



Impact of Plant Clinics on Farmers' Knowledge, Attitude and Practice With Plant Health Issues

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ABSTRACT

Plant clinics in Nepal has been started in 2008 and has coverage in more than 40 districts of Nepal. A study has been conducted in Chitwan district of Nepal to assess the changes on farmer's knowledge attitude and practice due to implementation of plant clinics. Total of 175 clinic attendants and 175 non-attendants were selected by simple random sampling method and interviewed by using semi-structured questionnaire. By and large, this study found wider positive changes among clinic attendants than non-attendants especially on their knowledge and skills to identify pests and diseases with their causes and practice appropriate remedial measures against those problems. The study revealed positive impact to by increasing knowledge and skillset among attending farmers to assess the season of disease and pest occurrence, estimate economic threshold level as well as preventive and curative measures against the plant health problems. Plant clinic has made impressive positive changes on adoption of recommended dose of pesticides and organic control methods among attendants than non-attendants. The level of awareness and adoption of waiting period after pesticide use was found higher among attendants than non-attendants.

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Introduction

Agriculture in Nepal has a long history but it received institutionalized extension services only since 1950s (K.C. et al., 2003). Currently, District Agriculture Development Office (DADO) and its Agricultural Service Center (ASC) are major public service units for overall agricultural extension services in Nepal including plant protection. Plant Protection Directorate (PPD) provides technical backup to the DADOs and ASCs on plant protection related matters. But the public extension staff to farming household ratio is 1:164 (Adhikari et al., 2013) that clearly indicates limited access to extension services for the farming community. The limited access and the quality of advisory services is directly related to the knowledge and skill of farmers to take care the plant health problems leading to poor yield (Oerke, 2006), decreased quality of produce (European Commission, 2005; Kroschel et al., 2009) and pesticides hazards (Atreya, 2005; Shrestha and Neupane, 2002).

The concept of plant clinic has developed to provide plant health care service to farmers (Bentley et al., 2007; Boa, 2009) as complement to existing agriculture extension services. It run by local plant protection expert or extension staffs called as plant doctor (Bentley et al., 2007) who are specially trained to diagnose the plant health problems and provide advice to farmers on healthcare for their plants (Danielsen and Kelly, 2010). This concept was introduced in Nepal in 2008 (Adhikari, 2009; Boa and Harling, 2008) and is being practiced by different government and non-government organizations (Adhikari et al., 2015, 2016, 2013). It promotes integrated pest and crop management approaches based on bottom up approach to respond the demands from farmers, rather than to the needs defined by extension workers or researchers. Different studies has emphasized positive impact of plant clinics on increased access to quality services, increased yield, income and increased adoption of eco-friendly

practices (Danielsen and Fernandez, 2008; Kelly et al., 2008; Negussie et al., 2011; Srivastava, 2013; Vakilian, 2017) but similar studies are very scanty in Nepal. Therefore, this study was conducted to see the effectiveness of plant clinics on change in farmers Knowledge, attitude and practices.

Methodology

The farm output depends on the appropriateness of the technology adopted and physical input use that in turn depends on existing knowledge, attitude and practices of the farmers. A farmer chooses various management practices to meet their objectives, based on their knowledge, belief and attitude on any farming technology. Knowledge, Attitude and Practice (KAP) analysis is common in anthropological and behavioral studies including agriculture due to its easy design, quantifiable data, ease of implementation and concise presentation of results and wider applicability (Launiala, 2009). It helps to identify knowledge gaps, behavioral patterns, and beliefs and understanding of issues during its baseline or impact assessment (Bhurtyal et al., 2016; Ngowi et al., 2002) and design or modify any extension projects for increased participation, adoption of technology and increased performance. It has been used in numerous studies related to plant health and pesticide uses (Janhong et al., 2005; Jors et al., 2014; WHO, 2008).

