Chapter V

Rice Blast Management Technologies

Extension plays a pivotal role in the transfer of technology and facilitates the flow of agricultural knowledge and information in the rural Bhutanese economy. The extension system in Bhutan has developed an extensive network of extension staff in all the districts and more emphasis is given in promoting technologies and providing technical support to enhance the goal of food self-sufficiency, improvement of incomes, living standards and environmental conservation (Extension Division, 2001). One-way approach of communication method to disseminate new knowledge and practices has dominated the district agricultural programs with the typical age-old conventional "transfer of technology approach" till the early nineties. Since then, the shift to new paradigm of "participatory extension", advocated by the government is followed with varying degrees and interpretations among different institutions within the Ministry of Agriculture and the district administrations. Furthermore, the new extension concepts have often been widely embraced on a conceptual level; the implications of these new ideas for changing field level practice have not always been confronted (Christoplos and Kidd, 2000). However, the main partners in rural development in Bhutan (researchers, extension agents and farmers) are reported to have excellent collaboration, especially in the adaptive research trials and assessment of technology generated in both the on-station and on-farm trials (Renewable Natural Resources Extension Support Project, 2002).

5.1 Institutional linkage

The shift in emphasis in extension from a technology transfer model to a more facilitative approach is in tune with the Ninth Five Year Plan, where the extension plans and programs are block (*geog*) based. Irrespective of whether this change is the result of a paradigm shift, or whether it is merely a return to the "help towards self-help" philosophy of extension applied in a community context, it calls for appropriate structures in order to be effective (Düvel, 1995). In other words, the effectiveness will depend on the extent to

which the principal enabling conditions for the development of agriculture sector exist (Christoplos and Kidd, 2000).

Düvel (1995) states that the most meaningful and sustainable development objective is one that is the product of intensive interaction between development agents and the community, and is based on a community decision, which is made possible by establishing appropriate institutional structures. The nagging problem in many traditional communities has been the chaotic confusion arising from unplanned and uncoordinated efforts of a large number of development agents and organizations anxious to become involved in development, resulting in tremendous duplication and eventually a largely reduced development impact. This implies to utilize, strengthen and integrate, as far as possible, the existing local community structures and the agencies involved in rural development.

One of the major achievements during the last 25 years has been the institutionalization of the renewable natural resources research and extension systems in the country. National research strategy and programs with fully integrated research institutions and support services to provide field programs are well established; the extension institution was strengthened through the establishment of the Natural Resources Training Institute (NRTI). For better linkage and co-ordination, the Renewable Natural Resources Sub-Sectors (agriculture, forestry and livestock) were integrated from the Seventh Five Year Plan (1992-97). Though, the research-extension linkage has improved with the creation of Extension Program Offices in the Renewable Natural Resources Research Centers, who are responsible to liaise regional extension programming and co-ordination (Chettri *et al.*, 1999), networking with other non-renewable natural resources sectors and local institutions has not been fully explored and exploited to benefit the rural communities. Still, much needs to be improved in equivocating the problems, issues and plans between research, extension and farming communities, which is often research-led. However, the disintegration of Renewable Natural Resources Sectors at departmental level in 2003, in tune to the changing socio-

political scenario in rural development, has yet to display its impact at the local and national levels. On the other hand, the coordination among the Renewable Natural Resources Sectors (agriculture, forestry and livestock sectors) in the district may conflict, as the line of control is hold by their respective departments in the Ministry of Agriculture.

Notwithstanding, the changes in the structure and functioning of the Ministry of Agriculture, the institutional and policy structures are already in place at the district and local levels and, therefore, it is a matter of urgency and commitment from the stakeholders for effective and efficient networking. Linking and liaisioning with different institutions operating in rural development are made easier because both at the district and local levels, the elected members of communities are represented in the District Development Committees and Block Development Committees. Hence, it is easier to facilitate and involve local institutions in drawing up collective decision-making and priorities to initiate means for their fulfillment.

