adoption studies. Each stage of crop production asks for a particular set of decisions by the farmers (Mittal et al., 2010). These decisions are influenced by the socio-economic factors of the farmers. Mittal and Mehar (2016) indicated that farmers had utilization of multiple information sources to meet their information needs. However, the farmers' information utilization behaviour was influenced by their age, education, farm size and experience of the farmers. Rehman et al. (2013) reported that education and the size of land holdings influenced farmers' access to agriculture information. Sometimes despite an agreement to adopt certain techniques, farmers remain to fail to fully adopt the technology due to inadequate awareness and poor financial position (Truong et al., 2002). Prudent et al. (2007) agreed that some of the agricultural technologies were not fully adopted because of poor farming experience and exposure to their needs and access to information to meet their needs.

We believed that relevant and timely dissemination of information followed by the string socioeconomic position of farmers has a significant role in fostering the adoption (Cartmell et al., 2004). Thus, this study was conducted to explore the effect of socio-economic attributes of the farmers in the four cropping systems on the adoption of weed management.

METHODOLOGY

This study was conducted in the District Gujranwala. Study district is one of the prominent district in Punjab province of Pakistan. The district is famous for its potential in agriculture and four types of cropping systems such as rice-wheat, rice-berseem, rice-maize, and rice-potato are widespread across the district. The district has a total of five tehsils (Sub-districts) such as Gujranwala city, Gujranwala Sadar, Wazirabad, Kamuke and Nowshera Virkan. Considering the time and resources, the study was further downsized to three sub-districts. Of the total five tehsils, three such as Wazirabad, Kamuke and Nowshera Virkan were selected purposively becaue of large number of farmers.

For selection of sample, list of farmers was obtained from the office of the Deputy Director of Agriculture (Extension), Gujranwala. The list contained 4782 farmers practicing farming under different cropping systems. Out of 4782 farmers, 1645 belonged to rice-wheat cropping system, 1360 from rice-maize, 935 from rice-potato and 842 from the rice-peas cropping system. Sample size of 356 respondents was determined through online software www.surveysystem.com while keeping 95% confidence level and confidence interval of 5. Using the proportionate sampling technique, 122 from rice-wheat, 101 from rice-maize, 70 from rice-potato and 63 respondents from the rice-peas cropping system were selected as respondents.

We used a structured questionnaire for data collection. The questionnaire was prepared in line with to study objectives. The questionnaire was administered through a face-to-face interview technique. The researcher itself collected the data and data collection lasted for a year. The collected data were analysed using Statistical Package for Social Sciences (SPSS) was used for the analysis of techniques. Desriptive technique such as frequency and percentages were calculated moreverm linera regression model was applied on the data to explore the impact of socio-economic attributes of the farmers on the adoption of weed management practices.

RESULTS

Demographic attributes of respondents

Table 2 portrays the demographic profile of the farmers involved in the study as respondents concerning the adoption of different weed management techniques in different cropping zones such as Rice-Wheat, Rice-potato, Rice-maize and Rice-Pease. The demographic attributes brought under discussion were age, education, household size, tenancy status, farming experience and income sources. Descriptive statistics were applied to explore the demographic attributes of the respondents by frequency and percentages (Table 1).

Table 1. Demographic profile of respondents.

