Research Article

Apple Industry and Use of Pesticides in Jammu and Kashmir: Cost Involvement and Growers Willingness to Pay for its Mitigation

Arshad Bhat[1]*, Masudul H. Wani[1], Shabir A. Wani[2], Abid Qadir[3], Iqra Qureshi[4] and Abid Sultan[2]

[1]Rajiv Gandhi Chair in Contemporary Studies on Livelihood and Food Security, [2]School of Agricultural Economics and Horti-Business Management, Sher-E-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar Srinagar, [3]The Glocal University, Utra Pardesh, India; [4]Central Institute of Temperate Horticulture, Rangreth Srinagar.

Abstract | Use of indiscriminate pesticides have severe negative impacts on human health, biosphere and ecological web-chains. Easy access and availability of pesticides has opened the sphere of choices to the growers, but the recognition of standard and sub-standard pesticides has made the growers very much perturbed and they lack confidence to rely on these pesticide outlets. By using such pesticides, the growers are being looted which in turn resulted in heavy cost involvement both visible and invisible. In this backdrop, present study attempts to highlight involvement of invisible costs in apple industry of Union Territory of Jammu and Kashmir. Defensive Expenditure Method and Willingness to Pay Model was used to estimate the costs incurred on the health and protective items purchased for reducing the impact of excessive pesticide use on health and ecosystem. Furthermore, Contingent Valuation Method was employed for knowing the willingness of the apple growers to use pesticides in biodegradable packages for reducing the environmental damage caused due to dumping of polyethene and other non-degradable bottle in the canals, streams orchards and other open spaces. The results reveal that number of sprays are positively affecting the defensive expenses and is having a negative relationship between educational attainment and defensive expenses but a positive relationship between willing to pay for purchase of biodegradable packages of pesticides and educational attainment. Likewise, gender of the respondent was also found to be having a positive relation with purchase of biodegradable bags.

Received | April 08, 2020; **Accepted** | March 15, 2021; **Published** | May 29, 2021
***Correspondence** | Arshad Bhat, Rajiv Gandhi Chair in Contemporary Studies on Livelihood and Food Security; **Email:** bhatarshad09@gmail.com, arshadrgc@skuastkashmir.ac.in
Citation | Bhat, A., M.H. Wani, S.A. Wani, A. Qadir, I. Qureshi and A. Sultan. 2021. Apple industry and use of pesticides in Jammu and Kashmir: Cost involvement and growers willingness to pay for its mitigation. *Sarhad Journal of Agriculture,* 37(2): 607-612.
DOI | https://dx.doi.org/10.17582/journal.sja/2021/37.2.607.612
Keywords | Combat, Illness, Cost involvement, Packaging, Defensive expenditure

Introduction

Pesticides use has posed severe threat to agriculture, horticulture, environment and human health and played a catastrophic role to contaminate every component of our ecosystem be it steams, springs or any other source of surface water. The abundant usage of pesticides has also deteriorated soil texture and the taste of vegetable grown on that very land (Pimentel, 2005). Himalayas in India are mostly rich in horticultural products and during 2015-16, it was recorded that over 20,000 people died due to pesticide self-poisoning (Naqash, 2019). Due to easy availability of pesticides in homes it was found that that there was a steady rise in suicidal deaths from past two decades (Toby *et al.*, 2020). Excessive use of pesticides is draining the resources of the poor farmers in multiple ways, like costs incurred on health and hygiene, expenditure on protective items etc. (Rola and Pingali, 1993; Antle and Pingali, 1995,

Antle *et al*., 1998; Ajayi, 2000; Maumbe and Swinton, 2003; Devi, 2007; Baba *et al*., 2012, 2017; Atriya, 2013). Studies across countries like India, Nepal and Africa (Ajayi, 2000; Maumbe and Swinton, 2003; Devi, 2007; Atriya, 2013) have valued and analysed the ill-effects of pesticides on human health and hygiene (Ajayi, 2000). Atreya (2008) highlighted a farmer always chooses increase in yield at the cost of his health. Health costs incurred by the farmers are inseparable from production cost and are directly responsible for their less production and production activities and therefore should be treated as part of the production costs instead of considering as externalities (Ajuzie and Altobello, 1997). Though lot of research has been conducting on the subject of pesticide use in agriculture /horticulture, but a modest attempt has been made to present a combined approach to highlight the hidden costs associated with the use pesticides in the horticulture/agriculture, with a suitable alternative preferred by the growers to combat and reduce the impact of pesticides on the health, ecology and ecosystem.

