CHAPTER 5

INDEPENDENT VARIABLES AND THEIR INFLUENCE ON PRODUCTION EFFICIENCY AND ADOPTION

5.1 INTRODUCTION

In the past it has been believed that human behavior, particularly the adoption behavior of farm operators is largely determined or influenced by socio-economic and personal factors (independent variables). This has led to a research tradition in the area of behavioral sciences, which is largely dominated by an investigation of the relationships between these variables and behavior. Roger's (1983) generalizations based on the findings of more than 200 studies, regarding the factors responsible for behavior change of a farm operator are, for example, reflecting the importance of these variables without taking account of the more direct intervening variables, which according to Düvel (1989 & 1991) are the immediate precursors of behavior. However, the findings are inconclusive and usually contradictory as already explained.

With an ultimate objective of assessing their relative importance and obtain a better perspective of the influence relationships, in this chapter an attempt will be made to identify the socio economic and personal characteristics of respondent farmers such as age, education and farm size, which are assumed to differentiate maize and dairy farmers into their various efficiency classes and thereby determine the relationships between these variables and production efficiency. It is also intended to evaluate the influence of the stimuli independent variables on the practice adoption behavior of maize and dairy farmers in the study area. Following the identification of the explanatory variables significantly associated with the two criterion variables, a more rigorous analysis will be made by employing the OLS method to determine the contributions of these factors to the variance in production efficiency and package adoption behavior of maize and dairy farmers.

5.2 PROFILE OF RESPONDENT FARMERS AND INFLUENCE OF INDEPENDENT VARIABLES ON PRODUCTION EFFICIENCY

5.2.1 Age

Literature review showed that studies conducted regarding the relationship between age and the adoption behavior and production efficiency of farmers are not consistent. (Alene *et al,* 2000:639; Getahun *et al,* 2001:21; Mahabile *et al,* 2002:326) did not find significant relationships between age and adoption. Significantly higher number of other studies (Coop, 1958; Bembridge & Williams, 1990; Foltz *et al*, 2002) also reported that age is negatively related with the adoption behavior and production efficiency of farmers and led to the hypothesis that there is a negative relationship between age and the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers in the study area.

As far as maize farming is concerned, Table 5.1 shows that there are significant differences between the different efficiency categories in age (F = 4.84, p = 0.001). The mean age of the efficiency categories show a systematic and an almost linear decrease from the least to the most efficient category. For example, the farmers in the least efficiency category have a mean age of 50.2 years, while that of the most efficient farmers (category 5) is only 37.2 years. This suggests that an increase in age tends to be associated with a decrease in efficiency, and thus a clear relationship or negative relationship between maize farmers' age and their production efficiency. This relationship is supported by the correlation coefficient (r = -0.300, p = 0.000) shown in Table 5.1 and provides evidence in support of the hypothesis (Hypothesis 2.1), that age is negatively related with production efficiency.

In contrast with the hypothesis, a positive relationship (r = 0.158, p = 0.025) is found in dairy. The lack of significant difference amongst the efficiency classes (F = 1.5, p = 0.191), does not, however, support this finding. A more sensitive efficiency scale (more than 5 categories) might have brought out this difference.

5.2.2 Education

Several studies (Alene *et al*, 2000:639; Zegeye *et al*, 2001:46; Mahabile *et al*., 2002:326) showed that education is positively related with the adoption behavior of farmers. Foltz and Chang (2002:1031) for instance, found that educated dairy farmers are more likely to use recombinant bovine somatotropin than the less educated ones. Education is also found to be positively related with production efficiency (Nigussie, 2001:53; Alene and Hassen, 2003:1). The findings of these empirical studies led to the Hypotheses in this study that education is positively related to adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers in the study area.

Table 5.1 The percentage distribution of maize and dairy farmers according to their efficiency and age

		Percentage distribution per efficiency class*					
Commodity	**Age**	1	2	3	4	5	Total
Maize							
	Frequency	n=41	n=24	n=43	n=54	n=38	N=200
	Mean	50.2	48.8	43.4	41.3	37.2	43.7
	18-30	19.5	8.3	23.3	33.3	42.1	27
	31-40	14.6	33.3	25.6	27.8	26.3	25
	41-52	26.8	25	25.6	14.8	21.1	22
	55-85	39	33.3	25.6	24.1	10.5	26
	Total	100	100	100	100	100	100
Dairy							
	Frequency	n=35	n=41	n=48	n=40	n=36	N=200
	Mean	44	47.7	46.4	47.5	51.3	47.3
	12-38	37.1	34.1	25	27.5	8.3	26.5
	39-45	20	19.5	29.2	22.5	25	23.5
	46-57	17.1	22	25	22.5	33.3	24
	58-80	25.7	24.4	20.8	27.5	33.3	26
	Total	100	100	100	100	100	100

Mize (F=4.84, p=0.001; r=-0.300, p= 0.000), Dairy (F=1.5, p=0.191; r=0.158, p=0.025)

1= Least efficient, 5 = Most efficient

According to Table 5.2, which presents the education characteristic or profile of maize and dairy farmers, it appears that dairy farmers are more educated than maize farmers. This is shown by the fact that 18.5 percent and 47.5 percent of dairy farmers have a tertiary and secondary level of education respectively, while in maize there is not a single farmer with a tertiary level of education and the number of those who attended secondary school education is only 16 percent.

As far as dairy farmers are concerned, Table 5.2 shows that there are significant differences between the different efficiency categories (F = 3.49, p = 0.009). The mean educational level of the efficiency categories shows a systematic and an almost linear increase from the least to the most efficient category. For example, the farmers in the least efficient category have a mean education of 6.7 years, while that of the most efficient farmers is 10.4 years. This suggests that higher education is associated with an increase in production efficiency, and thus a clear positive relationship between dairy farmers' education and their production efficiency. This relationship is supported by the correlation coefficient (r = 0.265, p = 0.000) shown in Table 5.2, and provides strong evidence in support of the hypothesized association (Hypothesis 2.1), which states that higher education is correlated with higher production efficiency. The same applies in maize, which present further evidence supporting the hypothesis.

Table 5.2 The percentage distribution of maize and dairy farmers according to their efficiency and level of education

		Percentage distribution per efficiency class*					
Commodity	**Education**	1	2	3	4	5	Total
Maize							
	Frequency	n=41	n=24	n=43	n=54	n=38	N=200
	Mean	0.8	1.4	3.2	3.3	4.3	2.7
	Illiterate	78	66.7	44.2	37	28.9	49
	Primary	19.5	29.2	37.2	42.6	42.1	35
	Secondary	2.4	4.2	18.6	20.4	28.9	16
	Total	100	100	100	100	100	100
Dairy							
	Frequency	n=35	n=41	n=48	n=40	n=36	N=200
	Mean	6.2	7.5	8.4	9	10.4	8.3
	Illiterate	22.9	26.8	20.8	17.5	8.3	19.5
	Primary	31.4	14.6	10.4	10	8.3	14.5
	Secondary	40	46.3	45.8	52.5	52.8	47.5
	Tertiary	5.7	12.2	22.9	20	30.6	18.5
	Total	100	100	100	100	100	100

Maize (F=7.7, p=0.000; r=0.349, p=0.000), Dairy (F=3.49, p=0.009; r=0.265, p=0.000)

* 1 = Least efficient, 5 = Most efficient

5.2.3 Farm size

It is generally believed that for farming to be profitable, farmers need to move away from subsistence, small and fragmented land holding system to a more market oriented system. This necessitates the use of modern technologies, which are often scale sensitive, i.e. relatively small farmers have less incentives to adopt new practices. Small farmers are also associated with risk aversion behavior while relatively bigger farmers are risk takers. Both arguments indicate the need for increasing the scale of operation. These assumptions are supported by several others (Demeke, 1989:230; Bizimana *et al,* 2000:240; Foltz and Chang, 2002: 103; Mahabile *et al,* 2002:326; Alene *et al,* 2003:1; Tesfaye, in press) and led to the hypotheses in this study namely that farm size is positively related with the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers in the study area.

Very small farms or holdings of approximately one hectare characterize maize farming in the study area. In this study, 25 percent of the respondents were classified into small (less than 0.75 hectare holding), 47 percent of them were medium (0.75 to 1 hectare holding) and 28 percent were grouped into the bigger category (more than 1.25 hectare holding).

Regarding maize farming, there is, as expected, a positive association between farm size and production efficiency. Evidence of the association is the fact that 34.1 percent of least efficient farmers have small farm size while the number of the most efficient farmers having small farm size is only 23.7 percent. The difference is, however, not significant ($F = 1.8$, $p = 0.125$), nor is the correlation ($r = 0.023$, $p = 0.748$).

As far as dairy farming is concerned, although volume of production is sometimes considered as a measure of production efficiency, the cooperative has the tradition that classification of its members based on the amount of milk supply to the cooperative is a best indication of farm size. Farm size was, therefore, measured by the level of average fortnightly milk supply computed from the 2001 annual milk supply records of each member. Based on the deviation of their produce from the mean, three categories were formed. Those farmers who supplied less than 110 liters per fortnight were grouped into the small enterprise (farm) category while those who supplied from 110 to 219 liters and more than 219 liters were grouped into the medium and the bigger enterprise category respectively.

There are significant differences among the different efficiency classes of dairy farmers in farm size ($F = 7.6$, $p = 0.000$), i.e. bigger farmers or farmers with bigger enterprise are more efficient than small farmers. The most efficient category of dairy farmers produce an average of 215 liters of milk per fortnight while the mean for the least efficient ones is only 99 liters. The middle groups have means of between 151 and 178 liters. The significant association between farm size and production efficiency is confirmed by the highly significant positive correlation coefficient ($r = 0.324$, $p = 0.000$), thus providing evidence in support of the hypothesized relationship (Hypothesis 2.1).

Table 5.3 The percentage distribution of maize and dairy farmers according to their efficiency and farm size

Commodity	Farm size	1	2	3	4	5	Total
		Percentage distribution per efficiency class*					
Maize							
	Frequency	n=41	n=24	n=43	n=54	n=38	N=200
	Mean	0.89	1.14	1	0.89	0.95	0.96
	Small	34.1	-	23.3	31.5	23.7	25
	Medium	36.6	62.5	44.2	48.1	50	47
	Bigger	29.3	37.5	32.5	20.4	26.3	28
	Total	100	100	100	100	100	100
Dairy							
	Frequency	n=35	n=41	n=48	n=40	n=36	N=200
	Mean	99	151	178	164	215	163
	Small	62.9	34.2	22.9	35	16.7	33.5
	Medium	25.7	39	35.4	30	33.3	33
	Bigger	11.4	26.8	41.7	35	50	33.5
	Total	100	100	100	100	100	100

Maize (F=1.8, p=0.125; r=0.023, p=0.748) Dairy (F=7.6, p=. 000; r=0.324, p=0.000)

*1 = Least efficient, 5 = Most efficient

5.2.4 Farming experience

Experience is considered to be an accumulation of human capital. With experience farmers are expected to build confidence and be willing to try alternative and better farming practices. Several studies support this assumption (Zegeye *et al,* 2001:46; Zegeye and Tesfaye, 2001:50; Mahalbile *et al,* 2002:326) and justify the hypothetical exposition that there is a positive association between farming experience and the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of respondents in the study area.

Regarding maize farming, the most efficient farmers appear to have less farming experience than the least efficient ones (F = 4.68, p = 0.001). Their mean experience is 21.4 years while the mean for least efficient ones is 30.6 years, clearly indicating that an increase in experience tends to be associated with a decrease in efficiency. This negative relationship is supported by the highly significant negative correlation coefficient (r = -

0.285, p = 0.000). This finding is not in accordance with expectations (Hypothesis 2.1). A possible explanation for the negative relationship is that experience above a certain threshold no longer contributes or differentiates regarding efficiency. With a mean of 25.7 years this threshold has probably been reached and can it be expected that the negatives associated with old age (which is highly correlated with farming experience r = -0.300) have a bigger influence.

