CHAPTER 6

THE INFLUENCE OF INDEPENDENT AND INTERVENING VARIABLES ON THE ADOPTION OF PHOSPHATE FERTILIZATION

6.1 INTRODUCTION

Although phosphate fertilization seem to have a tremendous influence on the production efficiency or maize yield, some of the maize growers do not apply the recommended amount or do not apply at all in the maize fields. These lead into the speculation of variables or factors that lead to such non-or poor adoption of this practice. This chapter presents the results of the influence of independent and intervening variables on the adoption of phosphate fertilization, and more specifically the level of adoption. The influences of the independent and the intervening variables are analyzed separately and then total contribution is compared to allow for a comparative influence of the two sets of variables.

6.2 INDEPENDENT VARIABLES

In this section each individual variable namely, sex, age, formal education, farm size and area under maize is assessed separately to explore its influence on adoption of the recommended rate of phosphate fertilization. Thereafter the linear regression model is used to determine the influence of all independent variables on adoption with the ultimate objective of assessing their relative importance in adoption behaviour.

6.2.1 Age

It is assumed that age of the respondents has an influence on the adoption of the recommended rate of phosphate fertilization in the sense that the adoption amongst younger farmers is assumed to be relatively higher than that of the older ones. The survey results with respect to the relationship between age and adoption of recommended rate of phosphate fertilization are summarized in Table 6.1.

Table 6. 1: Distribution of respondents according to their age and phosphate fertilization

Age (years)	Phosphate fertilization (kg/acre)							
	<30		30-50		>50		Total	
	n	%	n	%	n	%	N	%
>36	13	41.9	14	45.2	4	12.9	31	27.4
36-56	36	61.0	17	28.8	6	10.2	59	52.2
>56	20	87.0	1	4.3	2	8.7	23	20.4
Total	69	61.1	32	28.3	12	10.6	113	100.0

χ^2 = 12.404; df=4; p=0.015

r = -0.232; p=0.013

The differences between the age categories are significant at 5 percent probability (χ^2 = 12.404; df=4; p=0.015). The frequency distribution and negative correlation (r = -0.232) indicate not only that old farmers are less receptive than the young farmers to adopt the recommended phosphate fertilization but also, based on the linear relationship that the tendency to adopt decreases with increasing age. For example, the percentage farmers not adopting or applying no or only a minimum of phosphates increase from 41.9 in the case of young farmers, to 61 percent in the case of the middle-age group and to 87 percent in the case of the oldest category of farmers. In other words, there is a clear negative relationship between the age and the adoption behaviour.

6.2.2 Sex

Sex of the respondents was another independent variable that was dealt with to examine its influence on the adoption of recommended phosphate fertilization. Table 6.2 summarizes the results.

Table 6. 2: Distribution of respondents according to their sex and phosphate fertilization

Sex	Phosphate fertilization (kg/acre)							
	<30		30-50		>50		Total	
	n	%	n	%	n	%	N	%
Male	40	57.1	21	30.0	9	12.9	70	61.9
Female	29	67.4	11	25.6	3	7.0	43	38.1
Total	69	61.1	32	28.3	12	10.6	113	100.0

χ^2 = 1.514; df=2; p=0.469

r = -0.116; p=0.223

There are no significant differences between the sex categories (χ^2 =1.514; df=2; p=0.469) and the correlation analyses also confirms the non-existence of a relationship between sex and the adoption decision (r = -0.116). The negative correlation coefficient implies that, if anything; the adoption rate amongst female farmers is lower than in the case of male farmers.

These findings resemble those relating to the adoption of recommended maize varieties where the sex of the respondents was found to have no significant influence on the adoption behaviour and contributed only at a beta value of -0.039 (p = 0.691) to the adoption variance. This suggests that it is probably not the sex as such, but factors related with sex, like contact with extension, that determine the adoption behaviour.

6.2.3 Formal education

It is expected that the extent to which farmers are educated will have an influence on their adoption behaviour and thus also on the adoption of phosphate fertilization in the Njombe district. An overview of the respondent's education and adoption of phosphate fertilization is presented in Table 6.3 below.

Table 6.3: Distribution of respondents according to their formal education and phosphate fertilization

Formal education (years)	Phosphate fertilization (kg/acre)							
	<30		30-50		>50		Total	
	n	%	n	%	n	%	N	%
0	20	100.0	0	0.0	0	0.0	20	17.7
1-7	40	62.5	19	29.7	5	7.8	64	56.6
>7	9	31.0	13	44.8	7	24.1	29	25.7
Total	69	61.1	32	28.3	12	10.6	113	100.0

χ^2 =25.356; df=4; p=0.000

r= 0.401; p=0.000

According to the findings (Table 6.3) education has a very significant influence on the adoption of phosphate ferilization. Not a single respondent without formal education adopted the recommended rate of phosphate fertilization while about 31.9 percent of those with formal education applied the recommended amount of phosphate fertilizer. The relationship between the two variables is further confirmed by a highly significant correlation (r= 0.401; p=0.000), which implies that the more years of formal education farmers have, the more they tend to adopt the recommended rate of phosphate fertilization.

6.2.4 Farm size

The distribution of the respondents' farm sizes in relation to their adoption of phosphate fertilization is presented in Table 6.4

Table 6. 4: Distribution of respondents according their farm size and the adoption of recommended rate of phosphate fertilization

Farm size (acres)	Phosphate fertilization (kg/acre)							
	<30		30-50		>50		Total	
	n	%	n	%	n	%	N	%
<3	27	69.2	11	28.2	1	2.6	39	34.5
3-6	29	64.4	11	24.4	5	11.1	45	39.8
>6	13	44.8	10	34.5	6	20.7	29	25.7
Total	69	61.1	32	28.3	12	10.6	113	100.0

χ^2 =7.553; df=4; p=0.109

r= 0.236; p=0.012

Although the differences between the farm size categories are not significant (χ^2 =7.553; df=4; p=0.109), the correlation analyses shows a significant positive correlation (r = 0.236; p=0.012) between farm size and the adoption of recommended phosphate fertilization. This signifies that the bigger the farm size is, the higher the adoption. This evidence is clearly seen in Table 6.4 where 20.7 percent of those respondents with farm size of more than six acres adopted the recommended rate of phosphate fertilization, while only 2.6 percent of those with less than three acres did so.