Materials and Methods

The study was carried out in three zones of Kashmir valley with the help of a multi-stage sampling techniques. The date was collected from the apple growers, pesticide dealers and environmental experts. The data was collected from two selected blocks viz; Shadimarg and Zainpora from South Kashmir Pulwama and Shopian district respectively, blocks Nagam and Harwan from Budgam and Srinagar districts of the Central Kashmir zone and blocks Zainageer and Rafiabad of Baramulla and Kupwara districts of North Kashmir zone of Kashmir valley. From each community development block a cluster of 2 to 3 villages has been outlined and randomly selected. Lastly, 100 respondents have been selected randomly from a complete list of respondents in selected villages and in totality a sample of 600 respondents (apple growers) were interviewed with the help of a pre-tested structured questionnaire.

Econometric models

Defensive expenses method: The model was used to measure the impact of pesticide use on human health (Wilson, 1998, 2003; Wilson and Tisdell, 2001; Maumbe and Swinton, 2003; Atreya, 2013; Naqash, 2019). The model specifications employed is as follows;

$$DE = \alpha+\beta_1 x_1+ \beta_2 x_2+ \beta_3 x_3+ \beta_4 x_4+ \beta_5 x_5+ \beta_6 x_6+ \beta_7 x_7+u_i$$

Where,
DE= Defensive expenses (Expenditure on masks, handkerchiefs, long-sleeved shirts/pants, and sprayers), α= intercept, x_1= Gender of respondent, x_2= Age of respondent, x_3= Frequency of pesticides application, x_4= Exposure to fungicides, x_5= Farm experience of the respondent, x_6= Number of sprays done, x_7= Education of the respondent.

Willingness to pay method: For reducing ill-effects of the environment and human health, the new pesticides were assumed to be similar in terms of their pest killing effect to those of currently used pesticides. The algebraic expression for the items of willingness to pay were of the form as:

$$WTP = \alpha+\beta_1 Ge+ \beta_2 Ag+ \beta_3 Ed+ \beta_4 TRF+ \beta_5 FM+u_i$$

Where,
WTP= willingness to pay (for bio-degradable packaging); α= intercept; Ge= Gender of the respondent; Ag= Age of the respondent; Ed= Education of the respondent; TRF= Total rupees fetched; FM= Family members.

Results and Discussion

Age is considered one of the dominated factors for conducting a study which is of socio-economic nature. Age of respondent is taken as determining factor for the respondent to be involved in the activity depending upon the nature of that activity. Table 1 shows the age structure of the respondents in the sampled area and depicts that 43 percent of respondents in the sampled area fall in the age group 40-50 followed by 27 percent in 30-40 years of age group meaning thereby that young people are involving themselves in the horticulture sectors despite the fact that people are leaving the agriculture due to its less remunerative nature these days. From the table it can be observed that average age of the respondents in the sampled area is calculated at 16.66 years.

Family type has a tremendous role in using and choosing pesticide applications and in the sampled area also the range of family is one of the factors determining the damages caused to the human health and environmental biosphere. Table 2 presents the range of family size in the sampled area. Majority of the respondents (32.67%) belong to the households

having 0-5 members followed (31.17 %) by 5-7 members in the sampled area. Similarly, only 0.67 percent and 1.00 percent of the households were found having family size ranging from 25-30 and 30 and above, respectively in the sampled area.