Attributes	Rice Wheat		Rice-Potato		Rice Maize		Rice-Pease		Total	
	F	%	F	%	F	%	F	%	F	%
Age										
Young	32	26.2	19	27.1	25	24.8	28	44.4	104	29.2
Middle	53	43.4	36	51.4	40	39.6	17	27.0	146	41.0
Old	37	30.3	15	21.4	36	35.6	18	28.6	106	29.8
Education										
Illiterate	23	18.9	17	24.3	25	24.8	14	22.2	79	22.2
Primary-Middle	57	46.7	27	38.6	38	37.6	15	23.8	137	38.5
Matric	25	20.5	19	27.1	33	32.7	15	23.8	92	25.8
Above Matric	17	13.9	7	10.0	5	5.0	19	30.2	48	13.5
Household size										
Up to 5	42	34.4	29	41.4	36	35.6	24	38.1	131	36.8
6-10	50	41.0	26	37.1	42	41.6	20	31.7	138	38.8
Above 10	30	24.6	15	21.4	23	22.8	19	30.2	87	24.4
Tenancy Status										
Owner	81	66.4	46	65.7	72	71.3	32	50.8	231	64.9
Owner-cum-tenant	37	30.3	18	25.7	22	21.8	20	31.7	97	27.2
Tenant	4	3.3	6	8.6	7	6.9	11	17.5	28	7.9
Farming experience										
Low (Up to 10)	31	25.4	22	31.4	19	18.8	32	50.8	104	29.2
Medium (>11-20)	34	27.9	30	42.9	33	32.7	17	27.0	114	32.0
>20	57	46.7	18	25.7	49	48.5	14	22.2	138	38.8
Income sources										
Farming only	47	38.5	56	80.0	69	68.3	47	74.6	219	61.5
Farming + non-farming	75	61.5	14	20	32	31.7	16	25.4	137	38.5

Table 1 shows, that 29.2% of the respondents were young followed by 41% of respondent who was in the middle of their age. Almost 30% of respondents were old. Of the total respondents, 22.2% were illiterate and 77.8% of respondents had formal education. Among the participating farmers, 38.5% had an educational level of primary to middle followed by one-fourth (25%) of respondents who qualified for matric level. Of the total respondents, 13.5% had a qualification level of more than matriculation. Out of the total respondents, 36.8% of the respondents had less than 5 members in their households. Almost 39% of respondents had 6-10 family members. One-fourth (24.4%) of the households had more than 10 family members. The majority of respondents (64.9%) were owners of their lands. Greater than one-fourth (27.2%) of respondents were owner-cum-tenants and 7.9% of respondents were tenants. Data shows that 29.2% of the participating farmers (219 farmers) had farming experience of fewer than 10 years. Around 32% of respondents had experience in farming between 11 to 20 years. Of the total respondents, 38.8% (138 farmers) were highly experienced farmers entailing

an experience of over two decades. In the Rice-Wheat cropping system, 38.5% of respondents were reliant on farming for income. In Rice-Potato, (80%), 68.3% in Rice-Maize and 74.6% of respondents in Rice-Potato had key reliance on only farming to generate income. Private businesses and services were the secondary income sources accompanied by farming as well.

Lining socio-economic profile with adoption

Socio-economic characteristics of the farmers play an important role in increasing awareness and adoption of particular technology among farmers. The major constituent of the socio-economic attributes is age, level of education, size of possessed land, farm size, tenancy status of the grower, income earned in a year and sources of income (Ashraf et al., 2015). Age, education and land holding were viewed as significant in impacting the awareness and adoption of production practices (Chaudhry et al., 2012; Pervaiz et al., 2013; Ojo and Babayo, 2013; Saleem et al., 2022; Kidane and Zwane, 2022). This indicates that with the variation in demographic attributes of farmers, the likelihood of change in awareness and adoption does exist. In this study the impact of demographic attributes was examined through regression analysis (Table 2).

Table 2. Relationship between the demographic attributes and adoption of weeds management techniques.

Demographic attributes	Cropping systems							
	R-W		R-P		R-M		R-Peas	
	β	*P*	β	*P*	β	*P*	β	*P*
Age	.195	.000**	-.109	.000**	-.115	.000**	-.266	.000**
Education	.487	.008**	.388	.002**	.380	.018*	.221	.026*
Experience	.158	.460^{NS}	-.170	.284^{NS}	.225	.326^{NS}	.051	.518^{NS}
Income	.421	.025*	.332	.037*	.241	.014*	.267	.026*
Sources of information	.125	.412^{NS}	.387	.011*	.215	142^{NS}	.261	.025*
	R^2= 0.521		R^2= 0.671		R^2= 0.421		R^2= 0.791	
	Adjusted R^2=0.430		Adjusted R^2=0.645		Adjusted R^2=0.390		Adjusted R^2=0.773	
	P=0.031		P=0.040		P=0.000		P=0.000	