However, as Düvel (1995) points out, institutional structure or framework, although important, is only one of a multitude of factors that can influence the effectiveness of an extension service, but need real commitment from the stakeholders because he states that extension is about development and development is about people. He is apt to state that at the one end of the scale, there is still the common view that the farmer is a mere production function and, therefore, in the majority of cases, a potential hindrance in the quest for optimum production; towards the other end of the scale, the farmer or farm family constitutes the ultimate focus of development; not only as means to an end, but as an end in itself. This basic assumption or philosophy is critical because it will inevitably influence the approach towards development and, consequently the structures appropriate for its facilitation.

5.2 Extension methods

A number of agricultural extension approaches have been introduced progressively, since the Sixth Five Year Plan (1987-91) to address the emerging problems and advances in technologies. This section focuses on the most commonly used extension methods in the study area.

5.2.1 Individual farmer visit

Individual farmer visit comprises bulk of the agricultural extension activities in the district. Extension policy also states that the extension staff posted in the block should at least spend 25 days of the month in the field (Ministry of Agriculture, 1994). However, this is not conditional and largely depends on the cropping calendar, season and the activity of the region. Most often, the extension agents have busy schedule from February to November in the warm temperate regions, whereas, in the subtropical zones, extension agents are kept busy round the year.

Only 17.9 percent of the extension agents of Thimphu district made frequent individual farmer visit, while more than half (61.5 percent) of the extension agents of Paro district made frequent visit to their farmers' field to monitor and give advise (Table 19). In general, extension agents at least made a monthly field visit. Of the total sample households, only one farmer from easy and well-established transportation facility block (Chang) and four farmers from the far-flung and remote village of Geney block did not meet extension agent during their previous paddy-cropping season. This partly explains the difference in accessibility to rural villages between the two districts. Paro district has an extensive farm road network than Thimphu district, facilitating easier and faster monitoring and visits to farmers' fields.

Table 19. Percentage of sample households receiving individual farmer advice from extension agents

District	Sample household	Frequency of extension visit in %			
		No visit	Quarterly	Monthly	Frequent
Paro	91	0.0	1.1	37.4	61.5
Thimphu	67	6.0	23.9	52.2	17.9

Source: Survey, 2002.

5.2.2 On-farm trial

Over the past few years, on-farm trials were mostly focussed on screening and selecting the blast resistant varieties. These trials were conducted by the Research Centres in collaboration with districts in farmers' fields to evaluate the performance of new entries and to select promising blast resistant varieties under farmers' management. There is an evidence of farmers' participation in integrated plant and nutrition systems, which is a farmer-extension fertilizer use trials (FEFUT) conducted in collaboration with the Sustainable Soil Fertility and Plant Nutrition Management Project, Ministry of Agriculture. It is indispensable to come up with the recommended domain for optimum use of plant nutrient for high yielding improved varieties in the different biophysical regions of the country (Table 21).

The participation of sample households in on-farm trials in Paro and Thimphu were 12.1 percent and 20.9 percent, respectively (Table 20). However, varietal trial on blast resistant variety was predominant in both districts, comprising of 81.8 and 85.7 percent of the households participating from Paro and Thimphu, respectively (Table 21), with an overall participation of 84 percent. Only 16 percent of the households in both the districts participated in farmer-extension fertilizer use trials.

Table 20. Sample households' participation in on-farm trials

District	Sample household	Involving in on-farm trials	
		No. of household	%
Paro	91	11	12.1
Thimphu	67	14	20.9

Source: Survey, 2002.

The result from Table 21 strongly indicates that the effort of the Research and Extension was mainly concerted on breeding blast resistant varieties and selecting new and promising entries under farmers' socio-economic conditions, but these trials also hint that they were more inclined to varietal testing rather than identifying the causes to solve problems, plagued by rice blast on susceptible varieties. On the other hand, as increasing number of farmers adopt the improved blast resistant varieties, fertilizer trial may have to feature strongly in the future work plans to boost the productivity.

Table 21. Farmers' participation in different types of on-farm trial

District	HH involved in trial	Varietal trial		Fertilizer trial	
		No. of HH	%	No. of HH	%
Paro	11	9	81.8	2	18.2
Thimphu	14	12	85.7	2	14.3
Total HH	25	21	84.0	4	16.0

Source: Survey, 2002.

HH: household.