This study was carried out in Chitwan district of Nepal, purposively selected because of the clinic operation from initial periods (Adhikari, 2012) and availability of clinic information to frame the study population and sample. The list of plant clinic attendants mentioned in plant clinic register was taken as study population from which 175 farmers were randomly selected as study sample. Similarly, equal number of farmers who didn't attend any clinics were selected from same locality as the control group for impact assessment (Bamberger et al., 2004). Pre-tested semi-structured questionnaire was used to collect primary information from the sampled farmers. The questionnaire includes both the qualitative and quantitative variables on a wide range of knowledge, attitude and practices related to the plant health problems. Thus collected data were coded, entered into the computer and analyzed using Microsoft Excel and Statistical Package for Social Sciences (SPSS) version 20. The changes in KAP before and after the clinics were analyzed by adopting Difference in Difference (DiD) model as appropriate method for impact assessments (Bertrand et al., 2004; Chen et al., 2006; Ravallion, 2005; Sarma et al., 2016; Verner and Verner, 2013). The DiD method used in this study is illustrated in table 1 below, where the outcomes of two different points (T1 and T2) for the clinic attendants were compared with the non-attendants for the same time points.

Table 1 Difference in difference (DiD) model

C	Before Clinics	After Clinics	Difference
PH	X_{t1}	X_{t2}	$D_1 = (X_{t2} - X_{t1})$
NPH	Y_{t1}	Y_{t2}	$D_2 = (Y_{t2} - Y_{t1})$
D	$D_2 = (X_{t1} - Y_{t1})$	$D_1 = (X_{t2} - Y_{t2})$	$DiD = D_1 - D_2$

C: Category, PH: Participating households, NPH: Non-participating households, D: Difference, Adapted from Gertler et al. (2011)

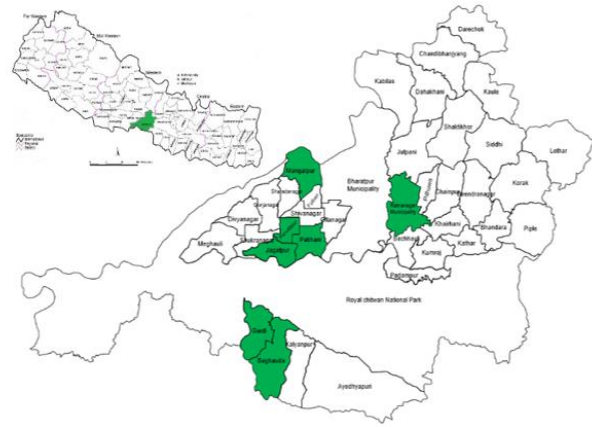


Figure 1 Map of Nepal highlighting study district and sites

Result and Discussion

Socio-economic Description of Respondents

The average household size of the respondents was significantly higher among attendants (5.11) than non-attendants (4.58) which is quite above the Chitwan district average of 4.5 (CBS, 2014). Majority of the attendants (60.06%) were male while majority of non-attending respondents (58.3%) were female. This indicates the limited access and exposure of females farmers to external environment and resources including access to information that is also supported by earlier studies (Cornhiel, 2006; Gartaula et al., 2010; Maharjan et al., 2012; Miiro et al., 2015; Rajendran and Islam, 2017). The study found 10.9% of attendants and 25.1% non-attendants were still illiterate with average of 18% in total. This resembles with district status of 23.02 illiteracy (CBS, 2014). The proportion of farmers attending secondary level (6-10th grade) education was found highest in both categories.

Figures in Parenthesis Indicate the Percentage

The average land holding of the surveyed household was 0.48 ha only with range of 0.10 ha to 3.87 ha. It was found significantly higher (0.54 ha) among attendants than the non-attendants (0.43 ha). Results of present study revealed that 72% of the total responding household are affiliated with farmer's organization such as groups or cooperatives. Comparatively, 84% of the attendants and 60% of non-attendants were member of farmers' organization. On the other hand, only 48.9% of the total respondents had participated in at least one training on agriculture wherein 64% among attendants and only 33.7% among non-attendants were found to be trained.

Knowledge on Insect, Pest and Disease Identification

Every extension project envisions positive changes on knowledge and skill among its beneficiaries. This study found revealed the clear impact of plant clinic on farmers' knowledge and skills to identify pest and disease (Table 3). Farmers' knowledge on disease and insect pest identification among both categories of the farmers was found to be increased over the time but the increment was distinctly higher among clinic attendants. Table 3 shows the proportion of farmers with different level of knowledge and skill both before and after the clinics and the marginal

change. The incremental proportion of respondents able to identify more than 5 types of diseases, 5 types of harmful insects and 5 types of beneficial insects was found to be higher among attendants by 6.9%, 5.2% and 9.7% respectively. None of the attendants were found unable to

identify a single disease or pest after the clinic but still 3.4% and 4.6% of the non-attendants were unable to do so. The study result revealed that the plant clinics has changed the farmer's knowledge and skill to identify more number of diseases and insect pests.