6.2.5 Area under maize

Results of analyses carried out to evaluate the influence of area under maize on the adoption are summarized in Table 6.5.

Table 6. 5: Distribution of respondents according to their area under maize and phosphate fertilization.

Area under maize (acre)	Phosphate fertilization (kg/acre)							
	<30		30-50		>50		Total	
	n	%	n	%	n	%	N	%
<=1	15	57.7	9	34.6	2	7.7	26	23.0
1.1-3	47	78.3	11	18.3	2	3.3	60	53.1
>3	7	25.9	12	44.4	8	29.6	27	23.9
Total	69	61.1	32	28.3	12	10.6	113	100.0

χ^2 =25.792; df=4; p=0.000

r= 0.276; p=0.003

Only 7.7 percent of the respondents owning one acre or less of maize fields applied the recommended rate of phosphate fertilizer while as many as 57.7 percent of them applied less than thirty kilograms per acre, which is regarded as the worst level of fertilization. As confirmed by the correlation (r= 0.276;) this relationship between the area under maize and the level of phosphate application is significant (p=0.003) implying that the bigger the area under maize, the higher the level of adoption.

6.2.6 Total influence of independent variables

In trying to assess the total influence of all the independent variables on the adoption of phosphate fertilization a regression analysis was used. The results are summarized in Table 6.6.

Table 6. 6: Total influences of independent variables

Variable	Beta	t	p
(Constant)		1.220	0.225
Sex	0.020	0.215	0.830
Age	-0.149	-1.492	0.139
Formal education	0.345	3.299	0.001
Farm size	0.100	0.930	0.355
Area under maize	0.129	1.322	0.189

$R^2 = 0.248$, $p = 0.000$

The overall contribution of independent variables to the explanation of variance is significant ($p = 0.000$) but amounts to only 24.8 percent ($R^2 = 0.248$). This relatively low contribution can be attributed to the fact that only education contributes very significantly to the explanation of variation regarding the adoption of phosphate fertilization. The fact that age, farm size and area under maize correlated significantly with adoption, but lost significance in the regression analysis indicates a multicollinearity, suggesting that it is not these variables as such, but rather factors associated with them, that have the influence on decision making and adoption behaviour.

6.3 INTERVENING VARIABLES

The other category of variables assumed to be important or more important than the personal and environmental variables (in this study referred to as independent variables) are the intervening variables. Here their influence is analyzed specifically in relation to the adoption of phosphate fertilization. The variables under consideration include the efficiency misperception (EM), need tension (NT), awareness and perception.

6.3.1 Efficiency misperception (EM)

As shown in Table 6.7 the majority of the respondents (84 percent) did not perceive their practice adoption efficiency (in this case the adoption of recommended rate of

phosphate fertilization) correctly in the sense that they either overrated or underrated it.

Table 6.7: Distribution of the respondents according to their efficiency misperception (EM) and phosphate fertilization

Efficiency perception (EP)	Phosphate fertilization (kg/acre)							
	<30		30-50		>50		Total	
	n	%	n	%	n	%	N	%
Underrate	16	42.1	16	42.1	6	15.8	38	33.6
Slightly underrate	10	41.7	8	33.3	6	25.0	24	21.2
Assess correctly	14	77.8	4	22.2	0	0.0	18	15.9
Slightly overrate	11	78.6	3	21.4	0	0.0	14	12.4
Overrate	18	94.7	1	5.3	0	0.0	19	16.8
Total	69	61.1	32	28.3	12	10.6	113	100.0

χ^2 =26.617; df = 8; p=0.001

r= -0.417; p=0.000

The findings show that the majority (54.8 percent) of respondents underrate the efficiency of their own phosphate fertilization, which has the effect of increasing their need tension and thus the assumed tendency to change their current fertilization. It is significant that about 41 percent of the respondents who underrated their current adoption efficiency had adopted the recommended rate of phosphate fertilization while not a single respondent who overrated or misperceived his/her current fertilization efficiency, did in fact adopt the recommended rate of fertilization.

This relationship between EM and adoption of the recommended rate of phosphate fertilization is highly significant (r= -0.417; p=0.000), which implies that the adoption rate decreases with an increasing overrating of the current adoption efficiency. The more respondents overrate or misperceive their current adoption situation to be better than it is, the lower the need to change their behaviour towards what is recommended.

6.3.2 Need tension (NT)

Need tension (NT) has been associated with forces that incite the individual to action or that sustain or give direction to motion (Düvel, 2004). It is therefore regarded as the force that energizes behaviour and gives it direction. According to him (Düvel, 2004) there appears to exist a field polarity consisting of a need (usually some form of deprivation resulting in disequilibrium or system in tension) located within the individual, and a goal-object situated in the environment. The goal-object will assume a positive character (positive incentive) if it is perceived by the individual as having a potential need-satisfying capacity, and a negative valence in the case of a threatening further deprivation (negative incentive). This implies that an object can only become a goal or assume a positive valence if there is a corresponding need tension. An indication of the NT regarding the adoption of the recommended rate of phosphate fertilization in the study area is provided in Table 6.8

Table 6.8: Distribution of the respondents according to their need tension (NT) and phosphate fertilization

Need Tension (NT)	Phosphate fertilization (kg/acre)							
	<30		30-50		>50		Total	
	n	%	n	%	n	%	N	%
Low	62	100.0	0	0.0	0	0.0	62	54.9
Medium	3	42.9	2	28.6	2	28.6	7	6.2
High	4	9.1	30	68.2	10	22.7	44	38.9
Total	69	61.1	32	28.3	12	10.6	113	100.0

χ^2 =92.268; df = 4; p=0.000

r = 0.803, p= 0.000

The need tension or need potential of farmers in the study area regarding the application of recommended rate of phosphate fertilization is somewhat low in that about 55 percent of the respondents were found to have a low need tension. All the respondents (62) in this category fall into the lowest adoption category (applying no or less than 30 kg of phosphate fertilizer).

