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Use of insecticides in vegetable production and the factors responsible for its use in vegetable production in lower Brahmaputra valley zone of Assam, India

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Abstract
Insecticides are mainly used by the farmers to control insect-pests in an agricultural farm. Due to ignorance, lack of awareness or some other reasons, the farmers apply the chemicals in injudicious way. Therefore, an attempt was made to know the extent of use of agricultural chemicals in vegetable production and to explore the factors responsible for the use of insecticides in vegetable production with the null hypothesis that 'there is no relationship between the application of insecticides and chemical fertilizers. The factors responsible for the use of insecticides were analyzed using the multiple regression analysis. The result revealed that all the vegetable growers used insecticides at a very higher concentration than the recommended dose. 74.66 per cent farmers applied insecticides in the fields at an interval of less than 10 days and 19.33 per cent farmers applied as and when necessary. Out of eight different determinants, the use of chemical fertilizers (in kg) showed a positive and significant relationship with the use of insecticides at 0.001 level in all the three groups of farmers and thus, it concluded that the null hypothesis 'there is no relationship between the application of plant protection chemicals and chemical fertilizers' was rejected. The determinant vegetable farming experience (years) showed positive and significant relationship in the farmers group II and group III at 0.1 level.

Keywords: Agricultural, determinants, injudicious, insecticides, null hypothesis

Introduction

Agricultural chemical refers to any substance involved in the growth or utilization of any plant or animal of economic importance to humans. The agricultural chemicals include fertilizers, insecticides, fungicides, acaricides, growth regulators, animal feed supplements and raw materials for use in chemical processes.

Insecticides are important agricultural chemicals for crop production. They help farmers grow more food on less land by protecting crops from pests, diseases and weeds as well as raising productivity per hectare. India is the second largest consumer of insecticides followed by USA. However, per hectare use of pesticide in India is much lower as compared to other countries like China (13.06 kg/ha), Japan (11.85 kg/ha), Brazil (4.57 kg/ha) and other Latin American countries (FAOSTAT, 2017) [6].

The application of pesticides is considered as one of the vital components of Green Revolution and it played a major role in maintaining high agricultural productivity. Consequently, in high input intensive agricultural production systems, the widespread use of pesticides to manage pests has emerged as a dominant feature (Tilaman *et al*., 2002) [13]. However, reliance on pesticides is difficult to sustain because of unintended long-term adverse effects on the environment and human health in particular (Pimentel D., 2005) [11].

Vegetable cultivation contributes to better income and employment opportunities, as well as to nutritional benefits of smallholder farmers, rural labourers and consumers. As compared to cereals and other crops, the vegetable crops can lead to enhance the farm productivity and higher farm gate income (Ali M., 2008; Johnson G. 2008; Weinberger K. and Lumpkin T.A., 2007) [2, 8, 15]. Stimulating the growing of the vegetable crops commercially may lead to enhance the economic growth. Vegetable gives 350% higher monthly net return than rice (Hasan M.R., 2005) [7]. Moreover, vegetables are considered as the major source of dietary micronutrients (Ali M. and Abedullah A., 2008) [3].

The farmers in the state of Assam have been using insecticides to save crop from insect-pests. But, they apply the insecticides without any technical know how about its uses.

Therefore, an attempt has been made to know the extent of use of agricultural chemicals in vegetable production and to explore the determinants responsible for the use of insecticides in vegetable production at Lower Brahmaputra Valley Zone of Assam with the null hypothesis that 'there is no relationship between the application of plant protection chemicals and application of chemical fertilizers'.

Materials and Methods

There are six agro-climatic zones in the state of Assam. Out of these agro-climatic zones, one agro-climatic zone namely, Lower Brahmaputra Valley zones was selected for the study. Out of the districts in the zone Barpeta district was selected for study based on the area under vegetable cultivation. Two Agriculture Development Officer Circles were selected for the study. Five villages from each circle and 15 vegetable growing farmers from each village were selected. Considering the time constraint, the study was confined to five winter vegetables namely, cabbage, cauliflower, potato, brinjal and tomato. A total of 150 numbers of respondent farmers were selected for the study. The farmers were categorized as group I, group II and group III based on their area under vegetable cultivation using the Cumulative Square Root frequency method (Singh R. and Mangat N.S., 1996) [12]. The farmers' group I included the farmers having vegetable cultivation area less than 0.4 ha, group II included the farmers having vegetable growing area 0.4 - 0.8 ha and the group III included the farmers having more than 0.8 ha vegetable growing area.