Table 2 Socio-demographic characteristics of respondents

Parameter		Category of Respondent		Total
		Attendant	Non-Attendant	
Gender	Female	69 (39.4)	102(58.3)	190 (48.9)
	Male	106 (60.6)	73 (41.7)	160 (51.1)
Household size	Mean number	5.11±1.518	4.58±1.573	t-statistics = 3.216 p-value=0.001
Occupation	Agriculture	139 (79.4)	119 (68.0)	258 (73.7)
	Business	6 (3.4)	14 (8.0)	20 (5.7)
	Service	20 (11.4)	24 (14.3)	45 (12.9)
	Student	3 (1.7)	5 (2.9)	8 (2.3)
	Foreign employment	7 (4.0)	12 (6.9)	19 (5.4)
Education	Illiterate	19 (10.9)	44 (25.1)	63 (18.0)
	Informal	32 (18.3)	24 (13.7)	56 (16.0)
	Up to 5 grade	26 (14.9)	22 (12.6)	48 (13.7)
	6 to 10 grade	66 (37.7)	51 (29.1)	117 (33.4)
	Intermediate	21 (12.0)	20 (11.4)	41 (11.7)
	University	11 (6.3)	14 (8.0)	21 (7.1)
Land holding	Hectare (Ha)	0.54±.518	0.43±.240	t-statistics = 2.406 p-value=0.017
Participation to farmers organization	Yes	147 (84.0)	105 (60.0)	252 (72.0)
	No	28 (16.0)	70 (40.0)	98 (28.0)
Participation in Trainings	Yes	112 (64.0)	59 (33.7)	171 (48.9)
	No	63 (36.0)	116 (66.3)	179 (51.1)

Table 3 Change in knowledge on disease and insect pest identification

KAP Parameters		Percentage of farmers by category						Difference in Difference (DiD)
		Attendant			Non-Attendant			
		Before	After	Difference	Before	After	Difference	
Number of diseases able to identify	0	10.9	0.0	-10.9	14.9	3.4	-11.5	-0.6
	1-2	66.3	32.0	-34.7	81.1	60.0	-21.1	13.6
	3-5	21.1	58.3	37.2	4.0	35.4	31.4	5.8
	>5	1.7	9.7	8.0	0.0	1.1	1.1	6.9
Number of harmful pests able to identify	0	8.6	0.0	-8.6	17.7	4.6	-13.1	-4.5
	1-2	63.4	16.6	-46.8	65.7	56.0	-9.7	37.1
	3-5	24.6	69.7	45.1	16.6	34.3	17.7	10.8
	>5	3.4	13.7	10.3	0.0	5.1	5.1	5.2
Number of beneficial insects able to identify	0	21.1	0.0	-21.1	48.0	34.9	-13.1	8
	1-2	64.6	26.3	-38.3	47.4	44.0	-3.4	34.9
	3-5	14.3	62.3	48	4.0	18.9	14.9	33.1
	>5	0.0	11.4	11.4	0.6	2.3	1.7	9.7

Knowledge of Cause and Remedies

Farmers' knowledge on cause of disease and pest and their seasonality will help them to prepare for preventive or curative measures. Effective control of the plant health problems are dependent upon early and accurate diagnosis of the cause and appropriate response measures (Stack et al., 2014). The study found positive changes in knowledge on season of disease, pest occurrence among attendant farmers than non-attendant farmers. On the other hand, this study revealed that plant clinic has impact to increase the accuracy of knowledge and skills to identify the cause of

plant health problems notably higher among the attendants than non-attendants. The study revealed that the plant clinic has made changes in farmer's knowledge and skill economic threshold level of pest diseases which is presented in Table 3. The changes in proportion of respondent with knowledge and confidence on economic threshold was found to be higher among clinic attendants than non-attendants. The study found about 41% progress among clinic attendant while only 20% among non-attendants.