*Significant at 95% ** highly significant at 99% ^{NS}= non-significant

For the rice-wheat cropping system, R^2 was 0.521 which explained a 52% variation in the model. The overall model is statistically significant (P = 0.031). For R-P (P = 0.40), R-M (P = 0.000) and R-Peas (P = 0.000) cropping systems, the models were statistically significant (P<0.05). R^2 values in the R-P, R-M and R-Peas cropping was 0.671, 0.421 and 0.791, respectively reflecting a variation of 67, 42 and 79% by the five independent variables in the model including age, education, experience, income and sources of information.

Age

Results indicated a statistically significant association with the adoption of weed management practices (P<0.05; β=0.195). age had a statistically significant but negative association with the adoption of weed management practices in R-P (P=0.000; β=-0.109), R-M (P=0.000; β=-0.119) and R-Peas (P=0.000; β=-2.66) cropping systems respectively. This negative relationship confirms that the unit increase in age of the respondents may dent the level of adoption regarding weed management. This has also been reported that the farmers who are considerably old remain less likely to adopt particular innovations. On contrary, the young farmers remain more likely to take risks and adopt the particular technology. This is endorsed by the results from Ashraf et al. (2015), as they found that age had a statistically significant relationship with the awareness and adoption of certain technologies. They further complemented that the farmers with a younger age were more inclined towards adoption rather than those who were considerably older.

Education

Education was statistically significantly associated with the adoption of weed management practices across the four cropping patterns R-W (P= 0.008; β=0.487), R-P (P= 0.002; β=0.388), R-M (P= 0.008; β=0.487) and R-Peas (P= 0.026; β=0.221), respectively. This is deduced that with the increase in the educational level of respondents the

level of adoption of weed management practices will remain higher. As reported by Rahman et al. (2015), due to illiteracy the farmers were unable to adopt agricultural innovations. Thus, on another hand, by improving the educational level of farmers the likelihood of more adoption will increase as endorsed by Nlerum (2006), Siddiqui et al. (2006) and Salehin et al. (2009). All of these cited studies established a significant relationship between education with the adoption of production technologies.

Farming Experience

Farming experience had a non-significant relationship with the adoption of weeds management practices (P>0.05) across the four cropping systems R-W, R-P, R-M and R-peas respectively. This implies that farmers' experience had no impact on the speed of adoption of weed management practices. It can be deducted from this non-significant association that weeds grow and their management is inevitable for the farmers irrespective of their farm experience. However, farming experience may help farmers in the selection of any suitable weed management technique. Although, chemical control of weeds is often adopted and implemented by the farmers for many reasons. Udensi et al. (2012) postulated that experience was associated with the adoption. Farmers having more experience might have more inclination towards adoption as compared to those have less experience of farming.

Income

The income of the farmers had a statistically significant relationship with the adoption of weeds management techniques in R-W (P=0.025; β=0.421), R-P (P=0.37; β=0.332), R-M (P=0.014; β=0.241) and R-Peas (P=0.026; β=0.261). This is the confirmation that income has a direct influence on the rate of adoption. The more income the adoption will be higher among farmers. The income strengthens the adaptive capacities of the farmers and persuades them by improving their affordability to adopt the particular technology. Findings are endorsed by those of Syiem and Raj (2015) as they found that income of the farmers had a significant impact on the adoption of modern techniques.

Source of information

The Source of information had a statistically non-significant relationship with the adoption of weed management techniques in R-W (P>0.05) and R-M (P> 0.05) cropping systems. Whereas the relationship was statistically significant in the R-P (P=0.011; β=0.387) and R-Peas (P=0.025; β=0.261) cropping systems. This can be stated that the penetration of information sources, dissemination of information and access to the information could be the factors behind this varying relationship across the four cropping systems. This can be concluded as well that with the increase in access to information the rate of awareness and adoption among farmers can be expedited. Findings are endorsed by those of Usman et al. (2021) as they found that farmers had inadequate knowledge and limited exposure to the accessible information sources, thus they were not adequately adopting the recommended weed management practices.