Table 1: *Age of respondents in the sampled area.*

Age in years	Percentage
20-30	6
30-40	27
40-50	43
50-60	12
60-70	8
70 and above	4
Average	16.66

Source: *Field survey.*

Table 2: *Range of family members in the sampled area.*

Family members	Male	Female	(%)
0-5	94	102	32.67
5-7	90	97	31.17
7-10	43	40	13.83
10-12	32	29	10.17
12-15	19	18	6.17
15-20	10	8	3.00
20-25	4	5	1.33
25-30	2	2	0.67
30 and above	4	2	1.00

Source: *Field survey.*

Education the only measuring rod which can be used for understanding the societal advancement, pattern of living, awareness about health and environmental issues, climate regarding challenges and mitigation measures. Table 3 presents the education structure of respondents in the study area and from the figures given in the table it can be observed that highest number of respondents fall in the category of primary/middle (40.17%) followed by illiterates (29.67%) educational level, which is not a good sign for the sampled area regarding the awareness of damages caused due to excessive pesticide use.

Table 3: *Educational status of respondents in the sampled area.*

Educational status	Percentage
Illiterate	29.67
Primary/Middle	40.17
High school	20.50
Graduate and above	9.67
Average	25.0

Source: *Field survey.*

Experience of an individual is considered one of the significant determinants for performing an activity in a wonderful manner. Experience is achieved with the passage of time and involvement in the specific activity. Table 4 presents the experience of growers with regard to apple growing and use of pesticides in the sampled area. From the table it is very much evident that highest number of respondent (40 %) who are actively involved with the apple business have 30-40 years of experience followed by 32 percent respondents who possess 15-30 years of farming experience. The average experience of respondents was calculated to 25 years which is good sign for the apple cultivation in the sampled area.

Table 4: *Farm experience of respondents in the sampled area.*

Years of experience	Percentage
1-15	7
15-30	32
30-45	40
45-60	21
Average	25

Source: *Field survey.*

Table 5: *Precautionary measures used by the respondents in the sampled area.*

Protective Items	Responses (%)
Face masks	15
Gloves	4
Boots	99
Aprons	23
Handkerchiefs	14
Long sleeved shirts	31
Hats	17
Average	29

Source: *Field survey.*

Though pesticide use is very helpful for the farmers to increase the productivity, quality of the fruits and in turn economic welfare. Judicious use of pesticides and fertilisers is good for health of both biotic and abiotic components of the ecosystem, but excessive use of pesticides and fertilisers can prove harmful to the food web and food chain of this ecosystem. Pesticides and fertiliser application is very risky and it poses huge economic costs to the respondents in the form cost on defensive expenditure and cost on purchasing precautionary items. Table 5 presents the responses regarding use of protective items by

the respondents while applying pesticides and other chemicals to the apple in the sampled are. Table 6 shows that 99 percent of respondents were using boots while applying pesticides in their orchards compared to 4 percent respondents who use gloves while applying pesticides to the apple crop. The Table 6 points out that on an average only 29 percent of the respondents were found using protective items while applying pesticides in their orchids.

Table 6: *Impact of different confidents on defensive expenses of pesticide application in apple cultivation.*

Estimates				
Model	Unstandardized coefficients		T	Sig.
	B	Std. error		
(Constant)	554.530	72.167	7.684	.000
Gender	5.986	13.915	.430	.667
Age	-.433	.530	-.817	.414
Frequency of pesticide application	2.259	.869	2.601	.010
Exposure to fungicides	2.363	6.292	.375	.707
Farming experience	.952	.603	1.578	.115
Number of sprays	-7.633	5.613	-1.360	.174
Education level	1.351	14.025	.096	.923