Table 4 Accuracy of knowledge on cause of plant health problem

KAP Parameters	Percentage of farmers by category						Difference in Difference (DiD)	
	Attendant			Non-Attendant				
	Before	After	Difference	Before	After	Difference		
Know how on season of disease and pest	52.6	84.0	31.4	48.6	68.6	20	11.4	
Accuracy of knowledge on cause of problem	Never	34.3	5.1	-29.2	36.6	16.0	-20.6	-8.6
	Rarely	53.1	44.0	-9.1	50.3	59.4	9.1	-18.2
	Mostly	11.4	44.6	33.2	13.1	24.0	10.9	22.3
	Always	1.1	6.3	5.2	0.0	0.6	0.6	4.6
Knowledge on economic threshold level	30.9	71.4	40.5	28.6	48.6	20	20.5	
Knowledge on preventive Measures	20.6	88.6	68	13.1	50.3	37.2	30.8	
Knowledge on curative measures	25.7	86.9	61.2	25.1	60.0	34.9	26.3	

Table 5 Comparison of herbicide and pesticide application by category of farmers

Category	Amount of herbicides (Kg/ha)			Amount of chemical pesticides (Kg/ha)		
	Before	After	Difference	Before	After	Difference
Attendant	0.37	0.04	-0.33*	0.41	0.64	0.23*
Non-Attendant	0.31	0.43	0.11*	0.47	0.58	0.11
Difference	0.05	-0.39*	-0.44*	-0.06	0.06	0.12

* significant at 99% CI, ** significant at 95% CI, *** significant at 90% CI

The principle of 'prevention is better than cure' always fits even in plant health issues too. Therefore, farmers' knowledge on preventive and curative measures against the major disease were discussed in this study too. The study finding shows the wider positive increment on proportion of attending farmers than non-attending farmers knowledgeable on preventive and curative measures against the plant health problems. The number of additional farmers familiar on preventive measures was found to be 68% among clinic attending category while only 37.2% among non-attending. Similarly, 61.2% additional farmers participating in clinics were found to be aware on curative measures while only 34.9% additional farmers from non-attending category were found familiar on curative measures. Similar study done in Bangladesh revealed that 100% of plant clinic users felt their ability to quickly identify crop problems had increased compared to 16% of non-users (Rajendran and Islam, 2017). These figures clearly address the impact of plant clinics on farmers' knowledge and skill on preventative and curative measures of plant health care.

Pesticides Use

Pesticides and herbicides are major agrochemicals used by farmers to control different crop pests and weeds. Quality advisory services has impact on farmers knowledge and practice the appropriate use of agrochemicals.. This study found the decrease in herbicide use but increase in pesticide use by farmers. Table 5 compares the difference dose of herbicide and pesticide application by category of farmers at two time points. The average dose of herbicides used by clinic attendants was found insignificantly higher (0.37 kg/ha) than non-attendants (0.31 kg/ha) before the clinic. After the

participation in clinic, it was found to decrease significantly to 0.04 kg/ha but significantly increased to 0.43 kg/ha among non-attendants. the study signifies the impact of plant clinics to minimize the use of herbicides. One the other hand, the average dose of pesticide used before the clinic was non-significantly higher among attendants (0.41 kg/ha) than non-attendants (0.47 kg/ha) but it was found to increased significantly by 0.23 kg/ha among attendants while insignificantly by 0.11 kg/ha among non-attendants.

The proportion of clinic attendants' using herbicides was decreased from 25% to 21% with dose of less than one kg/ha. On the other hand, the proportion of non-attendants using herbicide were found to increase from 30% to 39% where 17% farmers were using more than one kg herbicides per hectare. Figure 2 compares the proportion of attendants and non-attendants' farmers with herbicide dose category.

Similarly, this study found only 33% of clinic attending and 34% of the non-attending farmers were using chemical pesticides before the clinic which has increased by 9% among attendants and 3% among non-attendants. The details of the frequency of the farmers using different dose of pesticides is presented in figure 3. This increment among attendants obvious because they should have visited the clinic with their problems where the plant doctors recommended pesticides either organic or inorganic (combined here) against the problem and farmers used it but the non-attendants might not care about the plant health problems or take other action. On the other hand, if we consider the total amount of agrochemical use – it is lower among attendants than non-attendants which indicates the judicious use of chemical as advised by experts aiming for better harvest.

