IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 12, Issue 1 Ver. II (January. 2018), PP 38-44
www.iosrjournals.org

Perception Of Farmers And Consumers On Pesticide Use In Brinjal

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Abstract: *Brinjal is an important vegetable crop of India and accounted for 9 per cent of the total vegetable production in the country. The present study was conducted during the year 2014-15 in the Belagavi district of Karnataka with the objective to study the perception of farmers and consumers on health hazards due to pesticide use. The study was based on primary data obtained from brinjal growing farmers. Brinjal fruit and shoot borer was one of the most important insects causing yield loss in brinjal in the study area. Organophosphates, AnthralinicDiamides, Carbamates, Spinosyns, Organochlorines, Benzene Dicarboxamides, Benzoylureas, Pyrethroids, and fungicides were major groups of pesticide used by farmers in the study area.*
Keywords: *High yielding variety, fruit and shoot borer in brinjal, willingness to pay.*

Date of Submission: 27-11-2017 Date of acceptance: 09-12-2017

I. Introduction

India is the second largest producer of vegetables in the world, next only to China. India shares about 14 per cent of the world vegetables output from about two per cent of the cropped area in the country. Vegetable cultivation has become an important means for reducing poverty of small farmers in India. It helps to generate valuable income for farmers and laborers. The increase in population, urbanization and the rising income have given great impetus to the cultivation of vegetable crops which form an important source of minerals, particularly calcium, magnesium and iron, vitamins like A, B-complex and C and fibers.India ranks second in production of potatoes, onions, cauliflowers, brinjal, and cabbages. Among vegetables, potato (28%), tomato (11%), onion (10%) and brinjal (9%), together accounted for about 58 per cent of vegetable production. Karnataka is one of the leading states in Southern India with a great potential for horticultural development.. The state stands at 8th position with respect to area and production of vegetables. It is one of the leading vegetable producing states in the country with a production of 7841.9 thousand metric tonnes, grown over an area of 436.6 thousand ha [1].Belagavi is the major vegetable producing district in the Northern Karnataka, with an area of 34012 ha and production of 4.49 lakh tonnes[2].

Brinjal (*Solanummelongena* L.) is an important and indigenous vegetable crop of India. It is one of the most common vegetable grown throughout the country. India produced 126.34 lakh tonnes of brinjal in the year 2013 second only to China. It accounted for nine per cent of the total vegetable production in the country. Among major constraints in economic cultivation of brinjal, pest infestation causes heavy loss. It is infested by large number of insect pests including fruit and shoot borer, jassid, white fly which cause 70 per cent to 90 per cent losses in fruit yield. Among the major pest species that feed on brinjal, the brinjal fruit and shoot borer (BFSB) is the most destructive. Nearly all farmers rely exclusively on application of chemical pesticides to combat BFSB. Use of different chemical formulations helped in checking of various insect-pest and diseases of brinjal. Excessive use of chemical pesticides has destroyed natural enemies of BFSB, resulting in a resurgence of the pest population. This practice has resulted in tremendous misuse of pesticides, causing a multitude of side effects that includes increased cost of production as well as exposure of farmers and consumers to pesticide residues. Indiscriminate use of pesticide has led to several ecological consequences like destruction of natural enemy, fauna and effect on non-target organisms, ultimately resistance to pesticide use. India is the largest producer of pesticides in Asia and ranks 12th in the world with respect to the pesticide use. The area under plant protection has been continuously increasing in India.. The most damaging ecological disturbance of injudicious use of pesticides is the existence of high concentration of pesticide residues in food chain, including cereals, pulses, vegetables, fruits, milk and milk products, fishes, poultry, meat products and water. Fruit and vegetable crops receive considerably high quantity of pesticides, and with a cropped area of three per cent, they consume 13 per cent of the total pesticides in the country[3].Persistent chemicals can be magnified through the food chain and have been detected in products ranging from meat, poultry, and fish, to vegetable oils, nuts, and various fruits and vegetables. Finally, vegetables tend to be sprayed heavily up to the time of harvest, and then shipped

directly to market with no waiting period and moreover many are consumed whole. These create a very significant potential for pesticide residues causing negative health effects on consumers [4]. The effect of chemical pesticide-use is more harmful in vegetables. Pesticide poisoning is a major global health problem in the recent days. The harmful effects on human beings in the form of acute and chronic toxicity exposed to insecticides are well established. These problems have necessitated assessing of views of farmers and consumers on health hazards due to indiscriminate use of pesticide and make them aware about negative effect of indiscriminate use of pesticides. This study attempts to assess the perception of farmers and consumers on health hazards due to pesticide use.