Source: *Authors estimations.*

Table 6 shows that defensive expenditure is having positive relation with age means old aged respondents are supposed to apply the more of pesticides and it is found that there is an increase of 0.43 percent increase in pesticide applications with the increase in age, gender of respondent is also a determining factor in pesticide application to fruits with a value of 5.98 percent, that means, if the respondent who applies pesticides is a male has to spent less on the illness caused due to pesticide exposure and if the applicant is a female, she has to spent more on the illness expenses, because women are considered to be more vulnerable to the exposure caused due to smell and residues of pesticides. Pesticide application frequency is having a significant effect on the defensive expenses in the sampled area and the value of the cost incurred by the respondents was estimated as 2.25 percent and exposure to fungicides is also significantly contributing to the defensive expenses incurred on health of the respondents in the sampled area and the estimated value is 2.36 percent. Experience in farming a significant attribute in the pesticide application was also take care of, and it was found that with increase in farming experience there is found a reduction of 0.95 percent in the defensive expenses. While number of sprays are positively affecting the defensive expenses and there is a 7.63 percent decrease recorded in defensive expenses with the reduction in number of pesticides in the sampled area. Education of the respondent a dominant factor plays a significant factor in awaring the people regarding ill effects of excessive pesticide use and it was observed to be contributing highly in reducing defensive expenses. The estimates reveal that with one stage (illiterate to primary, primary to secondary, secondary to college level and college level to university level) increase in education leads to 1.35 percent decline in defensive expenses.

Table 7: *Respondents willingness to pay for purchase of pesticides in biodegradable packages.*

Coefficients [a]				
Model	Unstandardized coefficients		t	Sig.
	B	Std. error		
(Constant)	98.600	12.529	7.869	.000
Gender	3.693	5.701	.648	.517
Age	-.108	.175	-.621	.535
Education level	-2.506	5.709	-.439	.661
Total rupees fetched/ha	-1.067E-005	.000	-2.497	.013
Family members	.435	.561	.776	.438

Source: *Authors estimations.*

Table 7 presents the willingness to pay of the respondents with regard to the safe alternatives available in the market to combat the environmental pollution and ill effect of human health. Gender is considered to an important in determining the use of pesticides in the apple orchards, therefore, male respondents are willing to pay 3.69 percent more to buy a pesticide in the biodegradable bags which gets easily decompose after their use as compared female respondents. Similarly, age of the respondent is also playing a tremendous role in choosing the pesticide, young respondents are willing to pay 0.10 percent more, to buy a pesticide in degradable packs. Education of respondents a very significant and highly determining factor to reduce the pollution and save the resources for the future generations and therefore, highly educated respondents are willing to pay 2.5 percent more to buy biodegradable packaged pesticides compared to illiterates. Likewise, income/ standard of living of the respondents also plays a dominant role in purchasing the quality pesticide for

the apple orchards, therefore, a high-income family is able to pay extra amount to reduce the environmental pollution, the growers are high conscious about the environment conservation and they are willing to pay 1.06 percent more to purchase pesticides in biodegradable packets than poor respondents. Family size is also contributing towards purchase of biodegradable packaged pesticides, as households with less number of family members are willing to pay 0.43 percent extra to buy a biodegradable packaged packet of pesticide than large family size households.

Conclusions and Recommendations

The study concludes that the apple growers made huge expenditure on pesticides every year, which poses a considerable damage to health and environmental. From the results it can be concluded that respondents were not highly literate and that was the reason for not using the protective items while applying the pesticides in their orchards. They were found dumping the residue in to Strems, on open spaces which ultimately cause damage to health and environment to a great extent. Being conscious of the climatic distress, apple growers are willing to 7 to 9 percent more prices to purchase pesticides in biodegradable packages which are environmental friendly and less risky to human health. The study suggests that the pesticide trade should be put under strict licencing as it was observed in the field that dozens of less qualified persons are running their outlets and recommending the dosage which is very dangerous to the community and to the fruit itself. Similarly, frequent checks should be made by the concerned KVK (Krishi Vigyan Kendra) staff to field during the pesticide spray season to show and recommend growers through field demonstrations how to mix the pesticides and how to apply and what to use while applying the pesticides.

Acknowledgements

The authors are highly grateful to Indian Council of Social Science Research (ICSSR), New-Delhi for providing Financial Support. We are equally thankful to University Grants Commission New-Delhi and Vice-chancellors of Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir and Central University of Kashmir for providing timely and logistic support in completion of this study.

Novelty Statement

This is a worldwide based approach to measure the impact of pesticide residues on human health and ecological biosphere.

Author's Contribution

AB, MHW and SAW: Designed methodology, analysed the data and wrote the interpretation of the article.
AQ and IQ: Collected and tabulated the data.
AS: Provided input on the interpretation of results.