The determinants of use of plant protection chemicals in vegetable production were evaluated using multiple regression analysis. The model used was explicitly expressed as

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + e_i$$

Where:

Y_i represents the amount of use of plant protection chemicals per hectare of vegetables produced

β_0 = constant

β_i = estimated coefficients of the explanatory variables

X_i = explanatory variables

e_i = disturbance term

The explanatory variables hypothesized to have a relationship with the dependent variable use of plant protection chemicals. The age of the head of households has been measured in year. The educational qualification of the farmer was set as a dummy variable, where 1, 2, 3, 4, 5, 6 represents illiterate, Lower Primary (LP) standard, Middle English (ME) standard, High school standard, Higher Secondary standard and Degree standard and above, respectively. Education helps to express the talents and inherent enterprising qualities of the farmers (Nwaru J.C., 2004) [10] and make them more skill and more responsive to risk taking and change than the illiterate farmers. Vegetable farming experience had been measured in years. The types of seeds used by the farmers was also set as a dummy variable taking the value 1, 2, 3, 4, 5 and 6 for hybrid, HYV, local, hybrid & local, HYV & local and hybrid & HYV, respectively. Distance to market was measured by the kilometers from the area of production to the market. Closer markets reduce transportation costs, hence motivate the farmers to use more agricultural chemicals. The total land cultivated under rabi vegetables was measured in hectares. The unit of quantity of manure used had been measured as quintal per hectare. The quantity chemical fertilizer was measured in kilograms per hectare.

Results and Discussion

Distribution of respondents according to educational standards

Education of farmers is a very important factor for getting a better production and return. The farmers should have better technological knowledge on farming practices for achieving a better productivity. The distribution of respondents according to educational standards has been depicted in Table 1. The table reveals that the highest 28.67 per cent respondents were attained higher secondary standard followed by high school standard (23.33 per cent), ME standard (13.33 per cent), degree and above standard (10.67 per cent) and LP standard (7.33 per cent) with the 16.67 per cent illiterate. The highest 42.11 per cent respondents under group III were found higher secondary standard. Out of the illiterate respondents, the highest 22.00 per was reported in group I. A study of Bangladesh reported that about 41% and 25% of farmers accomplished their primary and secondary education, respectively (Chowdhury F. *et al*., 2019) [5]. In Nigeria, most of the tomato farmers were literate with an average of secondary school education standard (Afolami C.A. and Ayinde I.A., 2001) [1].

Table 1: Distribution of respondents according to educational standard

Farmers' Groups	Educational standards						Total number of farmers
	Illiterate	LP	ME	High School	Higher Secondary	Degree and above	
Group I	11 (22.00)	3 (6.00)	6 (12.00)	14 (28.00)	12 (24.00)	4 (8.00)	50 (100.00)
Group II	9 (14.52)	7 (11.29)	11 (17.74)	13 (20.97)	15 (24.19)	7 (11.29)	62 (100.00)
Group III	5 (13.16)	1 (2.63)	3 (7.89)	8 (21.05)	16 (42.11)	5 (13.16)	38 (100.00)
All groups	25 (16.67)	11 (7.33)	20 (13.33)	35 (23.33)	43 (28.67)	16 (10.67)	150 (100.00)

The figure in brackets indicate percentage to the total.

Average area (ha) under rabi vegetables cultivation in the study area

The area under cultivation of rabi vegetables varies with vegetable to vegetable and between the groups. Table 2 shows the average area (ha/farmer) under rabi vegetable cultivation in the study area. From the table it is observed that the area under potato cultivation was found the highest followed by cabbage, cauliflower, brinjal and tomato. Besides these vegetables, some other vegetables were also grown. Out of the total vegetable grown area 34.78 per cent area was covered by potato crop followed by cabbage (19.23 per cent), cauliflower (16.51 per cent) and the lowest area was covered by tomato (7.37 per cent). The lower area under tomato cultivation was due to the problem of Late Blight disease. Other vegetables covered 10.74 per cent area. Framers' group wise analysis reveals that for all vegetable crops, the average area covered by the zones was found the highest in group III followed by group II and group I.