On the other hand 28.6 percent and 22.7 percent of those with medium and high need tension respectively, adopted the recommended rate of phosphate fertilization. As confirmed by the correlation (r = 0.803, p= 0.000) there is a highly significant relationship between the NT and the adoption depicting that the higher the NT is, the higher the adoption rate. In other words, the higher need tension acts as the force that energizes and drives a farmer in a direction towards adopting the recommended rate of phosphate fertilization.

6.3.3 Awareness of solution

The study model assumes that unawareness or lacking knowledge of the recommended practices as solution can contribute to the non-adoption of recommended maize production practices. Respondents were asked to indicate the recommended rate of phosphate fertilization in their area and were consequently judged as being aware or unaware of the recommended fertilization. An overview of the relationship between awareness and adoption is presented in Table 6.9.

Table 6.9: Distribution of the respondents according to their awareness and phosphate fertilization

Awareness of solution	Phosphate fertilization (kg/acre)							
	<30		30-50		>50		Total	
	n	%	n	%	n	%	N	%
Not aware	43	79.6	10	18.5	1	1.9	74	47.8
Aware	26	44.1	22	37.3	11	18.6	59	52.2
Total	69	61.1	32	28.3	12	10.6	113	100.0

χ^2 =16.833; df = 2; p=0.000

r= 0.385, p= 0.000

According to Table 6.9 the majority (52.2 percent) of the respondents seem to be aware of the recommended rate of phosphate fertilization. The knowledgeable and the non-knowledgeable farmers are significantly different (χ^2 =16.833; df = 2; p=0.000) in terms of adoption.

The difference lies mainly in the phenomenon that farmers who are aware of the recommended level of phosphate fertilization tend to adopt it more than those having no knowledge of it.

This relationship between awareness and adoption is highly significant (r= 0.385, p= 0.000). From the distribution in Table 6.9 it can be concluded (with the exception of one individual who was supposedly unaware of the recommendation but nevertheless adopted it) that awareness is a precondition but not a guarantee for adoption.

6.3.4 Prominence

Insufficient prominence – implying that the recommended practice is seen as less prominent or less advantageous than the current one or than other alternatives - is another intervening variable or factor hypothesized to cause unwillingness to adopt (Düvel, 1998). Table 6.10 shows the relationship between prominence and phosphate fertilization.

Table 6 10: Distribution of the respondents according to their prominence and phosphate fertilization

Prominence	Adoption							
	<30		30-50		>50		Total	
	n	%	n	%	n	%	N	%
Low prominence	53	94.6	3	5.4	0	0.0	56	49.6
Medium prominence	5	71.4	1	14.3	1	14.3	7	6.2
High prominence	11	22.0	28	56.0	11	22.0	50	44.2
Total	69	61.1	32	28.3	12	10.6	113	100.0

χ^2 =59.535; df = 4; p=0.000

r = 0.673, p= 0.000

As indicated in Table 6.10, the majority of the respondents (55.8 percent) perceived the recommended rate of phosphate fertilization to have a low or medium prominence.

Poor or low prominence clearly seems to have an influence on the adoption behaviour since not a single respondent who perceived the recommended rate of phosphate fertilization to have a low prominence adopted it. This clear positive and highly significant relationship between perceived prominence and adoption is also reflected in the correlation coefficient of 0.673 and the probability (p= 0.000) implying that the more the recommended rate is perceived to have a high prominence or higher prominence than the current one or than other alternatives, the higher the adoption tends to be.

6.3.5 Total influence of intervening variables

To assess the total influence of all discussed intervening variables (efficiency misperception, need tension, awareness and prominence) a regression analysis was conducted. Table 6.11 presents the findings regarding the influence of the different individual intervening variables as well as their combined contribution towards the total variance in adoption behaviour.

Table 6. 11: Linear regression analysis showing the relationship between intervening variables and adoption of phosphate fertilization

Variable	Beta	t	p
Constant		16.685	0.000
Efficiency misperception	0.030	0.514	0.608
Need tension	0.708	9.093	0.000
Awareness	0.053	0.933	0.353
Prominence	0.172	2.144	0.034

R^2 =0.732, p=0.000

According to Table 6.11 the intervening variables contribute highly significantly (R^2 =0.732, p=0.000) to the adoption of phosphate fertilization. They explain 73.2 percent of the variation in the adoption behaviour. The NT makes the biggest contribution towards explaining the adoption behaviour, which further support other researchers (Koch, 1986; Düvel and Botha, 1999; Düvel and Scholtz, 1986;) who identified the NT to be a key dimension in adoption behaviour.

6.4 COMPARISONS BETWEEN INDEPENDENT AND INTERVENING VARIABLES

When comparing the influence of the independent and intervening variables, it is clear that the intervening variables have a significantly bigger influence on adoption behaviour. Not only do a greater percentage of the intervening variables have an influence, but the influence as reflected in correlation coefficients is also much more significant. Particularly conspicuous is the comparison of the total influence of these categories of variables. As shown in Fig 6.1, the influence of intervening variables far outweighs that of the independent variables in terms of the percentage variation explained. The intervening variables explain 73.2 percent of the variation in phosphate fertilizer adoption as opposed to the 24.8 percent contributed by the independent variables.