Suggestions to bridge adoption gap

Respondents were experience growers across the four cropping systems. Researchers believed their opinions and suggestions would help to strengthen the policy implications of this study, especially in context of weeds management. Thus, respondents were asked to postulate the suggestions to bridge adoption gap among farmers regarding weeds control. The distribution of obtained response is given in Table 3.

Table 3. Suggestions made by the respondents to enhance the adoption of weed management practices.

Suggestions	Frequency	Percentage
Adulteration in weedicides should be controlled	251	70.5
Adulterated seeds should be removed from the markets to ensure quality	233	65.4
Interest free credit schemes for the farmers	225	63.2
Subsidized inputs	217	61
Technical skills regarding mechanical weed control measures should be given	203	57.0
Ensuring the availability of quality weedicides	199	55.9
Prices of weedicides should be controlled in local markets	184	51.7

Knowledge sharing regarding spraying techniques	151	42.4
Labour shortage needs to e bridged	130	36.5
Training programs should be launched by public and private sector extension field staff for the farmers	118	33.1
Ensure controlled prices of inputs i.e. pesticides	110	30.9
Awareness campaigns should be created regarding weed management practices	109	30.6
Link between farmers and extension field staff should be improved	105	29.5

Table 3 indicates different suggestions postulated by the respondents to bridge the adoption gap. The foremost suggestions made by the respondents were relevant to adulteration of pesticides and seeds. Around 70.5% of respondents suggested the control over adulteration of weedicides and seeds (65.4%). Seed is the basic unit which can guarantee a proper germination and potential production in the end. However, the adulterated seed not only adversely affects the germination but also decreases the production. Similarly, quality weedicides are much important in discourse of weeds management.

Finance is determinant to adoption, therefore 63.2% of respondents suggested initiation of interest free credit schemes for the farmers to combat the finance shortage and expedite the process of adoption. Subsidized inputs (61%) can also help farmers to meet the finance shortage and help in improving the production. More than half (57%) of respondents asked for imparting technical skills regarding mechanical weed control measures. More than half (55.9%) of respondents were of the view that ensuring availability of quality weedicides in the market with the controlled prices (51.7%) should be ensured. Quality weedicides were direly needed as the quality products give lasting results over the weeds control. In another case, application of substandard weedicides put stress on the crop.

Of the total participating farmers, 42.4, 36.5, 33.1 and 30.9% of respondents demanded for the knowledge sharing among farmers regarding spraying techniques, labour availability, training programs for the farmers by public and private extension field staff, and ensuring the controlled prices of inputs, respectively.

Among respondents, 30.6% asked for the initiation of awareness campaigns for the dissemination of awareness among fam farmers regarding weeds management practices. Linkage between the farmers and extension field staff should be improved as demanded by 29.5% of the respondents. Previously, it has been reported that linkage between farmers and extension field staff was weak, which had adverse impacts on the farmers and the adoption of particular technology. In this regard, this is much needed to strength the relation between farmers and extension field staff.

CONCLUSION AND RECOMMENDATIONS

This study was mainly concerned with the assessing the effects of socio-economic attributes of the farmers on adoption of weeds management practices. Weeds are competitors of the crops for the nutrients and all the available resources. Thus, weeds management remains an inevitable to ensure the potential production of crops. Adoption was associated with the socio-economic attributes of the farmers like, age, education, land size, household size, tenancy status, farming experience and income sources. This study confirmed that, Age, education and income level of respondents had statistically significant relationship ($P<0.05$) with the adoption of weeds management practices. Farming experience was non-significant with the adoption ($P>0.05$). as for as information sources were concerned, the association was significant in R-P ($P<0.05$) and R-Peas ($P<0.05$) cropping systems. This study has proven that socio-economic attributes had a key position in adoption process. With the increase in education and income of the farmers the rate of adoption will be higher. Therefore, training programs for the farmers, ensuring quality of the weedicides, and subsidized inputs for the farmers suggested to improve the socio-economic position of the farmers.

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