II. Materials And Methods

To evaluate the objective of the study, the information was collected from sample farmers by interviewing personally using a pre-tested structure interview schedule. Multistage sampling procedure was used to select the respondents to obtain the required data. The area under brinjal in Belagavi district of Karnataka was highest (2185 ha) forming 14.07 per cent of the brinjal area in the state. Hence this district was selected in the first stage purposively for the study. Further in Belagavi district, Gokak, Bailhongal, Saudatti, Hukkeri and Belagavitaluks were having maximum area under brinjal and hence these taluks were selected purposively for the study in the second stage. Two villages predominantly growing brinjal from each of the selected taluks were selected in the third stage. Twelve brinjal growers from each village were randomly selected at the final stage to make a total sample of 120 respondents for the study. Sample farmers were post classified into three groups based on number of pesticide applications. Those who applied pesticide less than mean -0.425 σ were classified as low pesticide users (LPU), those who applied between mean -0.425 σ and mean + 0.425 σ were considered as medium pesticide users (MPU). High pesticide users (HPU) were those who applied pesticide more than mean + 0.425 σ. The tabular presentation was followed for analyzing the data elicited through opinion survey from the sample farmers. The data has been compressed to form appropriate tables using mean and percentage.The data from 40 sample consumers in the Belagavi city market was collected randomly for the study.

III. Result And Discussion

1. Types of pesticide use by brinjal growers

Pesticide use in brinjal cultivation has become regular and inevitable feature, even though most of the farmers discount the complexities involved and consequences of indiscriminate use of pesticides. Organophosphates, AnthralinicDiamides, Carbamates, Spinosyns, Organochlorines, Benzene Dicarboxamides, Benzoylureas, Pyrethroids, and fungicides were major groups of pesticide used by farmers in the study area which is presented in Table 1. All the farmers used organophosphate and fungicides. Most of the farmers 83.87 per cent (low pesticide users), 88.46 per cent (medium pesticide users) and 75.67 per cent (high pesticide users) used AnthralinicDiamides for controlling the pest in brinjal followed by Carbamates, Spinosyns, Organochlorin, Benzene Dicarboxamides, Benzoylureas and Pyrethroids. The quantities of pesticide used by low, medium and high pesticide users were 1.09, 2.33 and 4.40 a.i (lit or kg per ha). Monocrotophos was a major organophosphates used with an average quantity of 0.18, 0.15 and 0.19 a.i. lit/ha followed by Quinalphos with average of 0.12, 0.07 and 0.13 a.i. lit/ha by low, medium and high pesticide users respectively.Dichlorvos was used with an average quantity of 0.07, 0.05 and 0.09 a.i. lit/ha and Chlorpyriphos with average quantity of 0.112, 0.03 and 0.02 a.i. lit/ha by low, medium and high pesticide users respectively. Insecticides like Chlorantraniliprole, Spinosad, Flubendamide, Nuvaluron and pyrethroid like cypermethrin were also used by the sample respondents. Among the Carbamates, Thiodicarb was used by low, medium and high pesticide users with average quantity of 0.035, 0.73 and 0.09 a.i. kg /ha respectively. Indoxacarb was another type of Carbamate used by low, medium and high pesticide users with average quantity of 0.23, 0.23 and 0.008 a.i. lit/ha respectively. Butachlor as weedicide was used with average quantity of 0.37, 0.25 and 0.52 a.i. lit/ha by low, medium and high pesticide users respectively. Mancozeb was a major fungicide used (0.13, 0.26 and 0.34 a.i. kg /ha by the low, medium and high pesticide users respectively). Hexaconozole, Difiniconozole and Carbendazim were another type of fungicides used by sample respondents.

Among the Organophosphates, Monocrotophos was major insecticide used by the sample farmers. Organophosphates are highly toxic to human and livestock compared to other groups of insecticides [5]. They may often cause short run health problems to applicators of these chemicals. Organochlorines are another group of pesticide which is also toxic in nature but highly persistent in the environment.