Conflict of interest
The authors have declared no conflict of interest.

References

Ajayi, O.C., 2000. Pesticide use practices, productivity and farmers' health: the case of cotton-rice. https://www.researchgate.net/publication/259799107

Ajuzie, E.I.S. and M.A. Altobello. 1997. Property rights and pollution: Their implication for Long Island Sound and the oyster industry. Rev. Agric. Econ., 19(2): 242-251. https://doi.org/10.2307/1349739

Antle, J.M. and P.L. Pingali. 1995. Pesticides, productivity, and farmer health: A Philippine case study. In: P.L. Pingali and P.A. Roger (Eds.), Impact of pesticides on farmer health and the rice environment (pp. 361–385). Philippines: Int. Rice Res. Inst., https://doi.org/10.1007/978-94-011-0647-4_13

Antle, J.M., D.C. Cole and C.C. Crissman. 1998. Further evidence on pesticides, productivity and farmer health: Potato production in Ecuador. Agric. Econ., 18: 199-207. https://doi.org/10.1111/j.1574-0862.1998.tb00499.x

Atreya, K. 2008. Health costs from short-term exposure to pesticides in Nepal. Social Sci. Med., 67: 511-519.

Atriya, K., 2013. Pesticide use in Nepal: Health effects and economic costs for farmers in the central mid-hills. Ph.D Thesis. Department of International Environment and Development Studies (Noragric). Norwegian University of Life Sciences

Baba, S.H., H.A. Malik, S.A. Mir, Y. Hamid and M.M. Kachroo. 2017. Externalities of Pesticide

Application on Apple in Kashmir Valley. Agric. Econ. Res. Rev., 30(1): 81-92. https://doi.org/10.5958/0974-0279.2017.00007.6

Baba, S.H., M.H. Wani, S.A. Wani and B.A. Zargar. 2012. Pesticide delivery system in apple growing belt of Kashmir Valley. Agric. Econ. Res. Rev., 25: 435-444.

Devi, I.P., 2007. Pesticide use in the rice bowl of Kerala: Health costs and policy options. SANDEE Working Paper No. 21. Kathmandu, Nepal: South Asian Network for Development and Environmental Economics.

Maumbe, B.M. and S.M. Swinton. 2003. Hidden health costs of pesticide use in Zimbabwe's smallholder cotton growers. Soc. Sci. Med., 57: 1559-1571. https://doi.org/10.1016/S0277-9536(03)00016-9

Naqash, F. 2019. Pesticide use pattern of horticultural crops in Kashmir with special reference to Apple. Ph.D thesis. Faculty of Horticulture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir.

Pimentel, D. 2005. Environmental and economic costs of the application of pesticides primarily in the United States. Environ. Develop. Sustain., 7: 229-252. https://link.springer.com/article/10.1007/s10668-005-7314-2

Rola, A.C. and P.L. Pingali. 1993. Pesticides, rice productivity, and farmers' health: An economic assessment. Philippines: International rice research institute and world resources institute systems in cote d'lvoire, West Africa. Pesticide Policy Project, Special issue publication series no 3. Hanover, Germany: University of Hanover.

Toby, B., U. Leah, K. Duleeka, G. David and E. Michael. 2020. Suicide by pesticide poisoning in India: A review of pesticide regulations and their impact on suicide trends. Bonvoisin *et al*. BMC Publ. Health, 20: 251. https://doi.org/10.1186/s12889-020-8339-z

Wilson, C. and C. Tisdell. 2001. Why farmers continue to use pesticides despite environmental, health and sustainability costs. Ecol. Econ., 39: 449-462.

Wilson, C., 1998. Cost and policy implications of agricultural pollution with special reference to pesticides. Ph. D thesis. Department of Economics, University of St Andrews, Scotland, UK. https://research-repository.st-andrews.ac.uk/handle/10023/3725

Wilson, C., 2003. Empirical evidence showing the relationships between three approaches for pollution control. Environ. Resour. Econ., 24: 97-101. https://doi.org/10.1023/A:1022838112228