5.2.3 Field day

The Research Centres and the District Agriculture Sector organize field days, either individually or jointly to promote discussion between farmers, extension agents and the

researchers on specific agricultural production problems at a field site and also to evaluate the technology based on farmers' selection criteria during field days. In 1998, the Renewable Natural Resources Research Center, Yusipang in collaboration with the districts organized field days at the time of harvest at Geney (Thimphu) and Lugyni (Paro) to evaluate new promising rice blast paddy entries. 70 farmers from Thimphu and 30 farmers from Paro attended field days (Renewable Natural Resources Research Center, Yusipang, 2000), but the field survey found out that only 2 farmers from Lamgong attended the field day, while rest of the respondent of the sample households had never participated in field days, specifically organized for paddy production. The result indicates that the coverage of field days is limited to few individuals. The research centres and districts organize field days once or twice a year (Renewable Natural Resources Extension Support Project, 2000), where wider coverage is impinged by logistical and budgetary constraints.

5.2.4 Farmers' training

The Ministry of Agriculture (1994) furnishes detail evolution of extension services and their genre of communication approaches used in Bhutan. Although, farmers' training was conducted long before the Fifth Five Year Plan, it became one of the core activities of the district extension program, based on fixed quantitative targets set by the district in the Fifth Five Year Plan (1982-87) concurrent with the establishment of extension network in the whole country. In fact, the decentralization process, which took root in the Fifth Five Year Plan, triggered the evolution of extension system in the district into systems approach by integrating forestry, agriculture and livestock into Renewable Natural Resources Sector in the Seventh Five Year Plan (1992-97). The extension plan target was set in consultation with the people, but the subjects and content of training activities had been mainly decided by the district as deemed necessary and relevant to the farmer at that particular point of time.

In the Eighth Five Year Plan, it became more consultative, but still the programs were prescriptive, target driven and commodity based, where the training topics ranged from introduction of new crops and its packages, improved cultural activities, plant and soil protection, post-harvest management, etc., (Chettri *et al.*, 1999). Usually often than not, farmers' training was unilateral as extension agents go with predetermined topics and contents, which discouraged interactive approach to draw on farmers' indigenous knowledge and practices. The dramatic change occurred under the personal initiative of His Majesty the King, when His Majesty commanded that the Ninth Five Year Plan (2002-2007) be prepared "by the people for the people".

The participation of farmers in the training on paddy production and disease management was quite low in the study area (28.5 percent). Household heads represented 15.2 percent of the total sample households, but there was no evidence of household heads attending more trainings than the other family members. However, low percentage of farmers' participation in the training can be attributed to the financial and logistics constraints that limit wider coverage, whereby, only one of the family members represents in the training course being conducted by the extension agents.

Table 22. Farmers' participation in the training on blast management

District	Sample household	Attended training			
		Number	%	No. of HH Head	%
Paro	91	20	22.0	8	8.8
Thimphu	67	25	37.3	16	23.9
Total sample HH	158	45	28.5	24	15.2

Source: Survey, 2002.

5.3. Summary of extension methods prevalent in the study area

The commonly used extension methods in the study area are individual farmer visit, on-farm trial, field day and farmers' training.

Table 23 shows that 97.5 percent of the respondents had access to individual farmer visit, followed by farmers' training (28.5 percent), on-farm trial (15.8 percent) and field day (1.3 percent). It is not uncommon on the part of the extension agents to make frequent visit to farmers fields during the paddy-cropping season, especially to monitor rice blast outbreak, which is why, almost all the farmers seem to have access to individual farmer visit as compared to other extension methods. Other extension methods incur high expenditure on administrative and material inputs and, thus, the coverage is limited to few individual farmers.

Table 23. Summary of extension methods used in by the sample households (n=158)

Extension methods	No. of respondent	% of respondent
Individual farmer visit	154	97.5
On-farm trial	25	15.8
Field day	2	1.3
Farmers training	45	28.5

Source: Survey, 2002.

5.4 Rice blast management strategies in the study area

This section covers the blast management strategies commonly followed by the extension and the farming communities of the study area. The section is divided into three sub-topics: chemical, cultural and varietal management strategies.

5.4.1 Chemical management

Use of chemicals for rice blast management is necessary under certain conditions depending on weather, host susceptibility and pathogen population size. Appropriate utilization of chemicals prevents blast disease and reduces losses significantly.