2. Number of pesticides application by brinjal growers

Distribution of sample farmers according to number of pesticide applications is shown in Table 2. Farmers used pesticides frequently since pest infestation was relatively high in brinjal compared to other vegetables. The number of sprays ranged from 5 to 15, with an average of 9 sprays per farm with standard

deviation of 2.64. About 25 per cent of the farmers applied on an average 9 sprays, followed by 18.33 per cent, 12.50 per cent and 11.67 per cent of farmers applied 8, 6 and 10 sprays respectively.

3. Optimum quantity of pesticide required in brinjal production

The optimum quantity of pesticide requirement for brinjal production was presented in Table 3. The optimum quantity of pesticide required for brinjal was estimated to be 1.15, 2.23 and 2.14 a.i. lit or kg for low, medium and high pesticide users respectively. But the actual quantities of pesticide used by low, medium and high pesticide users were 1.09, 2.33 and 4.40 a.i. lit or kg respectively. Thus low pesticide users were found to use less than the optimal quantity of pesticide required and medium and high pesticide users used more than the optimum requirement. In other words farmers belonging to medium and high pesticide users lost ₹385.13 and ₹ 8503.95 per ha because of an uneconomical use of pesticides.Jeyanthi.andKombairaju[6]reported that average pesticide usage has been estimated at 5.13, 2.77, 4.64 and 3.71 kg active ingredient per hectare on chilies, cauliflower and brinjal and bhendi crops, respectively. The study conducted by Singh*et al.* [7] in paddy, vegetables and cotton found that the pesticide consumption was 2.47 kgs and 1.85 kgs active ingredient per hectare on non IPM and IPM adopted farmers respectively. These studies revealed that the farmers were found to use more quantity of pesticide than the optimal.

4. Farmer's opinion towards pesticide use

It could be observed from Table 4 that majority of the farmers (93.55 % in low pesticide users, 96.15 % in medium pesticide users and 91.89 % in high pesticide users) had opinioned that pesticide use was adequate. About 41.94 per cent (low pesticide users), 11.54 per cent (medium pesticide users) and 48.65 per cent (high pesticide users) reported that they read the literature of pesticide and observed the instructions. In case of low, medium and high pesticide users, 25.81 per cent, 38.46 per cent and 29.72 per cent of the farmers were aware of prices of alternate pesticides available in the market. Only 6.54, 7.69 and 8.11 per cent of low, medium and high pesticide users were aware of importance of labels and colour symbols on PPC containers. Very low per cent of farmers (3.23 %, 3.84 % and 2.71 % of low, medium and high pesticide users) had awareness of lethal dose of pesticides. Only 9.68 per cent in low pesticide users, 5.77 per cent in medium pesticide users and 5.4 per cent in high pesticide users were aware of recommended dose of pesticides.

5. Pesticide handling practices

Pesticide handling practices followed by sample farmers are shown in Table 5. About 61.29 per cent (low pesticide users), 51.92 per cent (medium pesticide users) and 62.16 per cent (high pesticide users) of the respondent farmers have not adopted any safety measure while applying pesticides.

The protective coverings used by the respondents were facemasks, hand gloves, shoes and polythene bags in place of hand gloves. Only 6.45 per cent (low pesticide users), 11.53 per cent (medium pesticide users) and 10.81 per cent (high pesticide users) of the sample respondents used face mask while applying pesticides. No one used shoe while applying pesticide in the case of low pesticide users. Only 3.88 and 8.11 per cent of medium and high pesticide users wore shoe while applying pesticide chemicals. Hand gloves as protective covering was used only by 3.23, 3.88 and 5.40 per cent of the respondent farmers in case of low, medium and high pesticide users. About 32.2, 28.84 and 13.51 per cent used poly bag in place of hand gloves for handling pesticides. About 87.1, 86.54 and 91.89 per cent of farmers belonging to low, medium and high pesticide user class respectively have taken bath after spraying of the pesticide chemicals.

Majority of the respondents (90.32 % in low pesticide users, 84.61 % in medium pesticide users and 81.08 % in high pesticide users) washed their hands with the soap after handling pesticide chemicals. In the case of low, medium and high pesticide users about 51.61, 59.62 and 54.05 per cent of the respondents sprayed along the wind direction. Only 6.45, 3.85 and 8.11 per cent of low, medium and high pesticide users did not considered wind direction while applying pesticides. Majority of the farmers (64.52 % in low pesticide users, 83.78 % in medium pesticide users and 64.86 % in high pesticide users) sprayed in the morning hours. None of the farmers were found to apply pesticide in the afternoon. Most of the farmers used wooden stick to mix the pesticide. Majority of the farmers (90.32 %, 75 % and 59.45 % in low, medium and high pesticide users) used measuring jar to measure the quantity of pesticide to be used. Farmers chewing tobacco while applying pesticides were 22.58 per cent, 19.23 per cent and 21.62 per cent and farmers smoking during chemical application were 6.45 per cent, 1.92 per cent and 2.7 per cent in case of low, medium and high pesticide users respectively.