Table 5.4 The percentage distribution of maize and dairy farmers according to their efficiency and farming experience

		Percentage distribution per efficiency class*					
Commodity	**Experience**	1	2	3	4	5	Total
Maize							
	Frequency	n=41	n=24	n=43	n=54	n=38	N=200
	Mean	30.6	30.6	25	23.4	21.4	25.7
	Least	22.0	12.5	30.2	40.7	47.4	32.5
	Medium	26.8	37.5	27.9	31.5	23.7	29.0
	Most	51.2	50.0	41.9	27.8	28.9	38.5
	Total	100	100	100	100	100	100
Dairy							
	Frequency	n=35	n=41	n=48	n=40	n=36	N=200
	Mean	10.7	9.3	9.2	10	11.5	10
	Least	48.6	48.8	20.8	32.5	22.2	34.0
	Medium	17.1	19.5	52.1	37.5	36.1	33.5
	Most	34.3	31.7	27.1	30.0	41.7	32.5
	Total	100.0	100.0	100.0	100.0	100.0	100.0

Maize (F=4.68,p= 0.001; r=-0.285, p=0.000), Dairy (F=0.55, p= 0.696; r=0.042, p=0.555)

* 1 = Least efficient, 5 = Most efficient

5.2.5 Media contact

The use of media in rural areas is believed to facilitate change in the behavior of farmers and ultimately leads to significant improvement in the production efficiency of farmers. Research results show positive associations between the use of media and adoption of agricultural technologies. According to Saeed (1989:263), mass media exposure constitutes a principal factor associated with adoption of agricultural innovations in the Sudan. Elias (1999:72) also found a similar positive association between the use of media and adoption behavior. Based on the above it was hypothesized that media exposure is positively associated with the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers in the study area.

Media facilities available for farmers in the research area include public gatherings (meetings), radio, TV and the print media and this use is shown in Fig. 5.1 and 5.2.

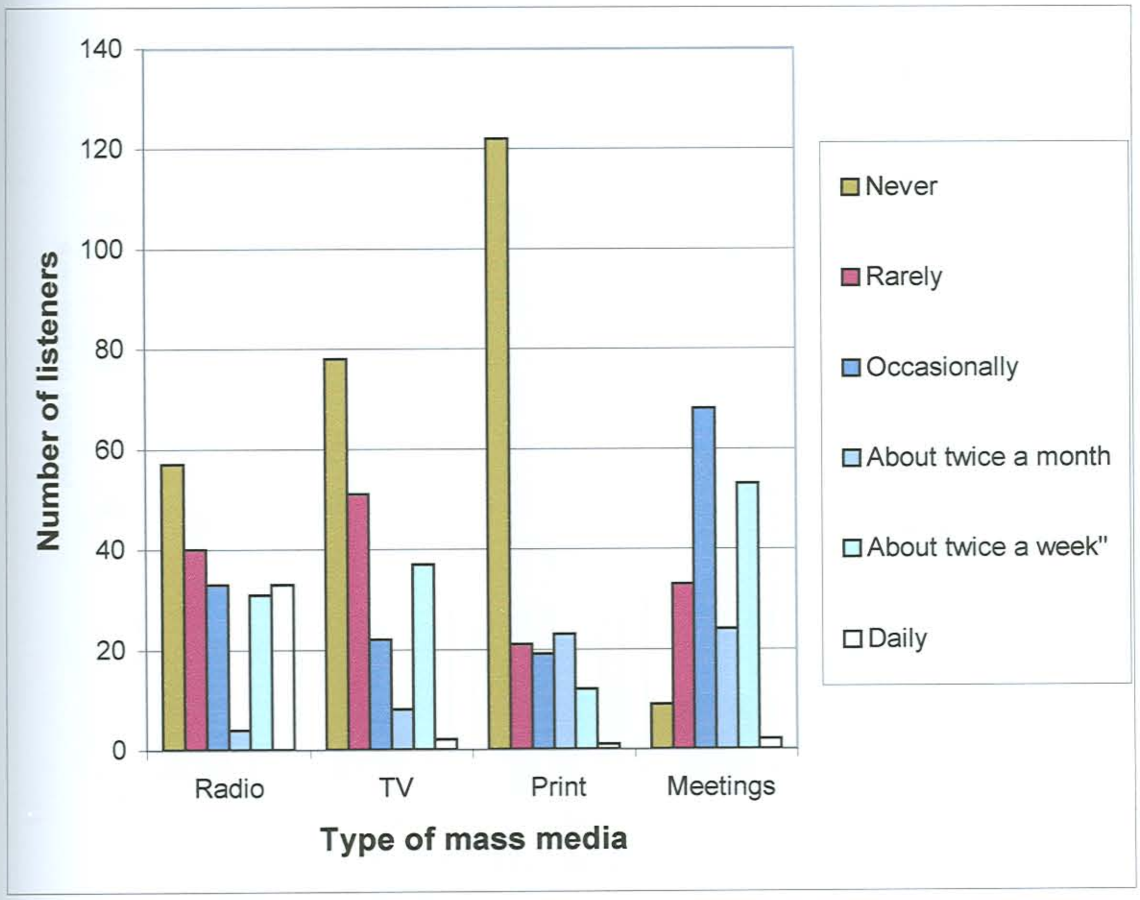

Fig. 5.1 Level of mass and group media use by maize growers

As far as maize farming is concerned, the radio is the only mass media, which is daily used by about 17 percent of the respondents. A fair number of farmers (17 to 27 percent) use meetings, radio and TV about once or twice a week. 10 to 25 percent of maize producers occasionally (less than once a month) and rarely use all of the available media facilities. Moreover, the print media, TV and radio in order of importance are the ones that have never been used by many farmers in the Shashemene district (Fig. 5.1). Radio is, therefore, the only reliable means of disseminating agricultural information in addition to the development agent assigned for this purpose implying that a lot is expected from the extension service to invigorate available sources of agricultural information, as more specific channels are appropriate for different messages.

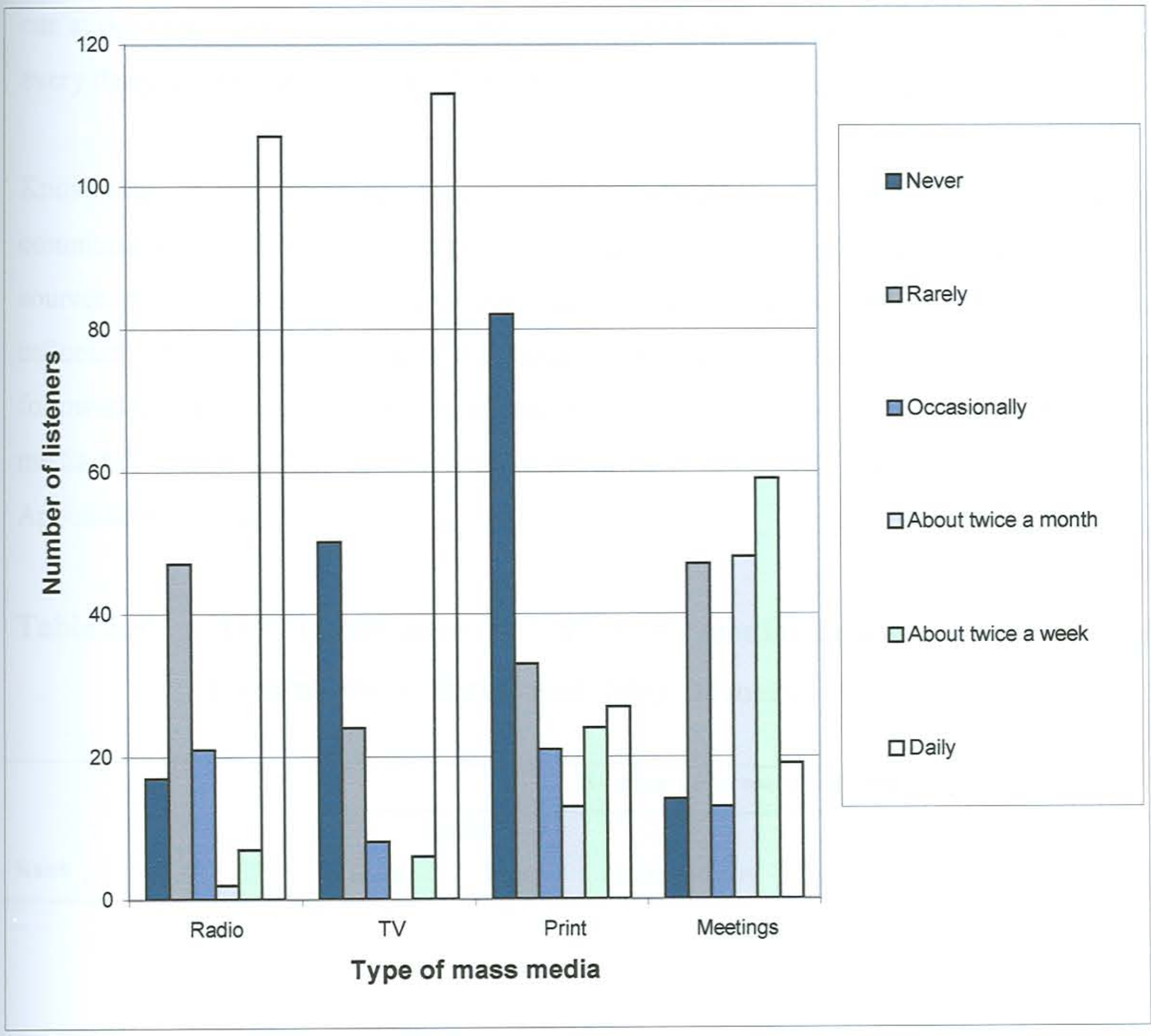

Fig. 5.2 level of mass and group media use by dairy farmers

Contrary to maize farmers, many dairy farmers have been extensively using all of the available media sources (Fig. 5.2). In dairy, TV and radio are the most popular media, which were daily used by more than 50 percent of the respondents. About 30 percent of dairy farmers use meetings at least once or twice a week. The least used is the print medium, which about 40 percent of dairy farmers had never used it at all. All of the mass media sources were never used by about 10 to 40 percent of all dairy farmers.

The extension service could make use of this opportunity and promote its services through the variety of information sources available for dairy farmers. Radio and TV, for example can be used for creating awareness and disseminate less skill oriented technologies. Meetings can be used to promote and enhance group decision-making. It can at the same time solve its own problem of being unable to assign extension agents for every dairy cooperative provided that the service has a shortage of manpower.

Knowledge of the extent of use of each media facility could help to design effective communication strategies. Correspondingly, respondents were asked to rank their media sources of information in order of importance or frequency to determine their potential influence. As depicted in Table 5.5, radio is found to be the most important source followed by meetings both for maize and dairy farmers. Importance of TV and the print media takes only a third or fourth position in both maize and dairy farming (See also Appendices 5.1 and 5.2).

Table 5.5 The importance of different media based on rank order assessments by maize and dairy farmers *

	Number of farmers responded							
	Radio		TV		Print		Meetings	
Rank	Maize	Dairy	Maize	Dairy	Maize	Dairy	Maize	Dairy
1	77	71	11	54	8	11	97	61
2	58	79	41	54	16	16	40	39
3	7	23	53	38	31	46	30	49
4	4	8	19	6	37	48	23	36
Total weight	500	575	292	460	179	232	483	495
Rank position	1st	1st	3rd	3rd	4th	4th	2nd	2nd

From field experience in disseminating technology in the form of a package program, it was found that farmers require extension assistance at critical periods or during the time of applying key recommendations such as improved seeds, planting, improved fertilizer, and methods of fertilization (Howard *et al,* 1999: 20-21). These activities are occurring

* The total weighted score is the sum of rank order frequencies multiplied respectively by 4 for the first position, 3 for 2nd position, 2 for 3rd position and 1 for 4th position.

roughly about one month apart from each other. If farmers listen to the mass media at least once a month, they are expected to receive timely information required to properly implement their field activities. Based on this assumption and for the purpose of analyzing the influence relationship between media exposure and production efficiency, those farmers who had no exposure to the available media at least once a month were grouped into the low media exposure category while those who had exposure at least once a month were grouped into the high exposure category.