Chemical management is categorized into seed treatment and spraying of fungicides to the standing crops. Generally, farmers use chemical spray only after infection. The most commonly used fungicide in the region is Tricyclazole (BEAM).

Chemical spray was more popular than the seed treatment in both the districts as indicated in Table 24. Only 19 percent of the farmers in the study site used seed treatment as a precautionary measure against the disease. None of the farmers used nursery sprays. Of the 59 farmers (56.2 percent) spraying chemical to paddy crop, 12 farmers (20.3 percent) in Wangchang sprayed before the blast fungus infested crop and the rest sprayed only after infection was observed. Therefore, farmers need to be made aware of taking preventive measures against the disease in the events of impending weather conditions that may trigger disease outbreak.

Table 24. Farmers following chemical management

District	No. of HH growing local variety	Seed treatment		Chemical spray	
		No. of HH following	% of HH following	No. of HH following	% of HH following
Paro	66	12	18.2	30	45.5
Thimphu	39	8	20.5	29	74.4
Total HH	105	20	19	59	56.2

Source: Survey, 2002.

5.4.2 Cultural practices

Cultural practices cover those improved management strategies that lead to healthy crop growth and deter from pest, disease and physiological malfunctions. Good agronomic practices are indispensable to prevent crops from weeds, unfavorable biophysical elements, pests and diseases.

In relation to blast disease management, cultural practices comprise of raising semi-dry bed nursery, adjusting planting date, selection of disease-free and healthy seeds, plant density, water management, nitrogenous fertilizer management, straw and stubble management and field sanitation.

Semi-dry bed nursery

None of the sample farmers reported of using semi-dry bed method to raise nursery seedlings to prevent seedlings from water stress that help in reducing susceptibility to blast. The farmers' current practice of dry bed nursery is further supported by the study done by Thinlay (1998). The author states that nursery practices in the high altitude cannot be related to blast occurrence in transplanted rice; and emphasized the impracticability of raising nursery in wet-bed in the water scarce and cold dry wintry season of high altitude.

Planting date

Manipulation of planting date according to the relationship between rice blast development and temperature is of prime importance, in order to avoid the vulnerability of crop to blast. The responses from farmers demonstrated that they follow the traditional planting time. Usually, nursery is raised in dry beds for about 3-4 months from February to May/June and transplants from May to June. All the farmers growing local varieties had not changed their traditional planting schedule and only 5.8 percent had adjusted their transplanting date of improved blast resistant variety, which matures two or three weeks late (127-137 days) after the local variety (117 days).

Even though, farmers have their own rational in following their traditional planting date based on their customs and beliefs of the locality, the nature of disease has changed dramatically that the traditional belief may not hold true. The paddy production system has become more intensive and less diverse than before, and quite often favors pest and disease incidences. Therefore, a sustained effort from the research and extension is

needed to determine the planting date and then convince and rationalize farmers' beliefs, the advantages of adjusting their planting dates in relation to rice blast management.

Table 25. Planting time of local and improved varieties

District	HHs growing local variety			HHs growing resistant variety		
	Total No.	Planting date (HH)		Total No.	Planting date (HH)	
		Change	No change		Change	No change
		------%			------%	
Paro	66	0.0	100	90	8.9	91.1
Thimphu	39	0.0	100	48	0.0	100.0
Total HH	105	0.0	100	138	5.8	94.2

Source: Survey, 2002.

Water, fertilizer, straw and stubble management

Water management, in the context of rice blast management for local varieties is to avoid cold water directly entering the fields. Therefore, it is recommended to collect water in the first terrace or letting the water flow through channels in staggered manner for gradual gathering of heat, since cold weather and cold water with inadequate water is known to trigger the growth of rice fungus (Research Extension and Irrigation Division, 1997). It is suggested that paddy fields should not be kept dry after transplanting, since paddy plant is known to be more resistant, when grown under proper water management. The other aspect of water management is to keep the paddy field flooded with water so that there is no water stress that may induce the susceptibility of crop to blast fungus.

Only three farmers (7.7 percent) in Thimphu reported of having followed the water management, while no one followed it in Paro. Though, avoiding cold water injury will help reduce yellowing of leaves in blast resistant variety, Chumroo, water management, however, is not a major concern for the improved blast resistant varieties.