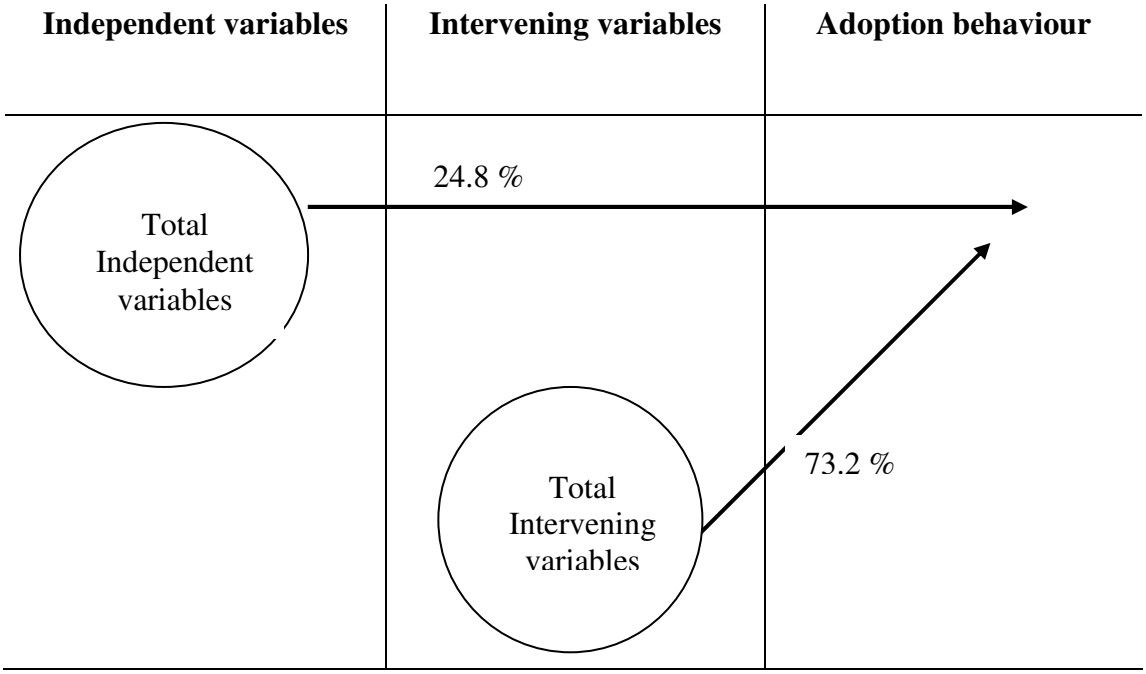

Figure 6.1: Comparative contribution of independent and intervening variables on adoption behaviour

CHAPTER 7

THE INFLUENCE OF INDEPENDENT AND INTERVENING VARIABLES ON THE ADOPTION OF NITROGEN FERTILIZATION

7.1 INTRODUCTION

Nitrogen fertilization is one of the practices recommended in the Njombe district in order to improve maize production. The practice consists of two aspects namely, the rate and time of nitrogen fertilization. In order to have an adoption score for total nitrogen fertilization, the scale points of the individual practices (nitrogen and time of nitrogen fertilization) were added before being re-categorized into three groups namely, <5 scale points for low adoption, 5-7 for medium adoption and >7 for high adoption or the recommended adoption.

Despite all efforts to promote these practices in the area, the adoption is still low. As already pointed out earlier only 30.1 and 25.7 percent of the respondents had adopted the recommended rate and time of nitrogen fertilization respectively. This chapter explores the factors that contribute to the non-or poor adoption. The independent factors or variables are examined first followed by the intervening ones.

7.2 INDEPENDENT VARIABLES

This part discusses the results of chi-square and correlation tests carried out to determine how the individual socio-economic and personal characteristics of farmers like sex, farm size and formal education influence the adoption of nitrogen fertilization in the Njombe district.

7.2.1 Age

Age of the farmers is one of the independent variables of assumed importance in affecting the adoption of nitrogen fertilization in the study area. It is hypothesized that the adoption is higher among young farmers than in older ones. The findings of the relationship between age and adoption are presented in Table 7.1 below.

Table 7.1: Distribution of respondents according to their age and nitrogen fertilization

Nitrogen fertilization	Age (years)							
	<36		36-56		>56		Total	
	n	%	n	%	n	%	n	%
1. Rate (kg/acre)								
<25	4	12.9	9	15.3	8	34.8	21	18.6
25-50	6	19.4	20	33.9	9	39.1	35	31.0
50-75	8	25.8	14	23.7	1	4.3	23	20.4
>75	13	41.9	16	27.1	5	21.7	34	30.1
Total	31	27.4	59	52.2	23	20.4	113	100.0
χ^2 = 11.976; df=6; p=0.063; r = -0.303; p=0.001								
2. Time of fertilization								
All at planting	1	3.2	2	3.6	1	5.3	4	3.8
All as top dressing	19	61.3	43	78.2	12	63.2	74	70.5
At planting & as top dressing	11	35.5	10	18.2	6	31.6	27	25.7
Total	31	29.5	55	52.4	19	18.1	105	100.0
χ^2 = 3.735; df=4; p=0.443; r = -0.085; p=0.388								
3. Total N-fertilizaton								
<5	4	12.9	9	15.3	8	34.8	21	18.6
5-7	10	32.3	29	49.2	9	39.1	48	42.5
>7	17	54.8	21	35.6	6	26.1	44	38.9
Total	31	27.4	59	52.2	23	20.4	113	100.0
χ^2 = 8.737; df=4; p=0.068; r = -0.236; p=0.012								

Although there are no significant differences between the age groups in terms of adoption of rate, time and total nitrogen fertilization the percentages and the negative correlation coefficients (r = -0.303; r = - 0.085; r = - 0.236) show that the adoption seems to be higher in the category of young farmers than in the older ones. This proof is shown in a statistically significant negative correlation (r = -0.236; p=0.012) between farmers age and the adoption of total nitrogen fertilization. For example only 26.1 percent of the oldest category farmers applied the recommended level represented by a scale point of more than 7, while the percentage of young farmers who did so is as high as 54.8 percent.

The opposite tendency is evident where the percentage of the oldest farmers who scored less than 5 points is 34.8 percent, while the percentage young farmers in the lowest adoption categry is only 12.9 percent. The findings are in correspondence with the other findings that younger farmers are more likely to adopt a new technology than the older ones (CIMMYT, 1993; Van den Ban and Hawkins, 1996). The results are not supportive of many other findings (Habtemariam, 2004; Kalineza, 2000; Temu, 1996) that reflect a non-linear or parabolic correlation between adoption and age, implying that frequently the middle-age group tend to be the ones with the highest adoption rate. In this case the middle group shows even bigger resemblance with the oldest group as far as poor adoption is concerned.