Table 2: Average area (ha/farmer) under rabi vegetables cultivation in the study area

Vegetables	Group I	Group II	Group III	All farms
Cabbage	0.040 (15.15)	0.110 (18.12)	0.210 (20.96)	0.120 (19.23)
Cauliflower	0.037 (14.02)	0.082 (13.51)	0.190 (18.96)	0.103 (16.51)
Potato	0.110 (41.67)	0.230 (37.89)	0.310 (30.94)	0.217 (34.78)
Brinjal	0.022 (8.33)	0.074 (12.19)	0.120 (11.98)	0.072 (11.54)
Tomato	0.015 (5.68)	0.041 (6.75)	0.082 (8.18)	0.046 (7.37)
Other vegetables	0.040 (15.15)	0.070 (11.53)	0.090 (8.98)	0.067 (10.74)
Total	0.264 (100.00)	0.607 (100.00)	1.002 (100.00)	0.624 (100.00)

Figures in brackets indicate percentage to the total

Distribution of respondents according to vegetable farming experience

The respondents under study have lots of vegetable farming experiences (Table 3). The experiences of the respondents had been grouped in 5 years interval. They were 0-5 years experience, 5-10 years experience, 10-15 years experience, 15-20 years experience, 20-25 years experience and more than 25 years experience. It is observed from the table that the highest 34.00 per cent farmers had vegetable farming experience 5-10 years followed by 10-15 years experience (28.00 per cent), 15-20 years experience (16.67 per cent) and the lowest 5.33 per cent farmers have more than 25 years vegetable farming experience. Farmers' group wise analysis reveals that the highest 40.00 per cent farmers under group I have 5-10 years farming experience and the lowest 3.23 per cent farmers under group II have more than 25 years farming experience. In a study conducted in Borno State of Nigeria revealed that 54.0 percent had farming experience of 11-20 years in vegetable production (Usman J. and Bakari U.M., 2013) [14].

Table 3: Distribution of respondents based on vegetable farming experience

Farmers' Group	Farming experiences						Total number of farmers
	0-5 years	5-10 years	10-15 years	15-20 years	20-25 years	More than 25 years	
Group I	2 (4.00)	20 (40.00)	13 (26.00)	7 (14.00)	5 (10.00)	3 (6.00)	50 (100.00)
Group II	3 (4.84)	21 (33.87)	22 (35.48)	10 (16.13)	4 (6.45)	2 (3.23)	62 (100.00)
Group III	4 (10.53)	10 (26.32)	7 (18.42)	8 (21.05)	6 (15.79)	3 (7.89)	38 (100.00)
Total of all groups	9 (6.00)	51 (34.00)	42 (28.00)	25 (16.67)	15 (10.00)	8 (5.33)	150 (100.00)

Figures in the bracket indicate percentage to the total.

Dose (quantity) of insecticides used (ml/lit water or kg/ha) in vegetable cultivation

Insecticides are any toxic substances that are used to kill insects. Such substances are used primarily to control insect-pests that infest grown up plants or to kill the disease carrying insects in specific areas. The concentration of insecticides varies with the types of insects and its population. Table 4 shows the dose (quantity) of the use of insecticides (ml/lit water or kg/ha) used by the respondent farmers for the vegetables cultivation under study.

The table depicts that the major insecticides used by the farmers in vegetables cultivation were Dimethoate 30 EC, Malathion 50 EC, Chlorpyriphos 20 EC, Endosulfan 35 EC, Monocrotophos 36 WSC, Cypermethrin 25 EC, Carbofuran 3G. It was observed that on an average the quantity of use of Dimethoate 30 EC in the study area was 5.09 ml per litre water. Similarly, for Malathion 50 EC, the average concentration used was 4.55 ml per litre water. For Chlorpyriphos 20 EC it was recorded as 4.87 ml per litre water. The chemical Endosulfan 35 EC was used at a concentration of 5.06 ml per litre water. The average concentration of the use of Monocrotophos 36 WSC was found 4.55 ml per litre water. The chemical Cypermethrin 25 EC was applied by the framers at a concentration of 4.60 ml per litre water. The granule type chemical Carbofuran 3G was applied by the farmers at the concentration of 32.5 kg per hectare. It is clear from the above discussion that in the study area, all the farmers used insecticides at a very higher dose as compared to the recommended dose (1.0-1.5 ml per lit water, 22.5 kg per hectare for Carbofuran 3G).

Farmers' group wise analysis reveals that farmers under group I used insecticides at a higher dose than the other two groups to control the insect-pests of vegetable crops except in the case of Chlorpyriphos 20 EC and Cypermethrin 25 EC. The reason behind the use of higher dose of insecticides might be due to the ignorance about the recommended dose of the insecticides, the increase of resistance of insect-pests to the chemicals due to repeated use of these chemicals, ignorance about the negative impact of use of insecticides in high dose to human and animal health, soil health and to the environment. The farmers opined that the insects could not be controlled at a lower concentration of the insecticides. Sometimes due to wrong identification of insect-pests, the farmer used incorrect insecticides and to control them they used the insecticides at a higher concentration repeatedly. A study conducted at Satkania, Patiya and Hathazari upazilas of Chittagong reported that about 95% of the farmers relied on the application of insecticides to control insect pests (Mohiuddin M. *et al.*, 2009) [9].