Safety measures like use of face masks, hand gloves and shoes while applying pesticide were followed by very less proportion of sample respondents. Most of the farmers have taken bath after pesticide application which is considered as good for practice to avoid contamination of body with pesticide. Most of the farmers used wooden stick to mix the pesticide. Correct time of application was followed by more than 40.38 per cent of the farmers.

6. Sources of information about pesticides use and perceived health hazards

The sources of information about pesticides use for the farmers were presented in Table 6. Majority of the farmer (70.96 %, 67.3% and 67.56 % of low, medium and high pesticide users) obtained the information from pesticide dealers. A low per cent of the farmers in different groups applied pesticide based on their own experience and information obtained from neighbors. Hardly 6.45 per cent, 5.76 per cent and 8.11 per cent of the respondents in low, medium and high pesticide users obtained information from Agricultural University. The proportion of farmers obtaining information from extension workers was also very low.

Health hazards perceived by the farmers to exposure of pesticides were presented in Table 6.1. Eye irritation, headache and blurred vision were major health problems faced by 41.94 per cent of farmers followed by skin irritation, dizziness, sweating and salivation, vomiting sensation, and diarrhea in the case of low pesticide users.

In the case of medium pesticide users, skin irritation was major problem faced (65.38 %) followed by dizziness, headache, eye irritation, blurred vision, shortness of the breath, sweating and salivation, vomiting sensation, diarrhea and heart palpitation in that order.

Skin irritation was the major health problem faced by high pesticide users (83.78 %) followed by eye irritation, dizziness, blurred vision, head ache, shortness of breath, sweating and salivation, vomiting sensation, diarrhea and heart palpitation (78.38 %, 73.8 %, 75.68 %, 67.56 %, 64.86 %, 51.35 %, 29.73 %, 13.51 % and 2.70 %).

7. Perception of consumers about pesticide use in brinjal

The perception and awareness of consumers about pesticide use in brinjal production is presented in Table 7. About 55 per cent of consumers were aware of pesticides used in brinjal production and 37.5 per cent were aware of the harmful effects of pesticide residues in brinjal on human health and 30 per cent consumers were aware of health hazards arising out of long term consumption of brinjal cultivated using pesticides. About 67.5 per cent consumers preferred to buy organically produced brinjal.The study conducted by Rima*et al.* [8]showed that more than 54 per cent of sample households were extremely concerned about pesticide residues and 35 per cent actually took extreme precaution in buying items considering this perceived threat. Schobesberger*et al.*[9]studied consumer perceptions of organic foods in Bangkok of Thailand. More than a third of the respondents reported having purchased organic vegetables or fruits. The main reasons for purchasing organic products were that consumers expect them to be healthier and organic products were environmentally friendly

8. Consumers' willingness to pay (WTP) more prices for pesticide free brinjal

The lowest willingness to pay (WTP) for pesticide - free brinjal was assumed to be zero. The direct estimation of WTP for pesticide free brinjal by means of different (direct) elicitation techniques and consumers simply indicate their WTP without purchasing the (non-market) hypothetical product. The WTP was elicited by asking respondents to indicate how much above regular market prices they would be willing to pay, choosing from 4 classes of price premiums: no extra, up to 10 per cent, 11 to 20 per cent and more than 20 per cent.Consumer's shown willingness to pay more prices for pesticide free cabbage in the Belagavi district of Karnataka and majority of the consumers expressed their WTP for pesticide free cabbage [10].