7.2.2 Sex

An overview of the influence of sex as a behaviour determinant is given in Table 7.2

Table 7.2: Distribution of respondents according to their sex and nitrogen fertilization

Nitrogen fertilization	Sex					
	Male		Female		Total	
	n	%	n	%	n	%
1. Rate (kg/acre)						
<25	10	14.3	11	25.6	21	18.6
25-50	20	28.6	15	34.9	35	31.0
50-75	16	22.9	7	16.3	23	20.4
>75	24	34.3	10	23.3	34	30.1
Total	70	61.9	43	38.1	113	100.0
χ^2 = 3.815; df=3; p=0.282; r = -0.176; p=0.062						
2. Time of N-fertilization						
All at planting	2	3.0	2	5.3	4	3.8
All as top dressing	47	70.1	27	71.1	74	70.5
At planting & as top dressing	18	26.9	9	23.7	27	25.7
Total	67	63.8	38	36.2	105	100.0
χ^2 = 0.429; df=2; p=0.807; r = -0.053; p=0.593						
3. Total N-fertilizaton						
<5	10	14.3	11	25.6	21	18.6
5-7	29	41.4	19	44.2	48	42.5
>7	31	44.3	13	30.2	44	38.9
Total	70	61.9	43	38.1	113	100.0
χ^2 = 3.228; df=2; p=0.199; r = -0.168; p=0.075						

The distributions in Table 7.2 indicate some relationship, but according to the χ^2 analyses the difference between the gender groups is not significant. (χ^2 = 3.815, df=3, p=0.282; χ^2 = 0.429; df=2; p=0.807; χ^2 = 3.228; df=2; p=0.199). However, the negative correlation coefficients, especially in the case of the rate of nitrogen fertilization and the total adoption score where the values approach the five percent probability, do suggest that male farmers are more inclined to adopt the recommended nitrogen fertilization. Again the suspicion is that this behaviour is indirectly rather than directly related to sex, and can be attributed to factors such as less access to resources and to extension information (Jefremovas, 1991; Stephens, 1992; Gass and Bigs, 1993).

7.2.3 Formal education

Formal education has already emerged as an important behaviour determinant in the practices already discussed and is also assumed to be an important factor in the adoption of nitrogen fertilization. Its influence is shown in Table 7.3.

Table 7.3: Distribution of respondents according to their formal education and nitrogen fertilization

Nitrogen fertilization	Formal education (years)							
	None		1-7 yrs		>7 yrs		Total	
	n	%	n	%	n	%	N	%
1. Rate (kg/acre)								
<25	11	55.0	9	14.1	1	3.4	21	18.6
25-50	7	35.0	23	35.9	5	17.2	35	31.0
50-75	2	10.0	14	21.9	7	24.1	23	20.4
>75	0	0.0	18	28.1	16	55.2	34	30.1
Total	20	17.7	64	56.6	29	25.7	113	100.0
χ^2 = 34.424 df=6; p=0.000; r = 0.510; p=0.000								
2. Time of N-fertilization								
All at planting	2	14.3	2	3.2	0	0.0	4	3.8
All as top dressing	12	85.7	40	63.5	22	78.6	74	70.5
At planting & as top dressing	0	0.0	21	33.3	6	21.4	27	25.7
Total	14	13.3	63	60.0	28	26.7	105	100.0
χ^2 = 11.547; df=4; p=0.021; r = 0.153; p=0.120								
3. Total N-fertilizaton								
<5	11	55.0	9	14.1	1	3.4	21	18.6
5-7	9	45.0	29	45.3	10	34.5	48	42.5
>7	0	0.0	26	40.6	18	62.1	44	38.9
Total	20	17.7	64	56.6	29	25.7	113	100.0
χ^2 = 30.957; df=4; p=0.000; r = 0.485; p=0.000								

The formal education categories differ significantly with respect to the adoption of the recommended rate, time and total nitrogen fertilization. With exception to the time of nitrogen fertilization the nature of the percentage distribution clearly indicates that the application tends to increase with an increased level of formal education. This is clearly seen in Table 7.3 where 62.1 percent of those respondents with formal education of more than seven years of schooling had adopted the recommended total nitrogen fertilization but not a single respondent of those who did not have formal education did so. The later could even be an indication that some form of formal training is essential for nitrogen fertilization to be adopted. This relationship also finds its expression in a highly significant positive correlation coefficient of 0.485 ($p = 0.000$), indicating that the higher the formal education is, the higher the adoption tends to be.

7.2.4 Farm size

With respect to the adoption of new ideas or technologies, indications have been that large farm operators have higher rates of adoption than small farmers (Rogers, 1983; Thakre & Bansode, 1990; Polson & Spencer, 1991; Kalineza, 2000; Kipaka, 2000). The findings regarding the influence of farm size on nitrogen fertilization are presented in Table 7.4

Table 7.4 Distribution of respondents according to their farm size and Nitrogen fertilization

Nitrogen fertilization	Farm size (Acres)							
	<3		3-6		>6		Total	
	n	%	n	%	n	%	N	%
1. Rate (kg/acre)								
<25	12	30.8	8	17.8	1	3.4	21	18.6
25-50	13	33.3	14	31.1	8	27.6	35	31.0
50-75	5	12.8	10	22.2	8	27.6	23	20.4
>75	9	23.1	13	28.9	12	41.4	34	30.1
Total	39	34.5	45	39.8	29	25.7	113	100.0
χ^2 = 10.682; df=6; p=0.099; r = 0.274; p=0.003								
2. Time of N-fertilization								
All at planting	1	2.9	3	7.0	0	0.0	4	3.8
All as top dressing	29	85.3	29	67.4	16	57.1	74	70.5
At planting & as top dressing	4	11.8	11	25.6	12	42.9	27	25.7
Total	34	32.4	43	41.0	28	26.7	105	100.0
χ^2 = 9.861; df=4; p=0.043; r = 0.258; p=0.008								
3. Total N-fertilizaton								
<5	12	30.8	8	17.8	1	3.4	21	18.6
5-7	17	43.6	19	42.2	12	41.4	48	42.5
>7	10	25.6	18	40.0	16	55.2	44	38.9
Total	39	34.5	45	39.8	29	25.7	113	100.0
χ^2 = 10.474; df=4; p=0.033; r = 0.299; p=0.001								

There are clear indications of a correlation at $p < 0.05$ between farm size and adoption. The positive correlations ($r = 0.274$; $r = 0.258$; $r = 0.299$) imply that the individuals with large farm sizes are more likely to adhere to the required nitrogen fertilization than small farm holders.