Table 4: Dose (quantity) of insecticides used (ml/lit water or kg/ha)

Chemical Insecticides	Dose (quantity) of insecticides used (ml/lit water or kg/ha)					
	Group I	Group II	Group III	Average	Recommended dose	Difference
	(1)	(2)	(3)	(4)	(5)	(6) = (4)-(5)
Dimethoate 30 EC (ml/lit)	5.21	4.93	5.13	5.09	1.0 - 1.5	3.59-4.09
Malathion 50 EC (ml/lit)	4.86	4.39	4.41	4.55	1.0 - 1.5	3.05-3.55
Chlorpyriphos 20 EC (ml/lit)	4.86	5.75	4.01	4.87	1.0 - 1.5	3.37-3.87
Endosulfan 35 EC (ml/lit)	5.96	3.89	5.32	5.06	1.0 - 1.5	3.56-4.06
Monocrotophos 36 WSC (ml/lit)	5.25	4.03	4.36	4.55	1.0 - 1.5	3.05-3.55
Cypermethrin 25 EC (ml/lit)	4.50	5.10	4.20	4.60	1.0 - 1.5	3.10-4.60
Carbofuran 3G (kg/ha)	33.75	33.75	30.00	32.50	22.50	10.00

Time interval for application of insecticides by the respondent farmers

The time interval of application of insecticides is very important both in economic as well as hazardous point of views. Table 5 reveals that in study area, the highest percentage of farmers (37.33 per cent) used insecticides at an interval of 4-7 days followed by 7-10 days (26.00 per cent) and as and when necessary (19.34 per cent). Another 11.33 per cent farmers applied the insecticides at less than 4 days interval. Farmers' group wise analysis also reveals similar trend in regards to the time interval for application of insecticides. No farmer applied the chemicals at an interval beyond 13 days.

The above discussion reveals that the vegetable growers mostly applied the insecticides at 4-7 days interval. 74.66 per cent farmers applied the chemicals at less than 10 days interval violating the rules for time interval for use of plant protection chemicals. This might cause to the health hazardous to human being, animals and environment. Generally the farmers should apply the chemicals at 10-15 days interval. Some of the farmers applied the chemicals as and when necessary. Since the farmers are not aware about the negative impact of these chemicals and cost effectiveness, they applied the chemicals at a very short interval of time. At Satkania, Patiya and Hathazari upazilas of Chittagong, majority of the farmers sprayed insecticides once in a week in winter vegetables (Mohiuddin M. *et al.*, 2009) [9]. In Tamil Nadu that 52.33 per cent of farmers maintained the spraying interval of pesticides 10-14 days (Chinnasamy M. and Bhuvaneswari K., 2017) [4].

Table 5: Time interval of application of insecticides by the respondent farmers

Farmers' group	Time interval of application of insecticides						Total number of farmers
	Less than 4 days	4-7 days	7-10 days	10-13 days	13-16 days	As and when necessary	
Group I	5 (10.00)	18 (36.00)	13 (26.00)	4 (8.00)	0 (0.00)	10 (20.00)	50 (100.00)
Group II	7 (11.29)	24 (38.71)	16 (25.81)	3 (4.84)	0 (0.00)	12 (19.35)	62 (100.00)
Group III	5 (13.16)	14 (36.84)	10 (26.32)	2 (5.26)	0 (0.00)	7 (18.42)	38 (100.00)
Total	17 (11.33)	56 (37.33)	39 (26.00)	9 (6.00)	0 (0.00)	29 (19.34)	150 (100.00)

Figures in the bracket indicate percentage to the total

Factors affecting the use of insecticides in vegetable production

The detail of the relationship between the dependent variable used of insecticides and different determinants responsible for use of insecticides has been presented in Table 6.