Table 26. Water management followed by the farmers

District	No.of HH growing local variety	Water management	
		No. of HH adopting	% of HH adopting
Paro	66	0	0.0
Thimphu	39	3	7.7
Total HH	105	3	2.9

Source: Survey, 2002.

Application of too much farmyard manure (FYM) and nitrogenous fertilizer to local varieties is known to predispose local varieties to rice blast. Extension agents, normally, advise farmers to apply less chemical fertilizers to the local varieties in the presence of farmyard manure. Only 16 farmers (24.2 percent) of Wangchang in Paro reported of not using the inorganic because of their awareness that the inorganic nitrogenous fertilizer predisposed the crop to blast disease. A lone farmer (2.6 percent) from Chang geog reduced the use of inorganic nitrogenous fertilizer after knowing its impact on rice blast disease. However, all the farmers growing local rice varieties, save one farmer in Dopshari, used FYM as one of the major sources of plant nutrients.

Table 27. Fertilizer management followed by the farmers

District	No.of HH growing local variety	Fertilizer management	
		No. of HH following	% of HH following
Paro	66	16	24.2
Thimphu	39	1	2.6
Total HH	105	17	16.2

Source: Survey, 2002.

Straw is commonly used as the cattle feed or fodder in the small subsistence mixed farming systems of the study area. Manure derived from stall-feeding of improved breeds and local cattle form the major source of farmyard manure (FYM). However, if the cattle shed is located near the paddy fields and the straw is staked near the fields, it also becomes a source of blast fungus under favorable weather conditions. Therefore, cattle shed should not be constructed near the paddy fields, where cattle, human beings or winds can easily spread the rice blast inoculum, harboring in the straw. On the other hand, removal or burning of stubble of infested paddy field is recommended to eliminate the blast pathogen for the ensuing crop. However, only 4.5 percent of the farmers (3 farmers) in Paro followed straw and stubble management, i.e., removal and burning of straw and stubble in the paddy fields.

Table 28. Straw and stubble management followed by the farmers

District	No. of HH growing local variety	Straw and stubble management	
		No. of HH adopting	% of HH adopting
Paro	66	3	4.5
Thimphu	39	0	0.0
Total HH	105	3	2.9

Source: Survey, 2002.

The low adoption rate of cultural practices or components of the technology are attributed to various reasons. The technology advocated should not conflict with its traditional use as is with the case of straw and stubble management. It should not further constrain their limited resources, as is illustrated by water management, whereby farmers were advised to uphold water in the first terrace at the source of irrigation water or maintain the paddy fields in flooded conditions, where the irrigation system is not well developed. It would be economical to devote to those technologies that directly address farmers' burgeoning problems.

5.4.3 Varietal resistance

Gliessman (1998) warns that the genetic base of agriculture has narrowed to a dangerous point as human societies have become increasingly depended on a few species of crop organisms and on a smaller number of genes and genetic combinations found in those species. He elaborates on the impacts of lost of diversity by stating that crop plants have lost much of their genetic basis of their pest and disease resistance and their ability to tolerate environmental conditions, leading to crop failures and increased dependence on human-derived inputs and technologies for the maintenance of optimum growth conditions. He further adds that genetic resources beyond the crops themselves-wild crop relatives, weedy derivatives, traditional cultivated varieties, genetic lines, and breeding stocks have been greatly reduced.

McConnel and Dillon (1997) note that mixed farms have four to six crop activities and three to six livestock activities; those of Bhutan somewhat fewer. In Bhutan, it is largely dictated by the short growing season and adverse climatic conditions of winter for crop growth and also of late due to farm labor shortage and animal depredation during the winter season. Therefore, to cope with the operating objective, farmers are now increasingly using the improved seeds and herbicides, especially after the rice blast epidemic in 1995. The number of traditional varieties grown is reducing as is evident from the two blocks of Kawang and Geney in Thimphu district, which has near 100 percent adoption and that too with only one kind of blast resistant variety (Chumroo). Of the total sample households in these two blocks, only 6 farmers used both traditional and improved variety. Overall, use of both varieties in Thimphu district (29.9 percent) was much lower than Paro district (71.4 percent). Very high proportion of farmers in Thimphu district used mono varieties (28.4 percent local and 41. 8 percent resistant varieties). Only one household in Paro district used local variety (1.1 percent) and 27.5 percent used only improved variety, demonstrating majority of the farmers grow more that one variety.