Tables

Table 1: Types of pesticides used by brinjal growers

Sl. No	Pesticide	LPU		MPU		HPU	
		Qtya.i. lit or kgs	Value (₹)	Qtya.i. lit or kgs	Value (₹)	Qtya.i. lit or kgs	Value (₹)
I	**Organophosphates**						
1	Monocrotophos 35% EC	0.1785	229.50	0.1490	191.59	0.1915	246.28
2	Quinalphos 25 % EC	0.1154	276.96	0.0716	171.92	0.1291	310.05
3	Chlorpyriphos 20% EC	0.1122	33.67	0.0287	43.15	0.0177	26.59
4	Dichlorvos 76 % EC	0.0708	53.81	0.0544	71.63	0.0924	121.62
II	**AnthralinicDiamides**						
1	Chlorantraniliprole 18.5 %SC	0.0200	1799.49	0.0154	1388.01	0.0166	1492.43
III	**Spinosyns**						
1	Spinosad 45 % SC	0.0124	413.71	0.0165	550.38	0.0263	876.89
IV	**Organochlorin**						
	Butachlor 50 % EC	0.3750	300.00	0.2561	204.92	0.5213	417.08
V	**Carbamate**						
1	Thiodicarb 75% WP	0.0357	35.79	0.7320	244.00	0.0923	307.78

2	Indoxacarb 14.5 % SC	0.2273	705.48	0.0290	90.00	0.0087	272.43
VI	**Benzene Dicarboxamides**						
1	Flubendamide 30 % SC	0.0084	213.90	0.0145	369.23	0.0367	934.45
VII	**Benzoylureas**						
1	Nuvaluron 10 % EC	0.0890	267.09	0.0027	83.07	0.0038	116.75
VIII	**Pyrethroids**						
1	Cypermethrin 5.5 % EC	0.0009	4.67	0.0010	5.16	0.0029	14.96
IX	**Others (Fungicides)**						
1	Hexaconozole 5 %EC	0.0098	118.74	0.0081	97.84	0.0128	154.21
2	Difiniconozole 25% EC	0.0275	440.96	0.0058	93.84	0.0153	245.67
3	Mancozeb 70 % WP	0.1381	69.09	0.2619	130.98	0.3390	169.51
4	Carbendazim 50 % WP	0.0646	124.18	0.0221	42.46	0.0329	62.01
	Total	**1.0848**	**5186.61**	**2.329**	**8973.32**	**4.398**	**16556.37**

Table 2: Distribution of sample farmers according to number of pesticide applications

Number of sprays	Number of farmers	%
5	12	10.00
6	15	12.50
7	4	3.33
8	22	18.33
9	30	25.00
10	14	11.67
11	1	0.83
12	12	10.00
14	2	1.67
15	8	6.67
Average application per farm	8.89	-
Standard deviation	2.64	-

Table 3: Optimum quantity of pesticide requirement in brinjal production

Farmer	LPU		MPU		HPU	
	Qtya.i. (lit or kg)	Value (₹)	Qtya.i. (lit or kg)	Value (₹)	Qtya.i. (lit or kg)	Value (₹)
Actual use	1.09	5186.61	2.33	8973.32	4.40	16556.37
Optimal use	1.15	5472.1	2.23	8588.19	2.14	8052.42
Savings	0.06	285.50	-0.10	-385.13	-2.26	-8503.95

Table 4 : Farmer's opinion towards pesticide us**e**

Sl. No	Particulars	LPU		MPU		HPU	
		Number of farmers (n_1= 31)	%	Number of farmers (n_2= 52)	%	Number of farmers (n_3= 37)	%
1	Sufficient use of pesticide	29	93.55	50	96.15	34	91.89
2	Reading the literature of pesticide and observing the instructions	13	41.94	6	11.54	18	48.65
3	Aware of prices of alternate pesticides	8	25.81	20	38.46	11	29.72
4	Aware of importance of labels and colour symbols on PPC containers	2	6.45	4	7.69	3	8.11
5	Aware of lethal dose of pesticide	1	3.23	2	3.84	1	2.71
6	Aware of recommended dose	3	9.68	3	5.77	2	5.40