Table 5.6 The percentage distribution of maize and dairy farmers according to their efficiency and media contact

Commodity	Media	Percentage distribution per efficiency class* 1	2	3	4	5	Total
Maize							
	Frequency	n=41	n=24	n=43	n=54	n=38	N=200
	Mean	1.9	2.2	2.7	3	3.3	2.7
	Low	85.4	83.3	69.8	46.3	39.5	62.5
	High	14.6	16.7	30.2	53.7	60.5	37.5
	Total	100	100	100	100	100	100
Dairy							
	Frequency	n=35	n=41	n=48	n=40	n=36	N=200
	Mean	3.8	3.9	3.4	3.8	3.7	3.7
	Low	28.6	29.3	39.6	30.0	36.1	33.0
	High	71.4	70.7	60.4	70.0	63.9	67.0
	Total	100	100	100	100	100	100

Maize (F=10.8, p= 0.000; r=0.336, p=0.000), Dairy (F=0.66, p=0.62; r=0.023, p=0.745)

* 1 = Least efficient, 5 = Most efficient

As depicted in Table 5.6, there are significant differences between the different efficiency categories (F = 10.8, p = 0000). The mean media exposure score of the efficiency categories show a systematic and almost linear increase from the least to the most efficient category. For example, the farmers in the least efficient category have a mean media exposure score of 1.9, while that of the most efficient farmers is 3.3. This suggests that an increase in media exposure tends to be associated with a similar increase in production efficiency, and thus a clear positive relationship between media exposure and production efficiency of maize farmers in the study area. This relationship is supported by the highly significant positive correlation coefficient (r = 0.336, p = 0.000) and provides evidence in support of Hypothesis 2.1, namely that higher exposure to media is correlated with higher production efficiency

Although dairy farmers have a higher exposure to media, there is no clear relationship between media exposure and the production efficiency of dairy farmers of ALWDADPMA ($F = 0.66$, $p = 0.62$; $r = 0.053$, $p = 0.745$). The reason for the lack of relationship could probably be attributed to easy access to media sources and the consequent lack of variation between herders. Dairy farmers are residing in town (equally exposed to media) and may not have differences in their media exposure compared to the purely rural maize farmers where the elites and youngsters have better access.

5.2.6 Extension contact

Extension is instrumental to agricultural development and can play a big role in equipping farmers with information required to improve their farming practices. The literature reveals a positive association between extension and the adoption behavior of farmers (Legesse, 1992:68; Elias, 1999:72; Getahun *et al,* 2000:21; Zegeye *et al,* 2001:43) and led to the hypothesis that extension contact is positively associated with the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers in the study area.

Available information sources for farmers in the study area include the local development agent (DA), fellow farmers who usually run farmer's demonstration plot on their own holding, demonstration plots (EMTPS), field days, Woreda Bureau of Agriculture (BoA), artificial insemination center (AI), Woreda Administrative Council (WAC), Non Governmental Organizations (NGOs) operating in the area and the peasant association (PA) itself. The frequency with which they are used is summarized in Fig. 5.3

Maize farmers have greater and frequent contact with their own fellow farmers, the PA, the DA, and the EMTPs. 54, 51,39, and 13 farmers respectively, have a very high and frequent contact (about twice a week) with these information sources. On the other hand, 184, 151, 148, and 132 farmers do not have any contact with NGOs, AI, WAC, and field days respectively.

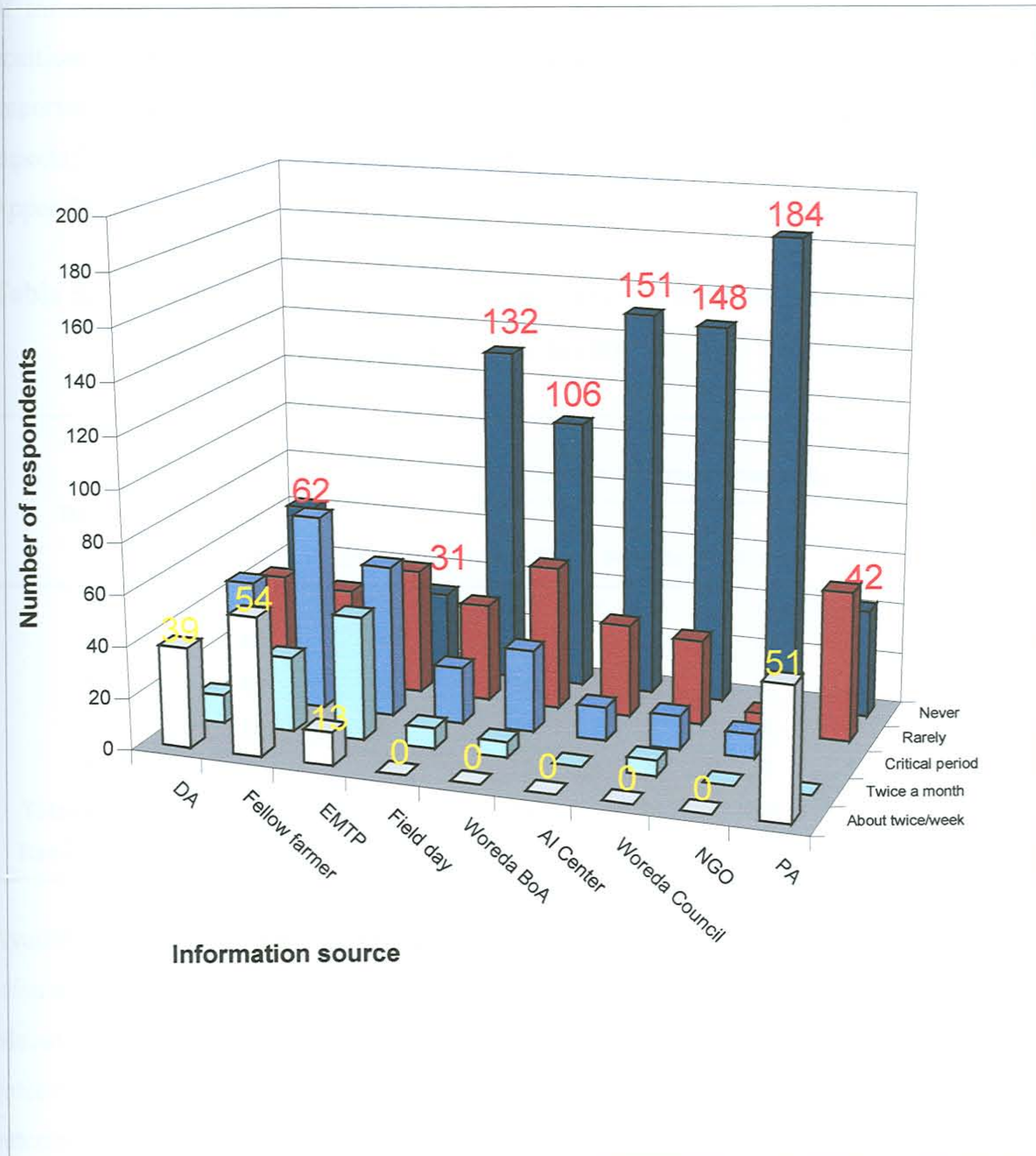

Fig. 5.3 Level of change agent contact of maize growers

As in the case of mass media, farmers were requested to rank their five most important information sources for the purpose of identifying the most widely used information sources in the district. The rank order position, which is determined based on the total weighted score is indicative of the fact that the fellow farmer, the PA, the EMTPS, the DA, and the BoA are, in order of importance, the five most important agricultural information sources, while WAC, AI, and NGOs are some of the least important sources of information. Based on the finding in Fig. 5.3 and judged according to the rank positions, it appears as if the fellow farmer, the PA, the DA, and EMTPS are the most important sources followed by BoA and field days. The rest are of little significance especially in view of the urgency of information needs of agricultural activities (see also Appendix 5.3).

Table 5.7 The importance of different information sources based on rank order assessments by maize farmers

Rank	Number of farmers responded								
	DA	Fellow farmer	EMTP	Field day	BoA	AI	WAC	NGO	PA
1	29	111	30	-	1	-	-	-	29
2	40	50	46	-	4	-	1	-	49
3	46	27	30	3	8	5	3	-	39
4	13	6	49	5	16	1	4	1	34
5	6	2	7	29	37	5	13	2	6
Total weight*	475	850	522	48	114	22	34	4	532
Rank position	4th	1st	3rd	6th	5th	8th	7th	9th	2nd

Available information sources for dairy farmers include the BoA, fellow farmer, EMTPs (displays), field days, International Livestock Research Institute (ILRI), research centers, educational center (Debrezeit Veterinary College), WAC, NGOs, and the private veterinary Services. In dairy 156,130 and 127 farmers at least occasionally use private veterinary services, BoA, and fellow farmers respectively. Displays, ILRI and Debrezeit Veterinary College are rarely used. The rest four sources namely WAC, field days, Research Center, and NGOs are the most little used sources where 196, 195, 194 and 185

* The total weighted score is the sum of the rank order frequencies multiplied respectively by 5 for the 1st position, 4 for 2nd position, 3 for 3rd position 2 for, 4th position and 1 for 5th position

farmers have never used them at all. The degree to which these sources are used is summarized in Fig. 5.4.

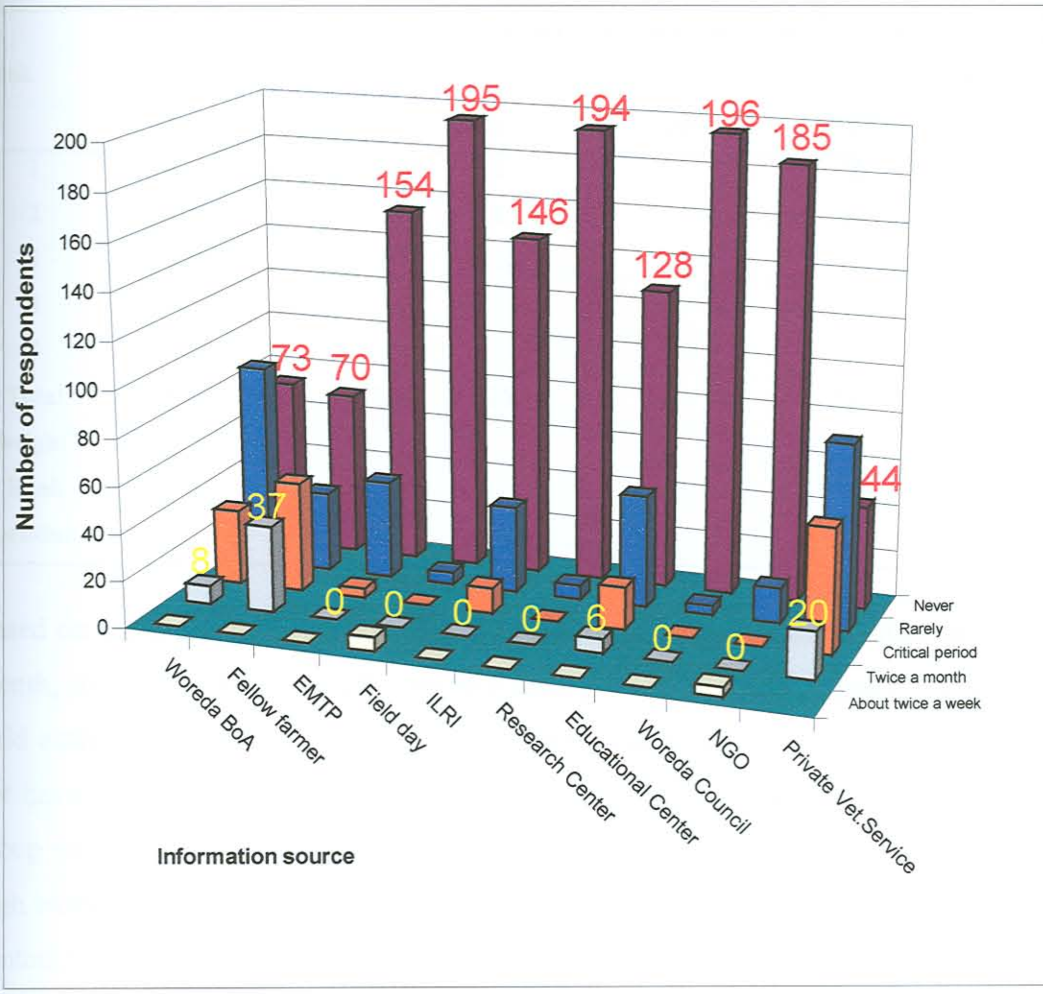

Fig. 5.4 Level of change agent contact of dairy producers

The response of respondents to rank their information sources in order of importance is summarized in Table 5.8. Private veterinary service, fellow farmer, BoA, veterinary college and ILRI are found to be the first five most important sources with weighted scores of 598, 562, 469, 233, and 175 respectively. Based on the frequency and weighted score values, it is concluded that private veterinary services, the fellow farmers and the Woreda BoA are the most important sources of agricultural information for dairy farmers of ALWDADPMA (see also Appendix 5.4).