As far as the rate of fertilization is concerned this relationship is clearly shown in Table 7.4 where 41.4 percent of those with farm sizes of more than six acres had the highest adoption rate while only 23.1 percent of those on smaller farms (less than six acres) accomplished the same level of adoption. It appears that farm size more than any of the other factors influences this practice, which might imply that practical considerations are a factor when it comes to farm size.

7.2.5 Area under maize

If size of farm acts as a behaviour determinant, a similar influence could be expected from the size of the enterprise, in this case the total area under maize production. The survey results with respect to the relationship between the area under maize and nitrogen fertilization are summarized in Table 7.5

As confirmed by both chi-square (χ^2 = 14.258; df = 4; p=0.007) and the correlation (r = 0.297; p=0.001) there is a significant relationship between the area under maize and the adoption of nitrogen fertilization (measured both in terms of the time and rate of application), implying that the bigger the area under maize, the higher the adoption tends to be.

For instance, 55.6 percent of those respondents with more than three acres had applied the recommended nitrogen fertilization, but the percentage of those with equal or less than one acre is only 30.8 percent.

Table 7. 5: Distribution of respondents according to their area under maize and nitrogen fertilization

Nitrogen fertilization	Area under maize (Acres)							
	<=1		1.1-3		>3		Total	
	n	%	n	%	n	%	n	%
1. Rate (kg/acre)								
<25	10	38.5	11	18.3	0	0.0	21	18.
25-50	7	26.9	20	33.3	8	29.6	35	31.0
50-75	4	15.4	12	20.0	7	25.9	23	20.4
>75	5	19.2	17	28.3	12	44.4	34	30.1
Total	26	23.0	60	53.1	27	23.9	113	100.0
χ^2 = 14.469; df=6; p=0.025; r = 0.310; p=0.001								
2. Time of fertilization								
All at planting	1	4.5	3	5.4	0	0.00	4	3.8
All as top dressing	16	72.7	41	73.2	17	63.0	74	70.5
At planting & as top dressing	5	22.7	12	21.4	10	37.0	27	25.7
Total	22	21.0	56	53.3	27	25.7	105	100.0
χ^2 = 3.526; df=4; p=0.474; r = 0.138; p=0.161								
3. Total N-fertilizaton								
<5	10	38.5	11	18.3	0	0.0	21	18.6
5-7	8	30.8	28	46.7	12	44.4	48	42.5
>7	8	30.8	21	35.0	15	55.6	44	38.9
Total	26	23.0	60	53.1	27	23.9	113	100.0
χ^2 = 14.258; df=4; p=0.007; r = 0.297; p=0.001								

7.6 TOTAL INFLUENCE OF INDEPENDENT VARIABLES

All the independent variables discussed above were entered into the linear regression model to evaluate their total contribution to the variance regarding the adoption of nitrogen fertilization. The model results are presented in Table 7.6.

Table 7.6: Regression analysis of the influences of independent variables on adoption of nitrogen fertilization

Variable	Beta	t	p
(Constant)		2.458	0.016
Sex	-0.061	-0.666	0.507
Age	-0.234	-2.425	0.017
Formal education	0.269	2.656	0.009
Farm size	0.214	2.059	0.042
Area under maize	0.102	1.081	0.282

$R^2 = 0.295$, $p = 0.000$

The regression analysis confirms the significant influence of most of the tested independent variables. Only the area under maize and sex do not contribute significantly to the total variance regarding adoption of nitrogen fertilization. However, the overall contribution towards explaining the variance in adoption is only 29.5 percent, which is reflected in R^2 value (R^2= 0.295 ; p = 0.000). As shown in Table 7.6 formal education seems to be the only variable contributing very significantly to the adoption behaviour.

7.3 INTERVENING VARIABLES

To establish the relative influence of intervening variables compared to the independent personal and environmental factors on nitrogen fertilization, the former are analyzed in a similar fashion. The following section deals with this. First the influences of the individual intervening variables are analysed, and then the overall influence is analysed and compared.

7.3.1 Efficiency misperception (EM)

The efficiency misperception of nitrogen fertilization is assumed to have an influence on the adoption behaviour. Table 7.7 shows the relationship between EM and adoption of recommended rate of nitrogen fertilization.

Table 7.7: Distribution of respondents according to their efficiency misperception (EM) and nitrogen fertilization

	Perceived current efficiency (PCE)											
Nitrogen fertilization	**Underrate**		**Slightly underrate**		**Assess correctly**		**Slightly overrate**		**Overrate**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**N**	**%**
1. Rate (kg/acre)												
<25	0	0.0	0	0.00	0	0.0	2	10.5	19	59.4	21	18.6
25-50	4	12.9	7	36.8	0	0.0	11	57.9	13	40.6	35	31.0
50-75	12	38.7	5	26.3	0	0.0	6	31.6	0	0.0	23	20.4
>75	15	48.4	7	36.8	12	100.0	0	0.0	0	0.0	34	30.1
Total	31	27.4	19	16.8	12	10.6	19	16.8	32	28.3	113	100.0
χ^2 = 107.612; df=12; p=0.000; r = -0.695; p=0.000												
2. Time of N-fertilization												
Planting	0	0.0	0	0.0	0	0.0	0	0.0	4	9.3	4	3.8
Top dressing	0	0.0	7	87.5	0	0.0	30	85.7	37	86.0	74	70.5
Both	11	100.0	1	12.5	8	100.0	5	14.3	2	4.7	27	25.7
Total	11	10.5	8	7.6	8	7.6	35	33.3	43	41.0	105	100.0
χ^2 = 72.634; df=8; p=0.000; r = -0.613; p=0.000												
3. Total N-fertilizaton												
<5	0	0.0	0	0.0	1	3.7	9	24.3	11	100.0	21	18.6
5-7	4	36.4	8	29.6	14	51.9	22	59.5	0	0.0	48	42.5
>7	7	63.6	19	70.4	12	44.4	6	16.2	0	0.0	44	38.9
Total	11	9.7	27	23.9	27	23.9	37	32.9	11	7.9	113	100.0
χ^2 = 77.032; df=8; p=0.000; r =- 0.629; p=0.000												

The minority of respondents (7.6 percent) assess their current efficiency of total nitrogen fertilizer application correctly in the sense that their assessments are inline with the assessment by the enumerator and assuming that the more objective scale used by the enumerator is the objectively correct one. All of these respondents adopted the recommended rate of nitrogen fertilization. The findings further show that not a single respondent who overrated or assessed his/her nitrogen fertilization efficiency to be higher than it really is, adopted the recommended rate, which would imply that they are satisfied with their current rate of nitrogen fertilization and thus have no need (low need tension) to go for the recommended rate. The opposite tendency applies on all individuals that underrate their efficiency.