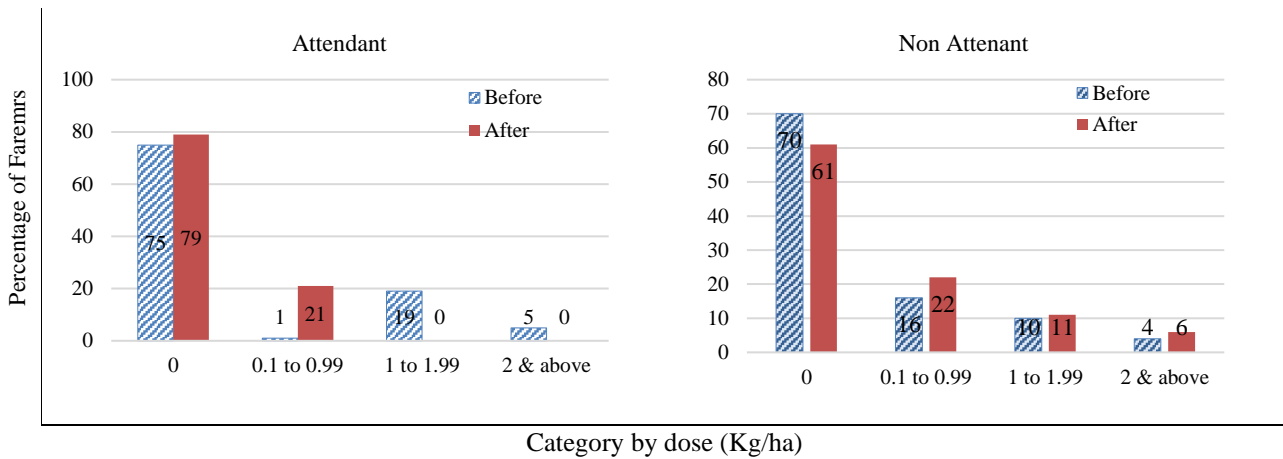


Figure 2 Proportion of farmers using different doses of herbicides

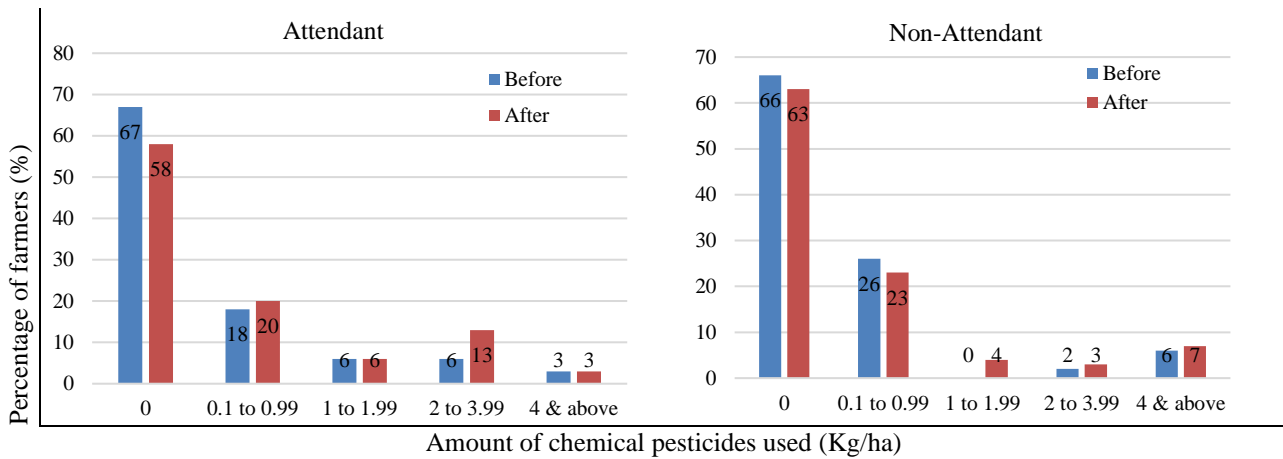


Figure 3 Proportion of farmers using different doses of chemical pesticides

Pesticide Dose Recommendation and Adoption

Knowledge and adoption of recommended dose of pesticides is another important factor for profitable and sustainable farming system. Before the clinic period, 29.7% of the attendant and 26.9% of the non-attendant were knowledgeable on recommended doses of pesticides but it was found to be increased to 75.4% and 52.6% among attendant and non-attendants respectively after the clinics. This difference in difference by almost 20% is meaningful both from economic and environmental perspectives.