Table 5.8 The importance of different information sources based on rank order assessments by dairy farmers.

Rank	Frequency of use of information source									
	BoA	Fellow farmer	EMTP	Field day	ILRI	Research center	Vet. College	Woreda council	NGO	Private vet. Center
1	40	65	8	3	8	-	12	-	-	61
2	32	45	11	2	14	2	22	-	6	51
3	41	17	16	1	18	1	18	1	3	21
4	8	2	8	-	10	2	14	1	5	11
5	3	-	6	-	5	3	3	2	1	4
Total weight*	469	562	154	26	175	22	233	7	44	598
Rank position	3	2	6	8	5	9	4	10	7	1

Based on the assumption that, farmers need to make an extension contact at least once a month, in order to receive sufficient and timely information to properly implement their field activities, a categorization of respondents was undertaken. Those farmers who do not have contact at least once a month were categorized into the low extension contact group while those who have contacts once a month and more were categorized into the high extension contact group. Both maize and dairy farmers have a very low extension contact. It is only 18.5 percent and 5 percent of maize and dairy farmers, respectively, who have high contact with extension (Table 5.9). This abnormal distribution has also influenced the classification of the variable into only two rough categories of low and high. These categories were related to efficiency categories and the findings are summarized in Table 5.9.

As far as the relationships between extension contact and the production efficiency of farmers is concerned, there is no significant relationship between efficiency and contact with extension ($F = 0.88$, $p = 0.480$; $r = -0.018$, $p = 0.803$). A possible explanation for the non-significant correlation may be that the variation and thus the correlation are too

* The total weighted score is the sum of rank order frequencies multiplied respectively by 5 for the 1st position, 4 for 2nd position, 3 for 3rd position, 2 for 4th position and 1 for 5th position.

small because of the rough scale of only two categories. After all the percentage respondents that have a high contact is 9.8 in the least efficient category and increases more or less systematically to 26.3 in the most efficient category. In dairy, many farmers (95 percent) have low extension contact and therefore, the data could not help to see the association of the two factors.

Table 5.9 The percentage distribution of maize and dairy farmers according to their efficiency and extension contact

		Percentage distribution per efficiency class*					
Commodity	**Extension**	1	2	3	4	5	Total
Maize							
	Frequency	n=41	n=24	n=43	n=54	n=38	N=200
	Mean	2	1.9	2	2.2	2.2	2.1
	Low	90.2	91.7	83.7	74.1	73.7	81.5
	High	9.8	8.3	16.3	25.9	26.3	18.5
	Total	100	100	100	100	100	100
Dairy							
	Frequency	n=35	n=41	n=48	n=40	n=36	N=200
	Mean	1.5	1.5	1.47	1.48	1.57	1.5
	Low	97.1	95.1	100.0	92.5	88.9	95.0
	High	2.9	4.9		7.5	11.1	5.0
	Total	100	100	100	100	100	100

Maize (F=0.88, p=0.480; r=-0.018, p=0.803), Dairy (not computed)

* 1 = Least efficient, 5 = Most efficient

5.2.7 Gender

Some studies (Nigussie, 2001:54; Mahabile *et al,* 2002: 326; Tesfaye, in press) reported that there is no relationship between gender and adoption. They argue that agricultural technologies are not gender sensitive and provided that extension services are aware of the important roles of women in agriculture, they can consciously target the female-headed households so that they may equally benefit from extension services. But it is also claimed that male farmers are more likely to adopt agricultural technologies that can improve their production efficiency. Addo (1972) and Okali (1983), quoted by Mensah and Seepersad (1992:51), for example, found that male farmers vastly outnumbered women cocoa farmers in Ghana. Mensah and Seepersad (1992: 54) verified this claim in their study. They found that there is significant and positive relationship between gender and overall production efficiency and adoption of the recommended agro chemicals and cultural practices. For this study it was hypothesized that gender is positively related to the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers.

In the Shashemene district, the great majority (92 percent) of all respondents were found to be male headed, and due to lack of variability regarding gender, it was not possible to effectively test the hypothesis. From the distribution in Table 5.10, however, there is an indication that male farmers are more efficient. Almost all (97.4 percent) of the most efficient farmers, for example, are male while there are substantial (19.5 percent) numbers of female farmers in the least efficient category.

The distribution is relatively better in dairy farming, where, thirty-four farmers or 17 percent of the respondents were females. The differences between the various efficiency classes of dairy farmers are significant ($\chi^2 = 11.25$, df = 4, p = 0.024) suggesting that male-headed households are more efficient than their female counterparts. The association, however, is not significant (r = 0.032, p = 0.658). Table 5.10 gives the impression that some sort of non-linear relationship exists between the two variables, which can contribute for the lack of significant association.

In general, an indication of a positive relationship in the case of maize farming and the presence of significant difference between male and female dairy farmers in production efficiency suggest that male farmers tend to be more efficient than their female counterparts. The cause for low efficiency regarding women farmers may be due to the inefficiency of the extension service to effectively target its clients and provide appropriate advices. Further research, is, however, required to verify this finding.

Table 5.10 The percentage distribution of maize and dairy farmers according to their efficiency and gender

Commodity	Gender	Percentage distribution per efficiency class* 1	2	3	4	5	Total
Maize							
	Frequency	n=41	n=24	n=43	n=54	n=38	N=200
	Male	80.5	95.8	90.7	96.3	97.4	92.0
	Female	19.5	4.2	9.3	3.7	2.6	8.0
	Total	100	100	100	100	100	100
Dairy							
	Frequency	n=35	n=41	n=48	n=40	n=36	N=200
	Male	80.0	87.8	85.4	67.5	94.4	83.0
	Female	20.0	12.2	14.6	32.5	5.6	17.0
	Total	100	100	100	100	100	100

Maize (χ^2 not computed), dairy (χ^2=11.25, df=4, p=0.024; r=0.032, p=0.658)

*1 = Least efficient, 5 = Most efficient

5.2.8 Attitudinal modernity

Attitudinal modernity is a composite variable reflecting the beliefs and thoughts of the individual under investigation regarding his attitude towards science, education, credit, technology, religion, family, marriage, exposure to the mass media etc. (Alex and Smith 1974). Cosmopoliteness is sometimes considered as the proxy variable for attitudinal modernity. In the past, attitudinal modernity was considered almost a precondition for a traditional man to change his behavior into a modern man so that he will be amenable to accept and adopt new ideas. The assumption is supported by research results (Saeed, 1989:263; Elias, 1999:74) and led to the hypothesis that attitudinal modernity is positively related with the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers in the study area.

According to Table 5.11, which shows farmer characteristics regarding their attitude and its relationship with their production efficiency, dairy farmers are found to be more modern than maize farmers. The mean attitudinal modernity score for dairy farmers is 24.6 while that of the maize farmers is only 16.8. However, there are no significant differences between the various efficiency classes of maize and dairy farmers in their attitudinal modernity. The mean attitudinal score of maize growers in the lowest efficiency category, for example, is 16.9. This percentage remains constant with increasing production efficiency until it reaches to only 17.3 in the most efficient farmers category suggesting the lack of significant relationships (F = 0.59, p = 0.680; r = 0.053, p = 0.453).

Table 5.11 The percentage distribution of maize and dairy farmers according to their efficiency and attitudinal modernity

		Percentage distribution per efficiency class*					
Commodity	**Modernity**	1	2	3	4	5	Total
Maize							
	Frequency	n=41	n=24	n=43	n=54	n=38	N=200
	Mean	16.9	16.3	16.6	16.8	17.3	16.8
	Low	36.6	33.3	37.2	40.7	34.2	37
	Medium	39.0	45.8	39.5	31.5	28.9	36
	High	24.4	20.8	23.3	27.8	36.8	27
	Total	100	100	100	100	100	100
Dairy							
	Frequency	n=35	n=41	n=48	n=40	n=36	N=200
	Mean	24.2	23.8	24.5	24.4	26.4	24.6
	Low	28.6	36.6	27.1	35.0	13.9	28.5
	Medium	40.0	29.3	41.7	32.5	33.3	35.5
	High	31.4	34.1	31.3	32.5	52.8	36.0
	Total	100	100	100	100	100	100

Maize (F=0.59, p=0.680; r=0.053, p=0453), Dairy (F=2.4, p=0.152; r=0.177, p=0.012)

1 = Least efficient, 5 = Most efficient

5.2.9 Organizational participation

Organizational participation, both formal and non formal, is assumed to enhance the use of agricultural technologies by creating access to information and boosting the bargaining power of producers particularly during the time of marketing. This assumption finds support in the literature (Saeed, 1989:264 Elias, 1999: 72; Getahun *et al,* 2000:21) and was accepted as a hypothesis in this study, namely that organizational participation is positively related to the adoption behavior and production efficiency of farmers in the study area.

The common institutions in the rural setting include, among others, Woreda Administrative Council (WAC), Peasant association (PA), Peasant association development committee (PADC), soil conservation teams, marketing cooperatives, irrigation associations, school and religious institutions. Respondents were requested to report their affiliation with any of these institutions during the last five years either as a member or in a leadership position. As can be seen in Fig. 5.5, the involvement of respondents in eight rural organizations is minimal. Between 165 and 200 farmers do not have any participation in any of these organizations. Institutions having the highest membership, albeit still very low, are religious institutions, PA and school committees.

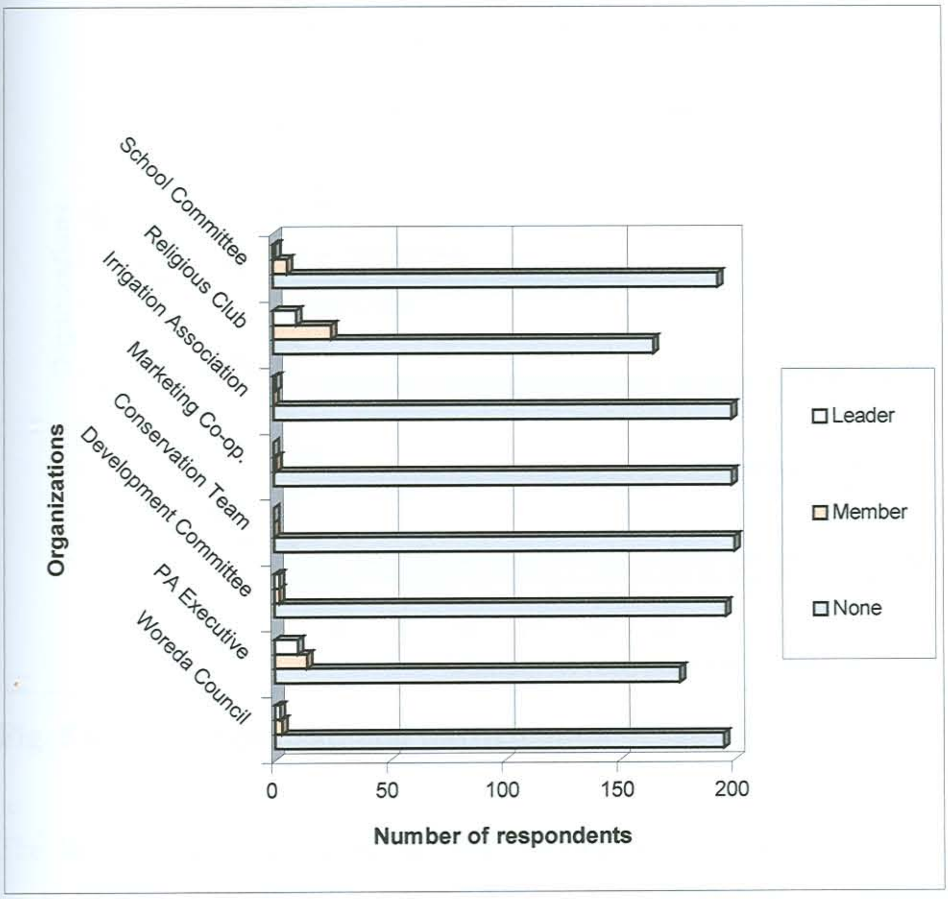

Fig. 5.5 Organizational participation of sample maize farmers

In addition to community-based organizations (CBOs), dairy farmers are affiliated with similar institutions commonly used by maize farmers. Most of the dairy farmers like the maize farmers do not have extensive organizational participation. Only 2 percent of the farmers have high organizational participation. The highest participation is in regard to CBOs and the marketing cooperative, of which 107 and 126 respondents are members. Most of the farmers (between 188 and 199), do not participate in any of the councils or clubs (Fig. 5.6).