This close relationship between efficiency misperception and adoption of recommended rate of nitrogen fertilization finds its expression in the highly significant negative correlation ($r=-0.695$, $p=0.000$). The same tendency and highly significant negative correlation is observed in time and total nitrogen fertilization, which implies that the adoption rate decreases with an increasing overrating of the current adoption efficiency. The more farmers misperceive or overrate their efficiency of nitrogen adoption, or the more they perceive their own efficiency of nitrogen application to be better than it really is, the lower the incentive to change their behaviour towards what is recommended.

7.3.2 NEED TENSION (NT)

The influence of NT on the adoption of nitrogen fertilization is indicated in Table 7.8

Table 7 8: Distribution of respondents according to their perceived need tension (NT) and Nitrogen fertilization

Nitrogen fertilization	Need tension (NT)							
	Low		Medium		High		Total	
	n	%	n	%	n	%	N	%
1. Rate (kg/acre)								
<25	17	77.3	4	11.4	0	0.0	21	18.6
25-50	4	18.2	24	68.6	7	12.5	35	31.0
50-75	1	4.5	2	5.7	20	35.7	23	20.4
>75	0	0.0	5	14.3	29	51.8	34	30.1
Total	22	19.5	35	31.0	56	49.6	113	100.0
χ^2 = 106.616; df=6; p=0.000; r = 0.758; p=0.000								
2. Time of N-fertilization								
All at planting	4	6.1	0	0.0	0	0.0	4	3.8
All as top dressing	61	92.4	3	23.1	10	38.5	74	70.5
At planting & as top dressing	1	1.5	10	76.9	16	61.5	27	25.7
Total	66	62.9	13	12.4	26	24.8	105	100.0
χ^2 = 56.064; df=4; p=0.000; r = 0.622; p=0.000								
3. Total N-fertilizaton								
<5	17	77.3	4	6.5	0	0.0	21	18.6
5-7	5	22.7	39	62.9	4	13.8	48	42.5
>7	0	0.0	19	30.6	25	86.2	44	38.9
Total	22	19.5	62	54.9	29	25.7	113	100.0
χ^2 = 91.104; df = 4; p=0.000; r = 0.735; p=0.000								

The biggest group of respondents, about 50 percent, seem to have high need tensions with regard to nitrogen fertilization and not a single individual from this group applied the lowest rate of no or less than 25 kg per acre of nitrogen. On the other hand, no one with low need tension applied the recommended rate. This low need tension can be attributed to the fact that (a) they either perceive their current adoption as more efficient than it really is and/or they are unaware of what the recommended application rate is. Evidence of this very close relationship between need tension and adoption of nitrogen fertilisation is provided by the extremely high correlation coefficient ($r = 0.758$; $p=0.000$). The positive coefficients in all three cases ($r = 0.758$; $r = 0.622$; $r = 0.735$) signifies that the higher the need tension is, the higher the adoption of nitrogen fertilization tends to be.

7.3.3 Awareness of solution

Table 7.9 below presents the findings of the relationship between knowledge or awareness of the recommended practice, in this case the recommended nitrogen fertilization and its adoption.

According to Table 7.9 the general awareness is low, with only 49.6, 30.5, 51.3 percent respondents being aware of the recommended rate, time and total nitrogen fertilization respectively. This is an indication of the work still to be done by extension agents as far as creating an awareness of the recommended nitrogen fertilization is concerned. The consequence of unawareness is expected to be reflected in the adoption rate attained. This is in fact the case. In all aspects there is a highly significant correlation at 1 percent level of probability with between awareness of the recommended nitrogen fertilisation.

Table 7 9: Distribution of respondents according to their awareness and Nitrogen fertilizer recommendations

	Awareness					
	Not aware		Aware		Total	
Nitrogen fertilization	**n**	**%**	**n**	**%**	**n**	**%**
1. Rate (kg/acre)						
<25	15	26.3	6	10.7	21	18.6
25-50	25	43.9	10	17.9	35	31.0
50-75	8	14.0	15	26.8	23	20.4
>75	9	15.8	25	44.6	34	30.1
Total	57	50.4	56	49.6	113	100.0
χ^2 = 19.938; df=3; p=0.000; r = 0.391; p=0.000						
2. Time of fertilization						
All at planting	3	4.1	1	3.1	4	3.8
All as top dressing	61	83.6	13	40.6	74	70.5
At planting & as top dressing	9	12.3	18	56.3	27	25.7
Total	73	69.5	32	30.5	105	100.0
χ^2 = 22.566; df=2; p=0.000; r = 0.416; p=0.000						
3. Total N-fertilizaton						
<5	14	25.5	7	12.1	21	18.6
5-7	30	54.5	18	31.0	48	42.5
>7	11	20.0	33	56.9	44	38.9
Total	55	48.7	58	51.3	113	100.0
χ^2 = 16.265; df=2; p=0.000; r =0.344; p = 0.000						

7.3.4 Prominence

The degree to which one alternative is perceived to be better than another, in other words the more one alternative is perceived to be more prominent than another, the more likely it will be adopted.

It is consequently expected that the more prominent the recommended nitrogen fertilization is perceived to be relative to other alternatives, the more likely it will be adopted. Findings relating to this assumption are summarised in Table 7.10.

Table 7.10: Distribution of respondents according to their perceived prominence of the recommended nitrogen fertilization and its adoption.