Table 6: Relationships between the dependent and independent variables (Dependent variable: Use of Insecticides)

Variables/Parameters	Lower Brahmaputra Valley Zone					
	Group I		Group II		Group III	
	Coefficients	Standard Error	Coefficients	Standard Error	Coefficients	Standard Error
Intercept	4.43153	0.665	2.797	0.601	2.027	1.345
Age (yr) of the head of the households (X1)	-0.631***	0.154	-0.165	0.109	-0.566*	0.225
Educational qualification (X2)	-0.067	0.059	-0.023	0.045	-0.147	0.208
Vegetable farming experience (years) (X3)	0.073	0.048	0.071*	0.041	0.228*	0.087
Type of seeds used (X4)	0.037	0.038	0.033	0.028	0.492	0.344
Distance from home to inputs dealer (km) (X5)	-0.025	0.061	-0.049	0.054	-0.079	0.139
Area under rabi vegetables (ha) (X6)	0.033	0.072	0.098	0.060	0.012	0.081
Quantity of Manures (X7)	0.044	0.056	0.001	0.011	0.004	0.018

Use of chemical fertilizers (X8)	0.651***	0.065	0.621***	0.037	0.770***	0.100
	R^2 = 0.817		R^2 = 0.884		R^2 = 0.757	

Relationships between age of the head of the households and their practices on insecticides used for vegetable cultivation

Table 3 depicts that in all the farmers' groups in the zone, the regression coefficients of age of the head of the households had shown a negative relationship with the use of insecticides for vegetable cultivation. In group I, the coefficient of the factor was found significant at 0.01 level and in group III, it was significant at 0.1 level. Thus, it suggested that with the decrease in age of the head of the household there is more use of insecticides. That meant that with the decrease in age by one year, there was 0.631, 0.165 and 0.601 unit more use of insecticides in group I, group II and group III, respectively.

Relationships between educational qualification of the head of the households and their practices on insecticides used for vegetable cultivation

The regression coefficients of educational qualification in all groups of farmers showed a negative relationship with the use of insecticides for vegetable cultivation no one was found significant. Thus, it suggests that with the decrease in educational qualification of the head of the household there was more use of insecticides in the vegetable fields by the farmers of all groups That meant with the decrease in educational qualification by one level there was 0.067, 0.023 and 0.147 unit more use of more insecticides in group I, group II and group III, respectively.

Relationships between vegetable farming experience of the head of the households and their practices on insecticides used for vegetable cultivation

It was observed from the table that the regression coefficients of the factor vegetable farming experience were found positive in all farmers' groups in the zone. It indicated that with the increase in vegetable farming experience of the head of the households, there was increase in consumption of insecticides. This meant that per unit increase in the farming experience of the farmers, there was 0.073, 0.071 and 0.228 unit increase in use of insecticides in group I, group II and group III, respectively. In group II, and group III, the coefficients of the factor were significant at 0.1 level. This meant that experienced farmers used the insecticides comparatively more efficient manner. They applied the chemicals when there was appearance of insect-pests in the field. The study conducted at Sadar upazila of Gazipur district in Bangladesh reported that farming experience towards practices of pesticide use had significant positive relationships (Yeasmin F. *et al*., 2018) [16].

Relationships between type of seeds used by the households and their practices on insecticides used for vegetable cultivation

The regression coefficients of the factor types of seeds used by the farmers were found positive in all the farmers' groups in the zone; but no significant relationship was found between type of seeds used by the households and the use of insecticides. The increase in the type of seeds included growing of both hybrid and HYV seeds by the farmers. Thus, it could be said that with the increase in types of seeds used by the head of the households, there was increase in consumption of insecticides. This suggested that per unit increase in the types of seeds used by the farmers, there were 0.037, 0.033 and 0.492 increase in use of plant protection chemicals in group I, group II and group III, respectively. The reasons behind that when the farmers grow the HYV and hybrid seeds of vegetables, the infestation of insect-pests generally increase due to its susceptibility. In such situation the farmers were bound to use insecticides to save the crop.

Relationships between distance from home to inputs dealer of the households and their practices on insecticides used for vegetable cultivation

The regression coefficients of distance from home to input dealer of the households in all farmer groups showed a negative relationship with the use of insecticides for vegetable production and no one was found to have a significant relationship. Thus, it suggested that with the decrease in distance from home to input dealer of the head of the household the farmers had a tendency to more use of plant protection chemicals in the vegetable fields. This meant that with the decrease in distance from home to input dealer of by one unit there was 0.025, 0.049 and 0.079 unit more use of more insecticides in group I, group I and group III, respectively.