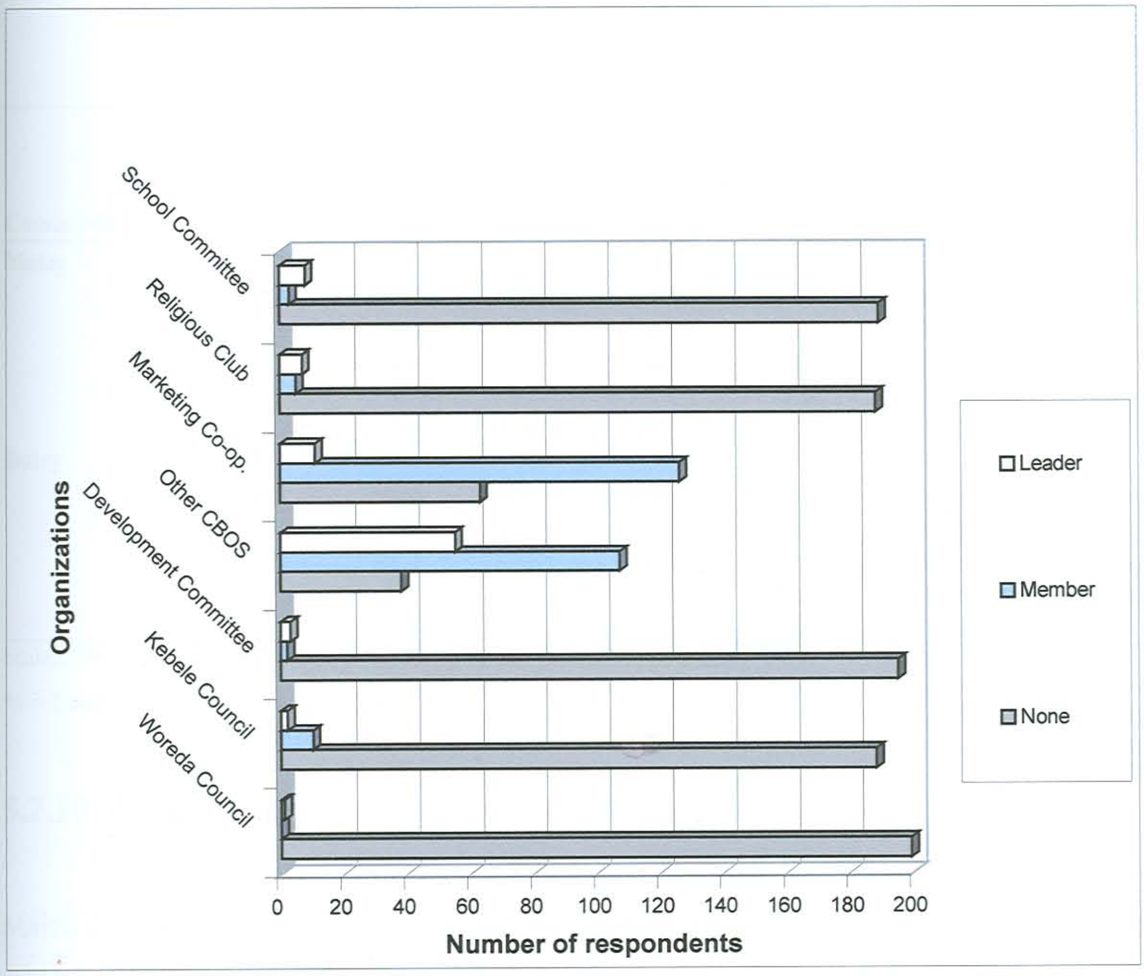

Fig. 5.6 Organizational participation of sample dairy farmers

The limited variation regarding organizational participation does not allow for valid analysis of variance, but the distributions in Table 5.12 indicate a tendency for efficient farmers to be slightly more organizationally involved. For example all the maize farmers that have a higher level of participation are efficient. As far as dairy farmers are concerned, there are significant differences between the various efficiency categories of dairy farmers (F = 3.6, p = 0.007). The percentage of farmers participating in one or other organization also tends to increase with increasing efficiency. In the lowest efficiency category the percentage of respondents with a higher level of participation is 8.6 percent and increases in an almost linear fashion to 19.4 in the case of the most efficient category. The relationship is, however, not significant (r = 0.077, p = 0.278).

Table 5.12 The percentage distribution of maize and dairy farmers according to their efficiency and organizational participation

		Percentage distribution per efficiency class*					
Commodity	**Participation**	1	2	3	4	5	Total
Maize							
	Frequency	n=41	n=24	n=43	n=54	n=38	N=200
	Mean	1	1	1	1.02	1.08	1.02
	Low	100	100	100	98.1	92.1	98
	High	-	-	-	1.9	7.9	2
	Total	100	100	100	100	100	100
Dairy							
	Frequency	n=35	n=41	n=48	n=40	n=36	N=200
	Mean	1.24	1.25	1.31	1.34	1.38	1.3
	Low	91.4	87.8	85.4	87.5	80.6	86.5
	High	8.6	12.2	14.6	12.5	19.4	13.5
	Total	100	100	100	100	100	100

Maize (F= Not computed), Dairy (F=3.6, p=0.007; r=0.077, p=0.278)

*1 = Least efficient, 5 = Most efficient

5.2.10 Agro ecology

Maize does well both in the middle and low altitude agro-ecological zones. However, the middle altitude zone produces higher yields than the low altitude zone, especially during times when moisture is limited. Farmers producing in the middle altitude zone will presumably be more likely to adopt recommended maize technologies in an effort to exploit the suitable weather conditions and optimize their production. Getahun *et al,* (2000: 21) found a positive association between agro ecological zone (altitude) and the adoption of agricultural practices.

According to Table 5.13, farmers residing in the middle altitude zone are more efficient than those living in the low altitude zone (F = 6.7, p = 0.000). The correlation between agro ecology and production efficiency is also significant (r = 0.244, p = 0.001) and thus in support of Hypothesis 2.1, which implies a positive association between the agro ecological zone where a farmer resides and his production efficiency. The result implies that risk (e.g., for lowland areas) is an important factor in technology adoption and may entail that associated practices like irrigation are critical.

Table 5.13 The percentage distribution of maize growers according to their efficiency and agro ecological area of production

	Percentage distribution per efficiency class*					
	1	2	3	4	5	Total
Agro ecology	n=41	n=24	n=43	n=54	n=38	N=200
Low altitude	63.4	83.3	53.5	37.0	28.9	50
Middle altitude	36.6	16.7	46.5	63.0	71.1	50
Total	100	100	100	100	100	100

F= 6.7, p=0.000; r=0.244, p=0.001; *1 = Least efficient, 5 = Most efficient

5.3 CONRIBUTIONS OF INDEPENDENT VARIABLES TO PRODUCTION EFFICIENCY VARIANCE

Multiple regression models were developed to assess the aggregate contribution of independent variables on the production efficiency of maize and dairy farmers and thereby select the most important variables affecting production efficiency. This aim was to identify a limited number of variables, which would account for a maximum amount of variance in production efficiency. According to Copp (1958:108), variable reduction has practical as well as theoretical values. He mentions that there is little reason for dealing with a large number of variables when a few variables will do the predictive job and furthermore, one of the goals of science is to secure a parsimonious summary of a system of relationships.

The bivariate analysis presented in section 5.2 provided the initial guide as to which variables should be included in the regression model. Explanatory, regressor or predictor variables subjected to multiple regression analysis were agro ecology, age, education, farm size, and media in maize and age, education, farm size and attitudinal modernity in dairy (Table 5.14). The rest of the variables, which were not significantly related with production efficiency such as extension contact, gender, organizational participation, and farming experience were discarded from further analyses.

All the variables included in the assumed regression models have signs corresponding to their theoretical definition.

Table 5.14 Model specification for determinants of the production efficiency of maize and dairy farmers

Variable	Expected sign (relationship)	Variable description
Agro ecology*	+	Middle altitude = 1
Age	-	Number of years of respondent
Education	+	Number of years of schooling
Farm size	+	Total holding excluding leased land
Mass media exposure*	+	Exposure once a month and better = 1
Attitudinal modernity	+	A33 item attitudinal scale (pre established)

*= Dummy variables

The results of the multiple regression analysis both for maize and dairy are given in Table 5.15. As far as maize farming is concerned, agro-ecological zone, education, farm size and media are found to be significantly correlated with production efficiency although the contribution of all the independent variables entered into the multiple regression model to the variance of production efficiency does not exceed 25.1percent.

Table 5.15 Multiple regression estimates of the effects of independent variables on the production efficiency of maize and dairy farmers, 2002

Variable	Maize			Dairy		
	Beta	t	p	Beta	t	p
Constant	-	4.958	0.000	-	3.217	0.002
Agro ecology*	0.333	4.345	0.000	-	-	-
Age	-0.950	-1.270	0.206	0.173	2.569	0.001
Education	0.200	2.454	0.015	0.243	3.146	0.002
Farm size	0.276	3.646	0.000	0.275	4.183	0.000
Media*	0.196	2.658	0.009	-	-	-
Modernity	-	-		0.069	0.902	0.326

R^2 = 0.251 (Maize), 0.193 (Dairy), *= Dummy variable

Age, education and farm size are also found to significantly contribute to the variance of the production efficiency of dairy farmers of ALWDADPMA. The contribution of these variables to the total variance in production efficiency is, however, rather limited and a mere 19.3 percent (Table 5.15), implying that they are probably not the major predictors of production efficiency. This appears to be in support of the general hypothesis of this study (Hypothesis 2.3), namely that independent variables are less important than intervening variables in explaining behavior variation. The latter will be analyzed in next chapters.

On the other hand, the respective significant association between some of the situational factors such as agro-ecology, media exposure and education with the production efficiency of both the maize and dairy farmers has an important implication for policies and strategies engaged in promoting rural development. The concerted effort of the Ethiopian Government in promoting primary education in rural Ethiopia is something to be appreciated and encouraged. But its attempt of spreading agricultural extension services equally to all parts of the country, irrespective of the agro ecological potential, does not seem the optimal use of scarce resources such as trained man power, time and financial resources that could have been invested to alternative development activities. If one area is found suited to crop, the other can, for example, be more favorable for mountain agriculture or forestry.

Regression analysis also revealed that media exposure is one of the key variables in predicting production efficiency, however, as indicted earlier, its use is limited to only very few number of farmers. From this it seems that revitalizing existing infrastructure and promoting development support communication or the use of mass media in rural extension is imperative.

The other, yet very important finding relates to farm size and its implication on landownership policies. The significant positive relationship with production efficiency suggests that land policies should be such as to prevent further land fragmentation.

5.4 INFLUENCE OF INDEPENDENT VARIABLES ON PRACTICE ADOPTION OF MAIZE FARMERS

Practices included in the maize package take account of fertilizer type, rate, measurement, and method of application, the variety, and area coverage by improved seed, source of seed, plant (inter- row) spacing and row spacing.

Chi-square analyses were used to test the significance of the relationships between recommended maize practices and independent variables. Cramer's V and Phi statistics (for 1 degree of freedom) for nominal variables and Gamma for ordinal variables were also used to specify the strength of the association between variables.