Table 29. Categorization of sample households by use of varieties

District	Sample household	Only local variety		Only resistant variety		Both varieties	
		No.of HH	%	No.of HH	%	No.of HH	%
Paro	91	1	1.1	25	27.5	65	71.4
Thimphu	67	19	28.4	28	41.8	20	29.9
Total sample household	158	20	12.7	53	33.5	85	53.8

Source: Survey, 2002.

The farmers of Thimphu, on average used one kind of blast resistant variety (0.7), while the farmers of Paro, on average used 1.7 varieties. Two farmers in Paro grew as many as four resistant varieties and four farmers grew three resistant varieties, while in Thimphu all the farmers used only one kind of blast resistant variety (Chumroo). The average use of traditional varieties in Paro (1.1) was also more diverse than in Thimphu (1). The standard deviation of Paro (0.7) and Thimphu (0.5) reflected that the former had more variation in the use of improved varieties that were resistant to blast.

Table 30. Comparison of paddy varieties grown by the sample households

	Paro		Thimphu	
	Local variety	Resistant variety	Local variety	Resistant variety
	----------Number of varieties----------			
Average	1.1	1.7	1.0	0.7
Standard deviation	0.9	0.7	1.0	0.5
Minimum	0.0	1.0	0.0	0.0
Maximum	3.0	4.0	3.0	1.0

Source: Survey 2002

Table 31 also shows that the sample households growing resistant variety was more in Paro (98.9 percent) than in Thimphu (71.6 percent).

Table 31. Comparison of paddy varieties grown by the sample households

District	Sample household	Growing resistant variety	
		No. of HH	%
Paro	91	90	98.9
Thimphu	67	48	71.6
Total sample household	158	138	87.3

Source: Survey, 2002.

5.5 Summary of blast management technology on local varieties

The cultural management such as seed treatment, chemical spray, water, fertilizer, straw and stubble managements are particularly recommended for those farm households growing local varieties. Local varieties when exposed to favorable conditions lead to blast disease incidence and are known to cause epidemic if proper management strategies are not followed.

Of the 105 sample households growing local varieties, 19 percent treated their seeds; 56.2 percent sprayed chemical fungicide to control blast disease; 2.9 percent followed recommended water management; 16.2 percent either reduced or did not apply nitrogenous fertilizer to local varieties and 2.9 percent removed and burnt straw and stubble. The management was predominated by chemical spray followed by chemical seed treatment, fertilizer management and very few followed water, and straw and stubble management.

Table 32. Summary of blast management by the sample households on local varieties

District	No. of HH growing local variety	Management technologies adopted on local variety				
		Seed	Spray	Water	Fertilizer	Straw
		----------% of HH adopting----------				
Paro	66	18.2	45.5	0.0	24.2	4.5
Thimphu	39	20.5	74.4	7.7	2.6	0.0
Total HH	105	19.0	56.2	2.9	16.2	2.9

Source: Survey, 2002.

5.6 Farmers' preference of extension methods

The extension methods commonly practiced in the study area were used to determine the preference of these methods by converting the ranks given by the farmers and extension agents into scores. The main reason behind converting ranks into scores was to establish distance between the successive ranks. The detail of this method is given in Chapter 3, section 3.5.

The ranking was based on 51 farmers, who were aware of all the extension approaches being ranked. Of all the extension methods used by the research and extension in blast management, farmers' training was the most preferred with a score of 6.6, closely followed by individual farmer visit (6), on-farm trial (4.9) and field day (2.5). Though, farmers stated that they could not follow everything that was taught in the training, it was a good source of information and knowledge, which created awareness. Individual farmer visit was also almost equally preferred by the farmers, since extension agents on their regular field visits to monitor their fields, report the observations and give advise and suggestion of the course of action to be followed or taken by the farmers. Some farmers viewed that it was very difficult to identify pests and diseases and the service of extension to diagnose the symptoms was essential. Extension agents often gave advice and helped farmers in preparing chemicals for seed treatments and sprays.