Table 5: Pesticide handling practices followed by sample farmers

Sl. No	Particulars	LPU		MPU		HPU	
		Number of farmers (n_1= 31)	%	Number of farmers (n_2=52)	%	Number of farmers (n_3= 37)	%
1	Safety measures followed						
	No protective measures	19	61.29	27	51.92	23	62.16
	Use of Face masks	2	6.45	6	11.53	4	10.81
	Use of hand gloves	1	3.23	2	3.88	2	5.40
	Use of Poly bag in place of hand gloves	9	32.2	15	28.84	5	13.51
	Use of shoes	0	0	2	3.88	3	8.11
	Taking bath after spray	27	87.10	45	86.54	34	91.89
	Washing hands after spray						
	a) with soap	28	90.32	44	84.61	30	81.08
	b) with both soap and mud	2	6.45	4	7.6	5	13.51
	c) with mud	1	3.23	2	3.85	2	5.41
2	Direction of Application						
	Along wind direction	16	51.61	31	59.62	20	54.05
	Not considering wind direction	2	6.45	2	3.85	3	8.11
	Against wind direction	13	41.94	19	36.53	14	37.83
3	Time of application						
	Morning	11	35.48	21	40.38	13	35.13
	Afternoon	0	0.00	0	0.00	0	0.00
	Evening	20	64.52	31	83.78	24	64.86
4	Pesticide mixing practice						
	Use wooden stick	29	93.55	46	88.46	34	91.89
	By pouring water and spray lancer	0	0.00	1	1.92	0	0.00
	Use Sprayer lancer	2	6.45	4	7.69	1	2.70
	Use bare hands	0	0.00	1	1.92	2	5.41
5	Measurement of pesticides						
	Measuring jar	28	90.32	39	75.00	22	59.45
	Bottle cap	4	12.90	13	25.00	15	40.54
6	Activities during application						
	Chewing tobacco	7	22.58	10	19.23	8	21.62
	Smoking	2	6.45	1	1.92	1	2.70

Table 6 : Sources of information about pesticides use for the farmers

Sl. No	Sources	HPU		MPU		HPU	
		Number of farmers (n_1= 31)	%	Number of farmers (n_2 = 52)	%	Number of farmers (n_3 =37)	%
1	Pesticide dealers	22	70.96	35	67.30	25	67.56
2	Own experience	3	9.67	4	7.69	4	10.81
3	Neighbors	2	6.45	3	5.76	3	8.11
4	Agricultural University	2	6.45	3	5.76	3	8.11
5	Extension workers	1	3.23	4	7.69	2	5.40
6	Extension literature	1	3.23	2	3.84	0	0.00
7	Television / Radio	0	0.00	1	1.92	0	0.00

Table 6.1: Perceived health hazards of pesticide exposure

Sl. No	Symptom /Hazard	LPU		MPU		HPU	
		Number of farmers (n_1 = 31)	%	Number of farmers (n_2 =52)	%	Number of farmers (n_3 =37)	%
1	Skin irritation	12	38.71	34	65.38	31	83.78
2	Eye irritation	13	41.94	31	59.62	29	78.38
3	Dizziness	11	35.48	32	61.54	29	78.38
4	Head ache	13	41.94	32	61.54	25	67.56
5	Shortness of breath	13	41.94	25	48.08	24	64.86
6	Sweating and salivation	9	29.03	24	46.15	19	51.35
7	Vomiting sensation	6	19.35	13	25.00	11	29.73
8	Blurred vision	13	41.94	29	55.77	28	75.68
9	Diarrhea	1	3.23	4	7.69	5	13.51
10	Heart palpitation	0	0.00	3	5.77	1	2.70

Table7: Consumer perception about pesticide use in brinjal production

Sl. No	Type of perception	Frequency	%
1	Aware of pesticides used in brinjal production	22	55.00
2	Aware of the harmful effects of pesticide residues	15	37.50
3	Aware of health hazards arising out of long term consumption of brinjal cultivated using pesticides	12	30.00

Table 8: Consumer's willingness to pay (WTP) more prices for pesticide-free brinjal

Sl. No	Willingness to pay	Frequency	Percentage
1	No extra	7	17.50
2	Up to 10 % more	22	55.00
3	11 to 20 % more	9	22.50
4	More than 20 %	2	5.00

IV. Conclusion

Majority of the farmers get the information about pesticide from the pesticide dealers. Farmers should be encouraged to get information on optimum quantity of pesticide use from Agricultural Universities and extension workers. Awareness needs to be created on use of personal protective measures among farmers, while handling pesticides. Farmers need to be encouraged to reduce the use of synthetic pesticides and induce them to go for bio pesticides and organic farming. Farmers need to be educated about different non-chemical control methods and encouraged to adopt Integrated Pest Management practices. Research activities to develop pest resistance varieties may be taken up more intensively. Fifty five per cent of consumers were willing to pay up to 10 per cent more than the price prevailing in the market. This willingness to pay more for pesticide free product shows consumer acceptance of agricultural crops grown with reduced pesticide applications. Long-term investment in health education campaigns on food-borne particularly risks from pesticide residues is needed so that consumers would be able to separate regular produce from organic produce.

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