5.4.1 Age

A clear and negative relationship is found between age and the adoption behavior of maize growers in all of the nine practices at the less than 1 percent level of probability. Appendix 5.17 provides the detail statistics of the influence relationships. The finding is consistent with the hypothesized association (Hypothesis 3.1). As far as the adoption behavior of farmers regarding the type of fertilizer used is concerned, for example, there are significant differences between the different efficiency categories ($\chi^2 = 17.17$, df = 6, p = 0.009). The difference lies in the fact that with increasing age, farmers tend to use less fertilizer or use none of the recommended type of fertilizers. In the oldest age category (55 to 85 years), 36.5 percent of the farmers do not use fertilizer. Only 10 percent of the farmers in the youngest age category (18 to 35 years) plant their seed without fertilizer. The opposite tendency is evident in the use of the two recommended type of fertilizers. In the lowest age category, 72.2 percent of the farmers use both type of fertilizers. This percentage decreases in an almost linear fashion (Fig. 5.7) to 46.2 percent in the oldest age category. This clear relationship finds expression in the highly significant Cramer's V value (Cramer's V= 0.207, p = 0.009).

According to Figure 5.17, which shows the relationship between age and the percentage of farmers adopting the recommended rate of technology practices, there is also a tendency of hyperbolic relationship, i.e. the percentage of adoption tends to increase up to a certain threshold with increasing age and starts to fall at about the age of 35 years. The only practices where adoption of the recommended rate and age do not show this type of relationship are source and area coverage of improved seeds and use of the recommended type of fertilizer. Regarding these three practices the graph declines throughout indicating a linear negative relationship.

5.4.2 Education

There is a clear and positive association between education and the adoption behavior of maize farmers regarding almost all of the nine maize practices at the less than 1 percent level of probability (Appendix 5.17) thereby providing evidence in support of Hypothesis 3.1. Regarding the adoption of fertilizer rate for example, there is a clear and highly significant linear relationship with education (Gamma = 0.395, p = 0.000). This relationship is also evident from the Chi-square analysis ($\chi^2 = 21.54$, df = 6, p = 0.000).

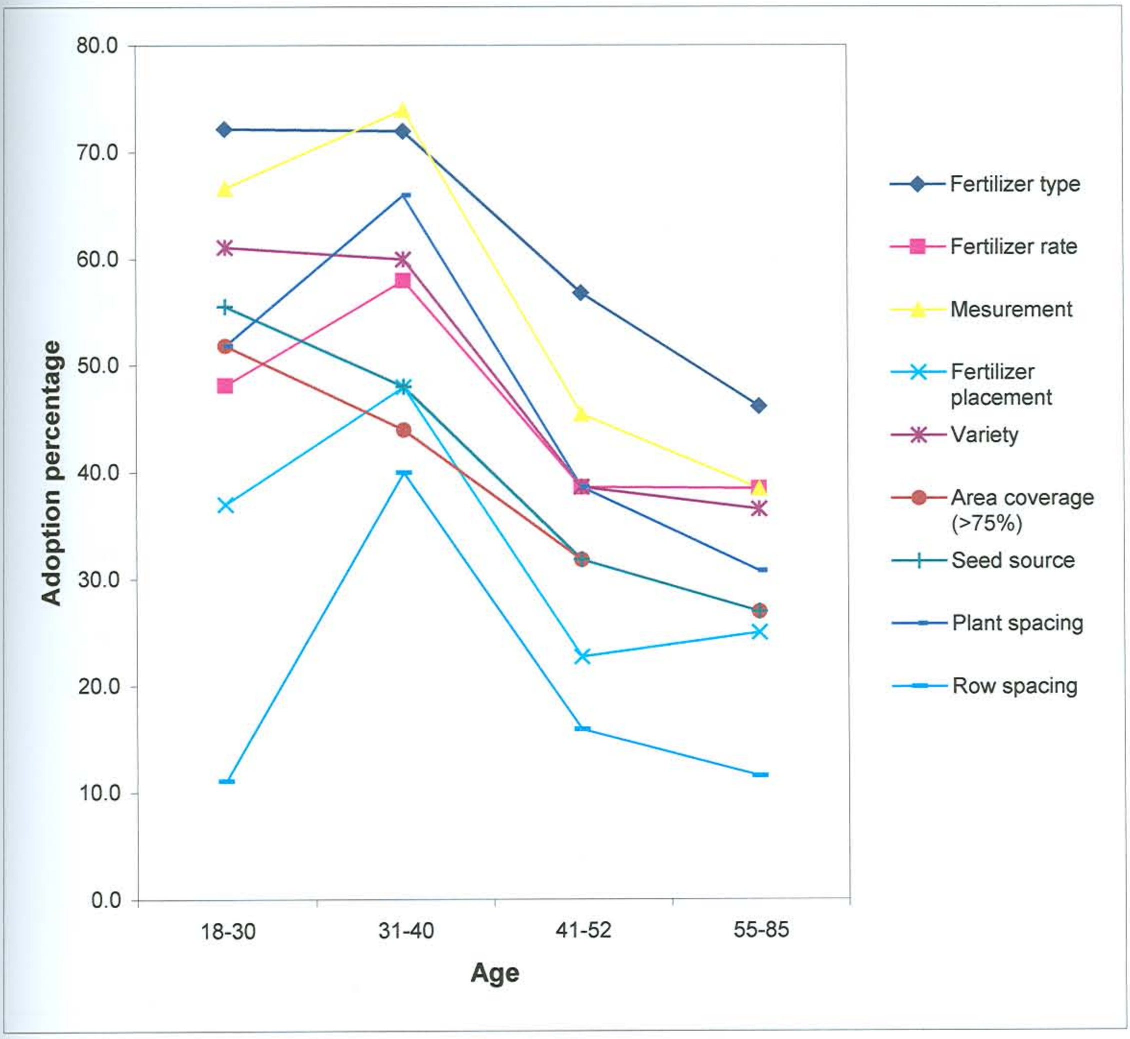

Fig. 5.7 Graphical illustration of the relationships between age and the percentage of farmers adopting the recommended rate of technology

34.7 percent of the illiterate farmers use no fertilizer at all while amongst those farmers who have a secondary level of education; only 6.3 percent do not use fertilizer. In the illiterate farmers category only 36.7 percent use the recommended rate. This percentage increases in an almost linear manner (Fig. 5.8) with increasing level of education to 71.9 percent in the category of maize farmers having a secondary school level of education.

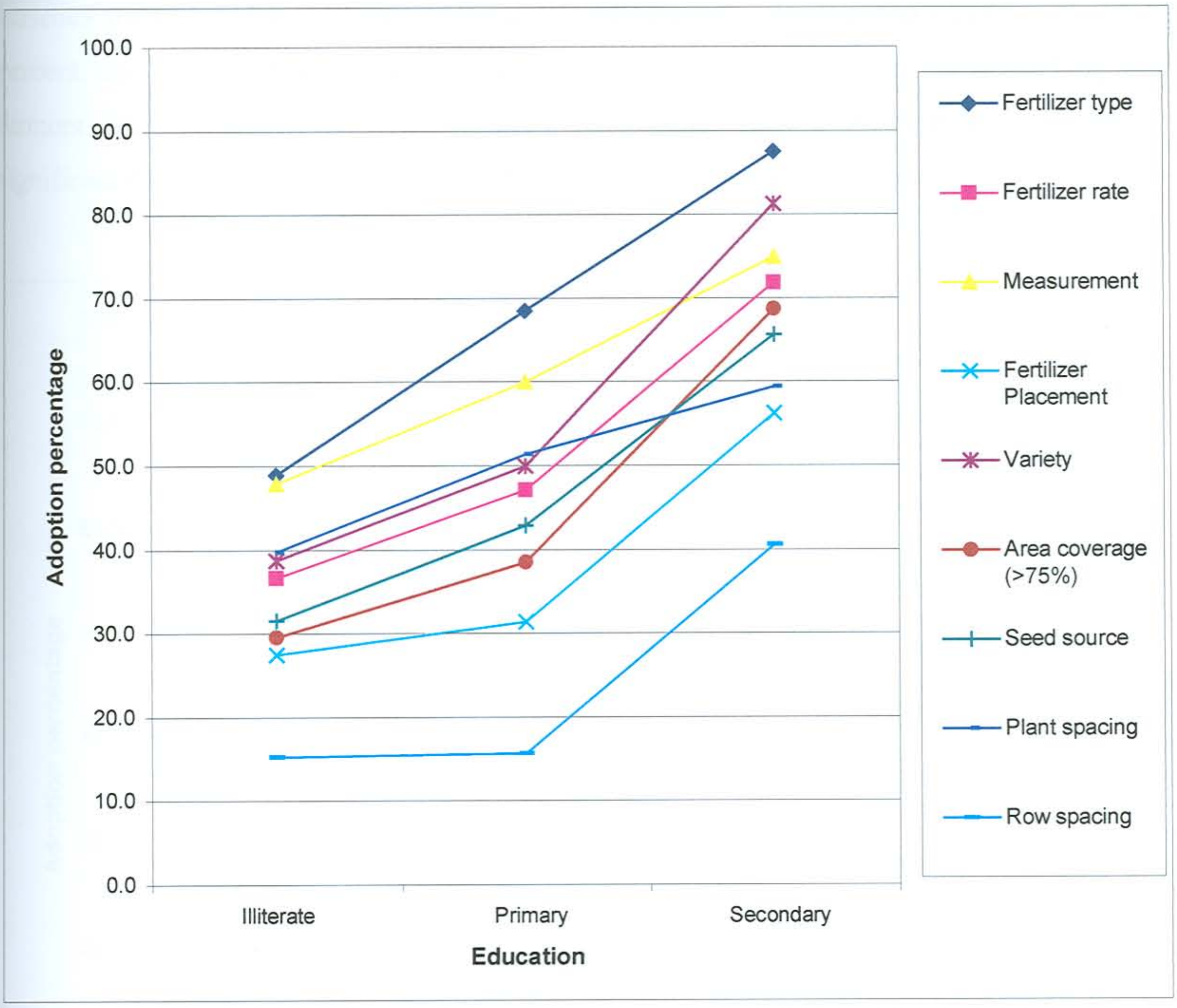

Fig. 5.8 **Graphical illustration of the relationships between education and the percentage of farmers adopting the recommended rate of technology**

5.4.3 Farm size

Farm size is found to be negatively correlated with the adoption behavior of maize farmers at the less than 1 percent level of probability regarding all of the recommended maize practices except fertilizer type, which is significantly related only at the less than 10 percent level (Appendix 5.18). Regarding adoption of improved variety for example, there is a significant difference between farm size and adoption ($\chi^2 = 22.76$, df = 4, p = 0.000). 64.3 percent of the farmers on bigger units use local varieties. This percentage decreases in an almost linear fashion with a decrease in farm size to 30 percent in the small farmers category. Conversely, while the number of farmers who use improved varieties such as, PHB 3253, BH 660 and BH 140 from the small farmers category is 70 percent, this percentage decreases in a similar linear fashion to 35.7 percent in the bigger farmers category (Fig. 5.9). This negative relationship finds expression in the highly significant Cramer's V value (Cramer's V = 0.239, p = 0.000).