On-farm trial was carried out jointly by the research and extension and it was particularly preferred because of free inputs, especially the varietal trial, in which, the seeds supplied to farmers became the source of seeds in the ensuing seasons. All the respondents were aware of field days, but the participation is limited to certain number due to logistical constraints.

Table 33. Scores allocated to ranks of extension methods to determine farmers' preference

Extension approach	Ranks				Scores allocated to ranks				Total scores	Mean Score
	1	2	3	4	1(8)*	2(6)	3(4)	4(2)		
	--No.of respondents--				------Scores------					
Individual farmer visit	17	19	12	3	136	114	48	6	304	6.0
On-farm trial	10	11	23	7	80	66	92	14	252	4.9
Field day	1	0	10	40	8	0	40	80	128	2.5
Farmers' training	23	21	6	1	184	126	24	2	336	6.6

Source: Survey, 2002.

( )*: Score; Rank 1 = 8 score; 2 = 6 score, 3 = 4 score, 4 = 2 score, and no response = 0 score.

The most preferred approach used by extension agents in delivering and providing their services to farming communities was through training with a score of 7.3. Individual farmer visit was also almost equally preferred with a score of 6.5.

The preference for on-farm trials was low because conducting on-farm trials require scheduled monitoring and data collection, which the extension agents can ill afford, since they have many other activities. Moreover, on-farm trials and field days involve prior administrative approval from the authority for financial expenditure. Thus, the extension agents do not take so much interest in initiating on-farm trials and field days.

Table 34. Scores allocated to ranks to determine extension agents' preference of extension method

Extension Approach	Ranks				Scores allocated to ranks				Total scores	Mean Scores
	1	2	3	4	1(8)*	2 (6)	3 (4)	4(2)		
	--No.of respondents--				------Scores------					
Individual farmer visit	3	4	1	0	24	24	4	0	52	6.5
On-farm trial	0	1	2	5	0	6	8	10	24	3.0
Field day	0	0	5	3	0	0	20	6	26	3.3
Farmers' training	5	3	0	0	40	18	0	0	58	7.3

Source: Survey, 2002.

* ( ): Score

However, the preference for on-farm trial and field day contradicted between the farmers and extension agents. Farmers seemed to prefer on-farm trial to the field day because they get free inputs, while the preference of extension agent for field day and on-farm trial was very low, since these two methods were largely determined by decision of the Research Center and the District Agriculture Office for administrative, material and financial support. In addition, conducting on-farm trials require scheduled monitoring and data collection, which the extension agents cannot maintain, since they have many other activities. In addition, on-farm trials and field days involve high expenditure on the part of the organizer.

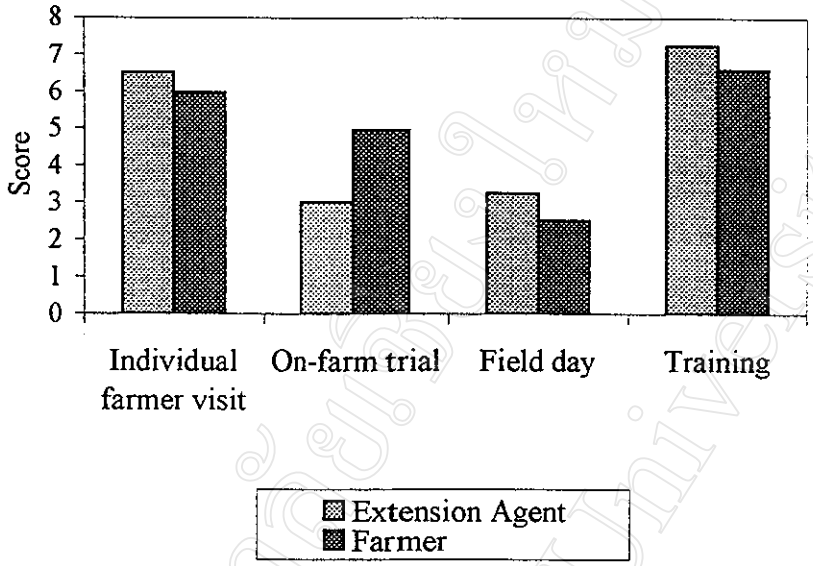

Figure 4. Comparison of scores allocated by farmers and extension agents on extension methods

Statistical test to demonstrate a difference among farmers' and extension agents' preference was conducted on the ranks they gave to the individual extension approach. The method was followed after Abeyasekera (2000), in which, the test was based on the approximation of chi-squared distribution. Friedman's test was applied to ranks given by the respondents (n) to each of the specified number of items, i.e., the extension methods (k) to the data as shown in Tables 5.8 and 5.9.