Relationships between area under rabi vegetable cultivation of the households and their practices on insecticides used for vegetable cultivation

It is observed from the table that the regression coefficients of the factor area under rabi vegetables were found to be positive in all farmers' groups in the zone. Thus, it could be said that with the increase in area under rabi vegetables of the households, there was increase in consumption of insecticides. This meant that with the per unit increase in the area under rabi vegetables of the farmers, there was 0.033, 0.098 and 0.012 unit increase in use of insecticides in group I, group II and group III, respectively. In the groups, no significant coefficient has been observed. At Sadar upazila of Gazipur district in Bangladesh a similar result was reported (Mohiuddin M. *et al*., 2009) [9].

Relationships between quantity of manures used by the households and their practices on insecticides used for vegetable cultivation

The regression coefficients of quantity of manures used by the of the households in all farmer groups a positive relationship and no one was found a significant relationship. Thus, it suggested that with the increase in quantity of manures used by the farmers, there was increase in consumption of insecticides. That meant that with the increase in quantity of manures used by the farmers by one unit, there was 0.044, 0.001 and 0.004 more unit use of the chemicals.

Relationships between quantity of use of chemical fertilizers by the households and their practices on insecticides use for vegetable cultivation

The regression coefficients of quantity of use of chemical fertilizers by the households in all groups showed a positive relationship with the use of insecticides for vegetable cultivation. All the coefficients were found significant at 0.01 level. Thus, it suggested that with the increase in quantity of use of chemical fertilizers used by the farmers there was more use of insecticides in the vegetable fields. This meant that with the increase in quantity of use of chemical fertilizers used by the of the farmers by one unit there was 0.651, 0.621 and 0.770 unit more use of more insecticides by the farmers in group I, group II and group III, respectively. This was due to that since most of the farmers were growing both hybrid and HYV seeds, the crops require more nutrients for its growth and development. Moreover, they were susceptible to most of the insect-pests. Therefore, to harvest a better production, it was very much essential to use more nutrients and insecticides.

The null hypothesis states that 'there is no relationship between the application of insecticides and chemical fertilizers. Our finding reveals that there was a significant positive relationship between the application of insecticides and use of chemical fertilizers for vegetable cultivation. Thus, it could be said that the null hypothesis was rejected.

The R^2 was calculated as 0.817, 0.884 and 0.757 for group I, group II and group III, respectively. This suggested that 82 per cent, 88 per cent and 76 per cent of the variation in quantity of insecticides use was attributed to the variables in the model in group I, group II and group III, respectively.

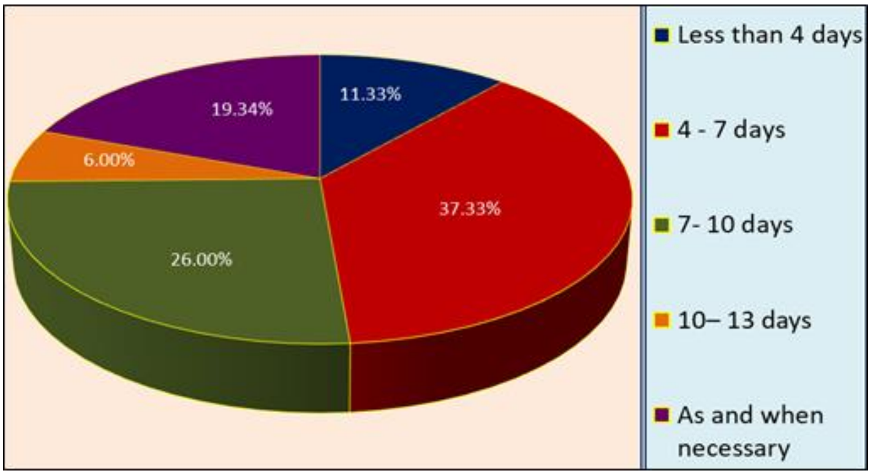

Fig 1: Time interval of application of insecticides by the farmers

Conclusion

Use of insecticides in vegetable crops is harmful to our health, health of animals, soil and the environment as well; provided chemical residues are retained in the edible parts. In most cases farmers are found ignorant about the use of insecticides even they are literate which is owing to lack of technical know how about the use of it. Besides this so many factors are found responsible for the use of these chemicals. Thus, it is advisable to the vegetable growers to consult with the agricultural experts before application of chemicals in the field. To grow a healthy crop, they should apply the insecticides at a recommended dose and they should follow the integrated pest management practices. The Government should take initiative to regular monitoring of agro-chemical input dealers on selling of agricultural chemicals. Moreover, to make the vegetable growers aware, some awareness and training programmes on judicious use of agro-chemical should be carried out time to time.

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