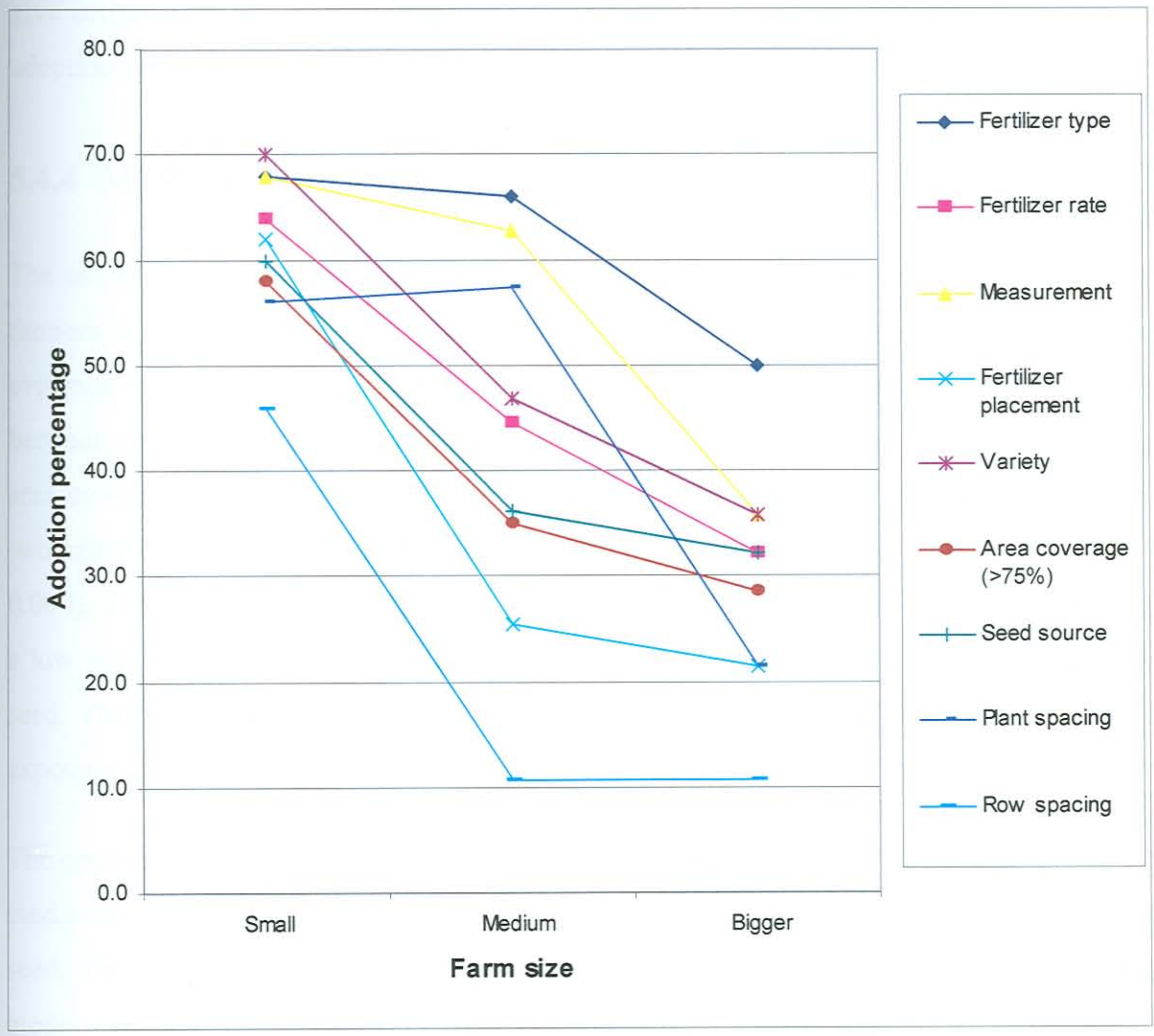

Fig. 5.9 **Graphical illustration of the relationships between farm size and the percentage of farmers adopting the recommended rate of technology**

The result is not consistent with the hypothesized association (Hypothesis 3.1), which states that farmers on bigger units are more likely to adopt innovations than small farmers and the findings of most adoption studies conducted in Ethiopia (Demeke, 1989:230; Alene *et al,* 2003:1). However, Legesse (1992:68) found similar result in herbicide adoption on wheat and Zegeye and Tesfaye (2001:47) also found a similar negative association between farm size and the variety adoption of maize farmers in Southern Ethiopia, although the association was not insignificant. But the fact that the rate of decline of the graph regarding the majority of the practices decreases to almost zero leads to an expectation that it will increase with a further increase in farm size. In other words, the variation in farm size in the study area is very limited (0.50 to 2.0 ha.) and couldn't give insight into the true relationship that is likely to exist between farm size and the adoption behavior with a more normal distribution.

5.4.4 Media contact

The use of media is found to be positively related with the adoption behavior of maize farmers regarding all of the practices included in dairy package providing further evidence in support of Hypothesis 3.1 (see Appendix 5.18). As far as the relationship between media exposure and the adoption behavior of farmers regarding improved seed area coverage is concerned, for example, a significant difference is found between the two categories (having low and high media exposure) of farmers ($\chi^2 = 29.76$, df = 2, p = 0.000). Evidence of the relationship is the fact that only 25.6 percent of the farmers with a low exposure to media have planted more than 75 percent of their plot with improved seed. This percentage increases to 61.3 percent in the category of farmers having high exposure to media (Fig. 5.10).

The opposite tendency is evident in the case of the area coverage of local seed. In the low media exposure category 65.6 percent of the farmers have planted their plot with local seed. This percentage decreases with increasing exposure to 26.7 percent in the higher media exposure category. This clear positive relationship is manifested in the highly significant Gamma value (Gamma = 0.629, p = 0.000), which supports Hypothesis 3.1, namely that high exposure to media is directly correlated with an increase in area coverage of improved seed.

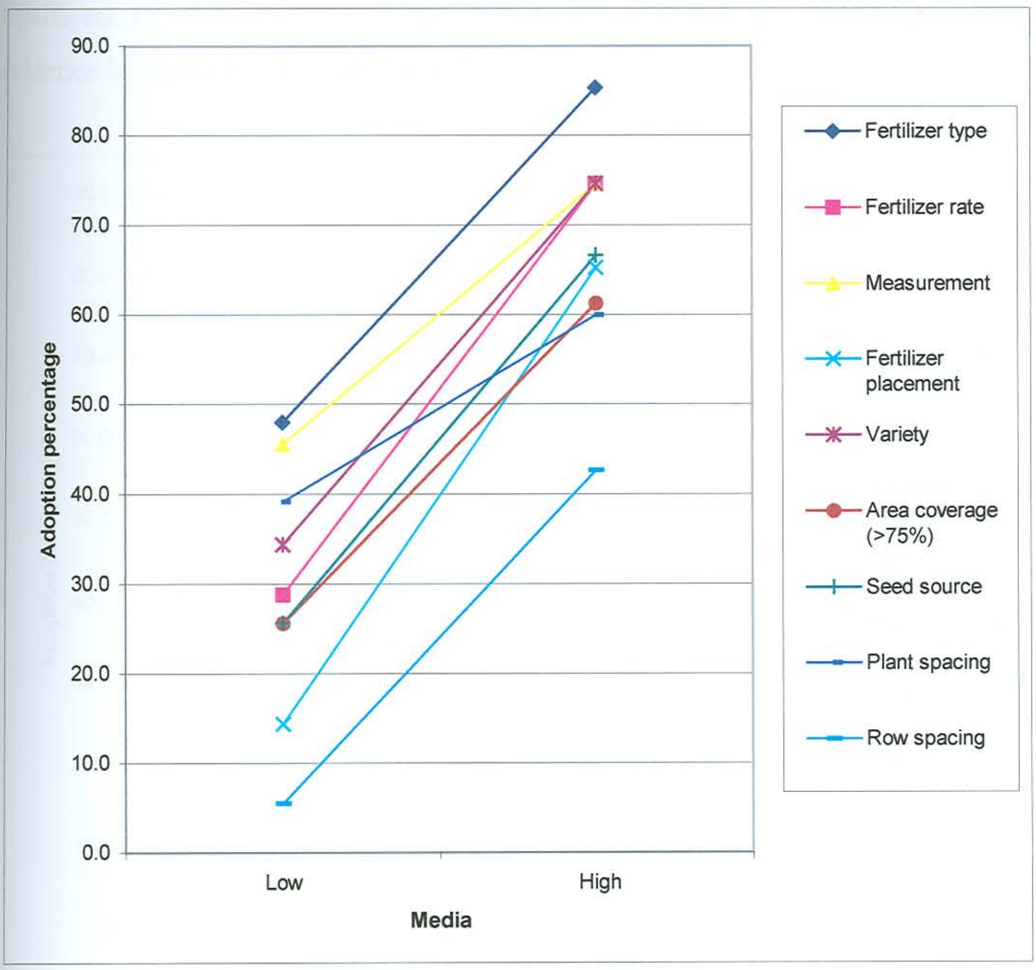

Fig. 5.10 **Graphical illustration of the relationships between media exposure and the percentage of farmers adopting the recommended rate of technology**

5.4.5 Agro ecology

The practice adoption behavior of maize farmers in the Shashemene district is related with the agro ecology where they reside in. Farmers who reside in the Woina dega zone (middle agro ecology) are better adopters of all the nine recommended maize practices than those who live in kola zone (Lower agro ecology) (Appendix 5.18). The difference is significant at the less than 1 percent level in all of the practices. An example is the source of seed where only 25 percent of Kolla zone farmers use certified seed as opposed to 57 percent of the Woina dega zone farmers (Fig. 5.11). The relationship is highly significant (χ^2 = 21.66, df = 1, p = 0.000; Phi = 0.325, p = 0.000) providing further evidence in support of Hypothesis 3.1.

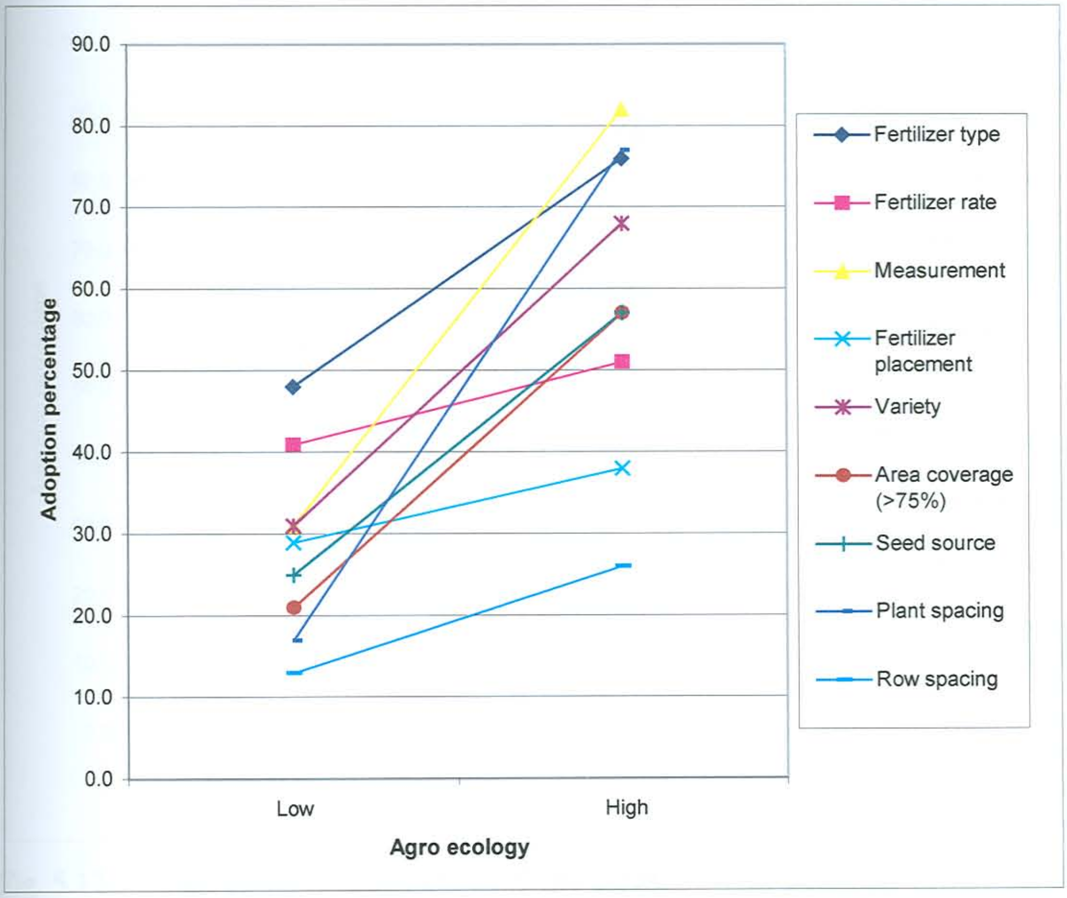

Fig. 5.11 **Graphical illustration of the relationships between agro ecology and the percentage of farmers adopting the recommended rate of technology**

5.4.6 Extension contact

The adoption behavior of maize farmers is positively related with their extension contact regarding all of the recommended maize practices at the less than 1 percent level of significance. The relationship is significant at the less than 5 percent level regarding only plant (inter-row) spacing (Appendix 5.19). While 64.9 percent of the farmers with a high extension contact applied the recommended plant spacing, only 42.9 percent of those who had low contact, applied this recommendation (Fig. 5.12) indicating a significant and positive relationship ($\chi^2 = 5.82$, df = 1, p = 0.016; Gamma = 0.421, p = 0.016). The result is consistent with the hypothesized association (Hypothesis 3.1).