The study found notable changes in farmer’s knowledge on appropriate method of pesticide applications. During the pre-clinic period, only 42.9% of the attendant and 41.1% of the non-attendant were knowledgeable on appropriate method of pesticide application. But, during the post-clinic period, 85.7% of attendant and 64.0% non-attendant were found to be familiar in appropriate method of pesticide application (table 6). The net difference in difference of 19.9% on proportion of respondent is the impact of plant clinics.

The study found the positive impact not only on knowledge but also on practice of using chemical pesticides. Table 5 describes the positive changes on adoption of recommended dose of pesticides and the changes was impressive among attendants. Before the clinic period, the proportion of farmers always adopting the recommended dose of pesticides were only 13.1% among attendants and 8.6% among non-attendants but after the

clinics, it was found to be increased by 37.8% and farmers among attendant and but only 10.8% among clinic non-attendants. This net difference of 20% indicates the highly positive influence of plant clinics on adoption of recommended dose of pesticides while curing their crop health. Another study done in Bangladesh revealed that 97% of the clinic users fully implemented the advice recommended by the plant doctors (Rajendran and Islam, 2017).

The study also found 31.4% of attendants and 27.4% of non-attendant respondents were knowledgeable on organic measures against pest and diseases before the clinic. But, after the clinic 64.6% of clinic attendants were found knowledgeable on organic measures whereas only 36% of non-attendant were found knowledgeable on this.

Waiting Period

The study found notably greater positive changes in knowledge and practice on waiting period among clinic attendants than non-attendants (table 6). The study found 16% of the clinic attendant and 19.4% of the non-attendant respondents were not aware about the waiting period after use chemical pesticides. But after the clinic, this proportion has sharply declined to 2.3% among attendants but still 13.1% among non-attendants. There were 21.7% attendants and 23.4% non-attendants were found not caring about the waiting period before the clinic that has dropped to zero among attendants while still 10.3% non-attendants were found not caring about it.

Table 6 Change in adoption of recommended dose of pesticides

KAP Parameters	Percentage of farmers by category						Difference in Difference (DiD)	
	Attendant			Non-Attendant				
	Before	After	Difference	Before	After	Difference		
Knowledge on recommended dose of pesticides	29.7	75.4	45.7	26.9	52.6	25.7	20	
Knowledge on methods of pesticide use	42.9	85.7	42.8	41.1	64.0	22.9	19.9	
Adoption of recommended dose of pesticides	Always	13.1	50.9	37.8	8.6	19.4	10.8	27
	Sometime	7.4	20.0	12.6	4.0	22.3	18.3	-5.7
	Not yet	9.1	4.6	-4.5	14.3	10.9	-3.4	1.1
Knowledge on organic measures	31.4	64.6	33.2	27.4	36.0	8.6	24.6	

Table 7 Practice of adopting waiting period after application of pesticides

Practice of Waiting Period	Percentage of farmers by category						Difference in Difference (DiD)
	Attendant			Non-Attendant			
	Before	After	Difference	Before	After	Difference	
Not aware	16.0	2.3	-13.7	19.4	13.1	-6.3	6.4
Rarely	20.6	23.4	2.8	21.1	31.4	10.3	-7.5
Mostly	17.1	41.1	24	17.1	21.7	4.6	19.4
Always	24.6	33.1	8.5	18.9	23.4	4.5	4
Don't care	21.7	0.0	-21.7	23.4	10.3	-13.1	8.6

Conclusion

Modernization in agriculture extension is vital to provide quality extension service with easy access to smallholder farmers to increase the global food production. Plant clinics, as innovation in extension system, performs important role largely by providing diagnostic and advisory services that are essentially unavailable elsewhere easily and has direct impact on farmers' knowledge, attitude and practice to tackle wide range of problems in their farming. The results of this study, particular the difference in difference (DiD) showed wider and positive changes among clinic attendants than non-attendants on insect, pest and disease identification. The study found net increment of 11.4% higher among attendants with knowledge on season of disease pest occurrence while 20.5% on economic threshold level of pest and diseases. The higher increment of among attendants who are knowledgeable on preventive measures (30.8%) and curative measures (26.3%) are clear indicator of impact of plant clinic on farmer's knowledge and attitudes. The significant increase in pesticide use and significant decrease in herbicide use illustrates the impact of plant clinic on judicious use of agro-chemicals by the attendants than non-attendants. It should also be considered together with use of recommended dose and cost incurred in relation to incremental yield.

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