First the sum of ranks was calculated, (R_j) for item j.

Where:

j = 1 for individual farmer visit

j = 2 for on-farm trial

j = 3 for field day

j = 4 for farmers' training

Second step used the Friedman's test statistic χ^2 to calculate:

$$\chi^2 = 12/nk\,(k+1)\Sigma[R_j - \{n\,(k+1)/2\}]^2$$

Then the value obtained (χ^2) was compared with tabulated values of a chi-squared distribution with (k - 1) degrees of freedom to test the significance.

Table 35. Farmers giving ranks to different extension methods according to their preferences

Rank	Farm visit	On-farm trial	Field day	Farmers' training
1	17	10	1	23
2	19	11	0	21
3	12	23	10	6
4	3	7	40	1
n	51	51	51	51
Rj	103	129	191	87

Source: Survey, 2002.

n = Number of farmers; R_j = Sum of ranks.

R_1 (Individual farmer visit) = (1 * 17) + (2 * 19) + (3 * 12) + (4 * 3) = 103

R_2 (On-farm trial) = (1 * 10) + (2 * 11) + (3 * 23) + (4 * 7) = 129

R_3 (Field day) = (1 * 1) + (2 * 0) + (3 * 10) + (4 * 40) = 191

R_4 (Farmers training) = (1 * 23) + (2 * 21) + (3 * 6) + (4 * 1) = 87

$$\chi^2 = 12/(51)(4)(4+1)\,[\{103 - (51)(4+1)/2\}^2 + \{129 - (51)(4+1)/2\}^2 + \{191 - (51)(4+1)/2\}^2 + \{87 - \{51)(4+1)/2\}^2]$$

$$\chi^2 = 0.011 * 6275$$

$$= 69.01.$$

Table 36. Extension agents giving ranks to different extension methods according to their preferences

Rank	Number of extension agents			
	Individual farmer visit	On-farm trial	Field day	Farmers' training
1	3	0	0	5
2	4	1	0	3
3	1	2	5	0
4	0	5	3	0
n	8	8	8	8
R_j	14	28	27	11

Source: Survey, 2002.

R_1 (Individual farmer visit) = (1 * 3) + (2 * 4) + (3 * 1) + (4 * 0) = 14

R_2 (On-farm trial) = (1 * 0) + (2 * 1) + (3 * 2) + (4 * 4) = 28

R_3 (Field day) = (1 * 0) + (2 * 0) + (3 * 5) + (4 * 3) = 27

R_4 (Farmers training) = (1 * 5) + (2 * 3) + (3 * 0) + (4 * 0) = 11

$$\chi^2 = 12/ (8) (4) (4 + 1) [\{14 - (8) (4 + 1)/2\}^2 + \{28 - (8) (4 + 1)/2\}^2 + \{27 - (8) (4 + 1)/2\}^2 + \{11 - \{8) (4 + 1)/2\}^2]$$

$$\chi^2 = 0.075 * 230$$

$$= 17.25$$

Chi-square (χ^2) value at .01 CI = 11.345

The results computed from Tables 35 and 36 reveal the highly significant difference ($p<0.01$) of preferences of extension methods, both by the farmers and extension agents. In case of farmers' preferences, the difference was mainly due to the familiarity with the approach, complex nature pests, in which, extension agents' monitoring and advice was required. Nature of the approach of on-farm trial, whereby farmers got free inputs and

saw tangible results, motivated them to adopt such technology. The significant difference of extension agents' preferences among the different extension methods was influenced by the nature of decision that they had over the technology. Extension agents could initiate the on-farm trials and field days, but they had to rely on the Research Center and the District Agriculture Office for administrative, material and financial support. However, this situation may change overtime as the plans and activities in the current plan are being prepared by the farmers, however, it is still unclear, how much influence and authority the extension agents will have in determining the type of extension approach to be implemented in addressing perceived or existing problems.