Nitrogen fertilization	Prominence							
	Low		Medium		High		Total	
	n	%	n	%	n	%	n	%
1. Rate (kg/acre)								
<25	13	76.5	5	17.9	3	4.4	21	18.6
25-50	4	23.5	22	78.6	9	13.2	35	31.0
50-75	0	0.0	0	0.0	23	33.8	23	20.4
>75	0	0.0	1	3.6	33	48.5	34	30.1
Total	17	15.0	28	24.8	68	60.2	113	100.0
χ^2 = 100.265; df=6; p=0.000; r = 0.732; p = 0.000								
2. Time of fertilization								
All at planting	4	6.3	0	0.0	0	0.0	4	3.8
All as top dressing	58	92.1	4	30.8	12	41.4	74	70.5
At planting & as top dressing	1	1.6	9	69.2	17	58.6	27	25.7
Total	63	60.0	13	12.4	29	27.6	105	100.0
χ^2 = 49.272; df=4; p=0.000; r = 0.599; p=0.000								
3. Total N-fertilizaton								
<5	13	76.5	7	11.1	1	3.0	21	18.6
5-7	4	23.5	38	60.3	6	18.2	48	42.5
>7	0	0.0	18	28.6	26	78.8	44	38.9
Total	17	15.0	63	55.8	33	29.2	113	100.0
χ^2 = 69.401; df=4; p=0.000; r =0.647; p = 0.000								

Again in all nitrogen fertilization practices there is a very close relationship between the perceived prominence and adoption. The importance of this intervening variable is further emphasised by the indications that it is almost a precondition of adoption, although its prevalence does not necessarily guarantee it.

It is noteworthy, for example that not a single individual with a low prominence perception (and only one with a medium perception) adopted the recommended level of nitrogen fertilisation.

7.3.5 Total influence of intervening variables

For purposes of a more accurate analysis of the various intervening variables, as well as for a holistic overview of their total influence on practice adoption, a linear regression analysis was conducted and the results presented in Table 7.11.

Table 7.11: Influence of intervening variables on adoption of nitrogen fertilization

Variable	Beta	t	p
(Constant)		3.314	0.001
Efficiency misperception (EM)	-0.281	-3.874	0.000
Need tension	0.411	5.582	0.000
Awareness	0.085	1.584	0.116
Prominence	0.250	3.730	0.000

$R^2 = 0.74.8$, $p = 0.000$

The need aspects namely, need tension and the efficiency misperception seem to have the biggest influence on the adoption of the recommended rate of nitrogen fertilization. They are followed by prominence, which similarly contributes in a highly significant degree to the variance in adoption. Awareness is the only intervening variable, which does not contribute in a significant way to the variation in adoption, and this can probably be attributed to its inaccurate measurement. The total influence of all intervening variables on adoption behaviour is highly significant. As indicated in Table 7.11 they explain 74.8 percent of the adoption variance, which is reflected in R square of 0.748.

7.4 COMPARISON B ETWEEN INDEPENDENT AND INTERVENING VARIABLES

Having assessed the influence of independent and intervening variables in the previous sections, this part provides a brief summary of the comparison between the two with the view of shedding light on which variables are more important in predicting the adoption decision or adoption behaviour of maize growers as far as nitrogen fertilizer application in the study area is concerned. Figure 7.1 summarizes the results

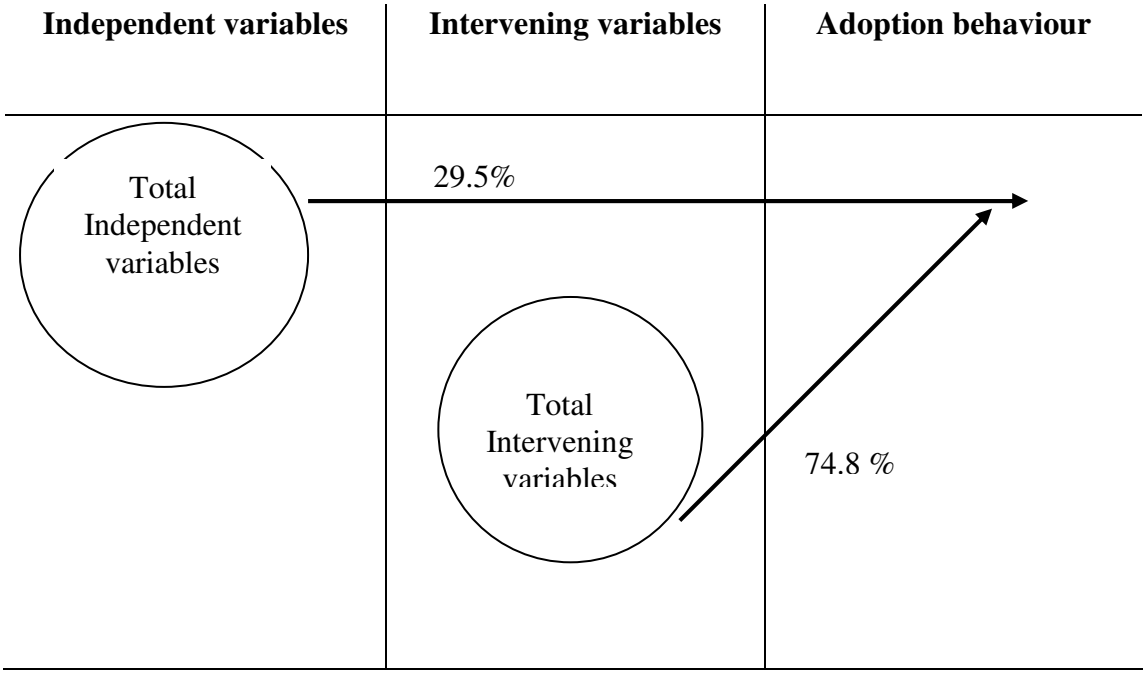

Figure 7.1: Comparative contribution of independent and intervening variables on adoption behaviour

As presented in Fig 7.1 the total influences of the two variables on adoption behaviour are quite different as can clearly seen in their percentage contributions. The total influence of intervening variables explains up to 74.8 percent while independent variables contribute only at 29.5 percent. The findings are in support of the hypothesis of the study, which states that the influence of intervening variables on adoption decision is higher than that of the independent variables.