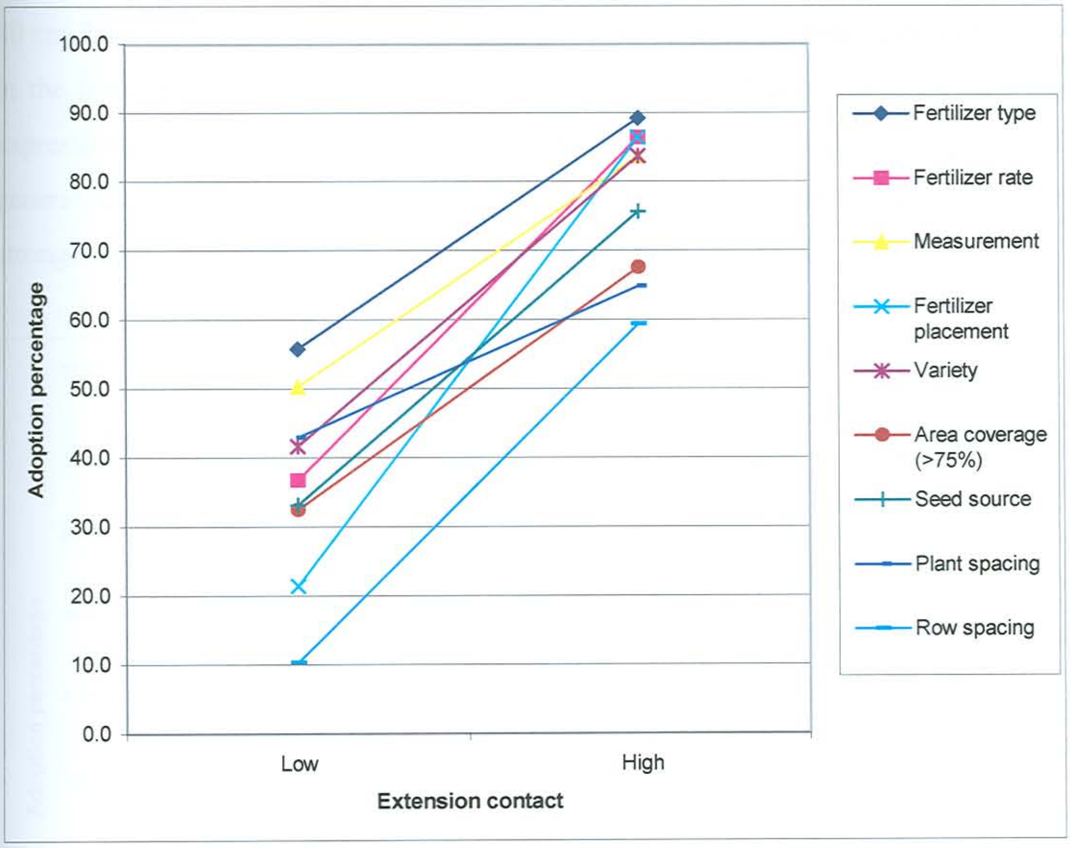

Fig. 5.12 **Graphical illustration of the relationships between extension contact and the percentage of farmers adopting the recommended rate of technology**

5.4.7 Attitudinal modernity

The adoption behavior of maize farmers is positively related with their attitudinal modernity in five of the recommended practices (rate and method of fertilization and use source and row spacing of seed) at the less than 1 percent level of significance. The association is significant at 5 percent in the case of area coverage of improved seed, while the remaining practices (type and measurement of fertilizer and plant spacing) show no statistically significant relationship with attitudinal modernity (Appendix 5.19).

As far as row spacing is concerned, for example, there are significant differences between the various modernity categories (χ^2 = 25.91, df = 2, p = 0.000). 42.6 percent of the farmers with high attitudinal modernity score had adopted the recommended spacing (50-80 cm-2 seed per hill). This percentage declines in an almost linear fashion to 8.1 percent in the least modern farmers category (Fig. 5.13). This clear positive relationship finds expression in the highly significant Gamma value (Gamma = 0.617, p = 0.000). In general, the results tend to support the hypothesized relationship, which could have been stronger with greater variation of attitudinal modernity among the respondents.

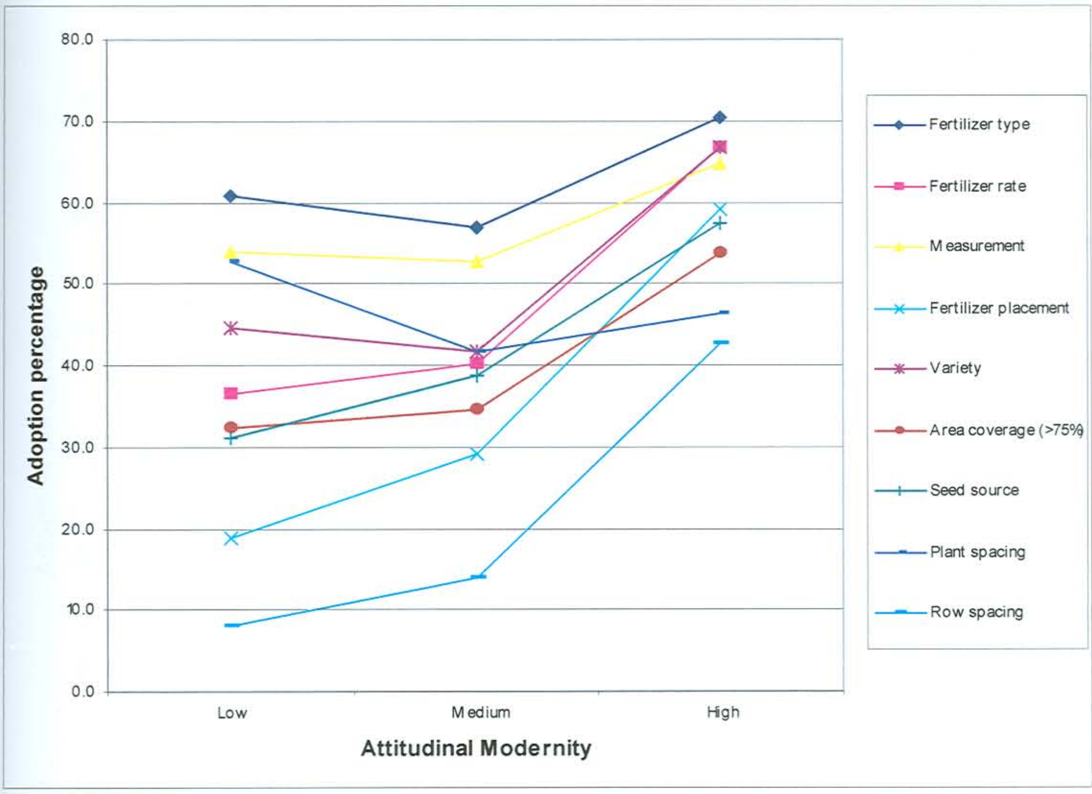

Fig. 5.13 **Graphical illustration of the relationships between attitudinal modernity and the percentage of farmers adopting the recommended rate of technology**

5.4.8 Farming experience

There is a clear and negative relationship between the experience of maize farmers and their adoption behavior regarding almost all of the recommended maize practices

(Appendix 5.19). Regarding fertilizer measurement, for example, while 70.8 percent of the farmers with the least farming experience have adopted the recommended technique, only 46.8 percent of the farmers with the most experience have adopted this technique (Fig. 5.14). This relationship is significant ($\chi^2 = 8.58$, df = 2, p = 0.014; Gamma = -0.324; p = 0.003) but the negative nature is not in accordance with the hypothesized association (Hypothesis 3.1). The influence of farming experience is very similar to that of age, with which it is highly correlated (r = 0.913).

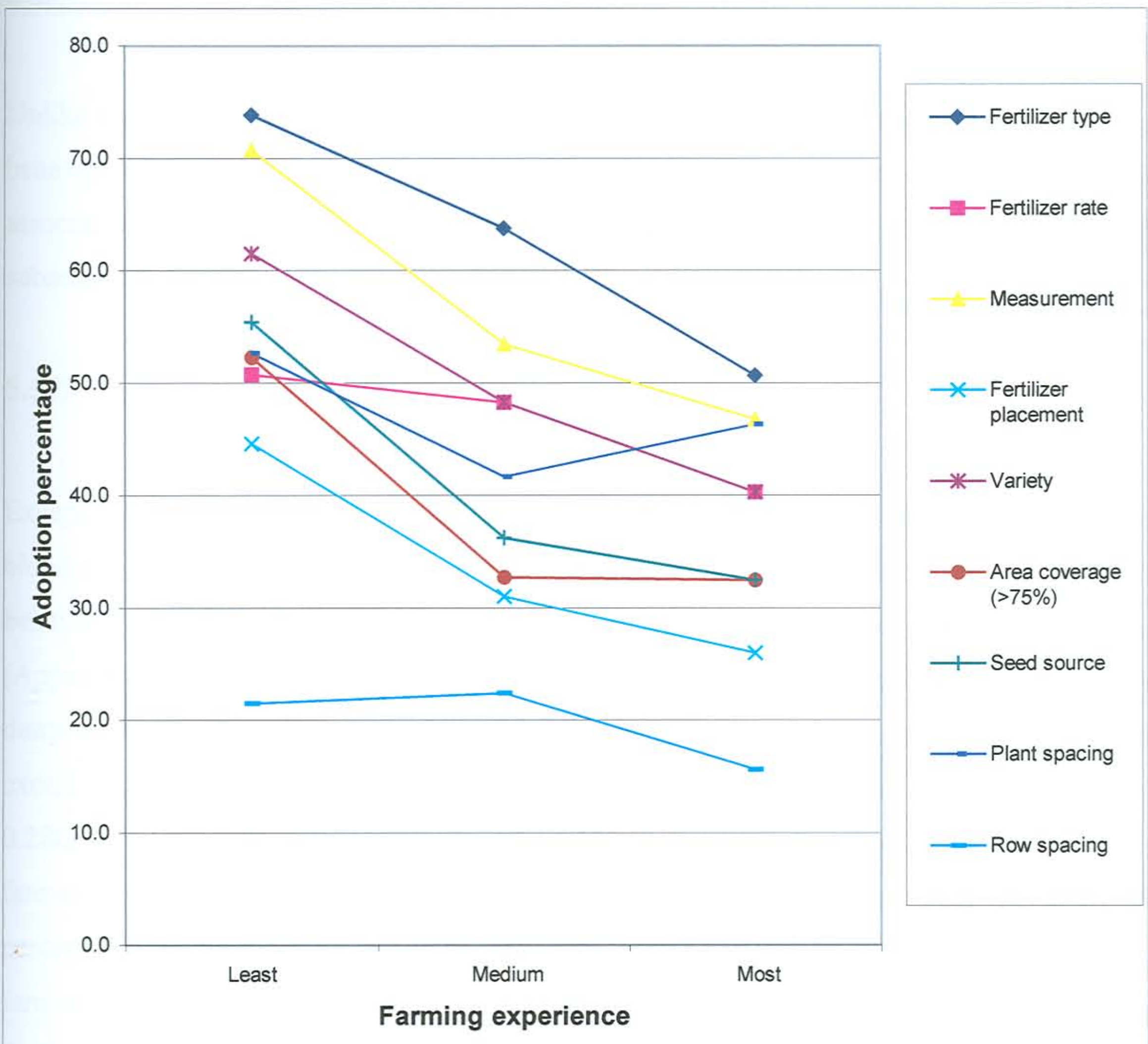

Fig. 5.14 **Graphical illustration of the relationships between farming experience and the percentage of farmers adopting the recommended rate of technology**