CHAPTER 8

THE ROLE OF INDEPENDENT AND INTERVENING VARIABLES ON THE ADOPTION OF THE TOTAL FERTILIZER PACKAGE

8.1 INTRODUCTION

Various independent and intervening factors have been found to be reasonably important in influencing the adoption of fertilization practices. The influence of these factors seems to be bigger with the practices that contribute more significantly to yield improvement and less evident in the practices less associated with increased production efficiency, like the time of nitrogen fertilization. In this chapter these variables are further evaluated to determine their influence on the adoption of the total fertilization package in order to make a comparison with the individual fertilization practices already discussed.

8.2 INDEPENDENT VARIABLES

8.2.1 Age

The influence of age on decision-making regarding the total fertilizer package is shown in Table 8.1. As indicated in chapter four, the scores for the adoption of total fertilization package were obtained by adding the scale points of the individual fertilizer practices[8] (phosphate, nitrogen and time of nitrogen fertilization) already discussed. The scores were then categorized into three groups namely, <6 scale points for low adoption, 6-10 for medium adoption and 11-15 for high adoption.

[8] The scale points for total fertilization package were obtained before the individual fertilizer practices were re-categorized

Table 8.1: Distribution of the respondents according to their age and the adoption of fertilization (total fertilizer package)

	Fertilization Categories							
	<6		6-10		>10		Total	
Age	n	%	n	%	n	%	N	%
<36	4	12.9	12	38.7	15	48.4	31	27.4
36-56	13	22.0	26	44.1	20	33.9	59	52.2
>56	11	47.8	8	34.8	4	17.4	23	20.4
Mean ages	53.0		44.1		41.3		45.4	

χ^2 =10.956; df=4; p=0.027

r= -0.310; p=0.001

Although the results show that there are no significant differences between the age groups in terms of adoption of fertilizer package (χ^2 =10.956; df=4; p=0.027), the correlation is significant (r= -0.310; p=0.001) and can be attributed to the fact, although the differences between the groups is not very big, the relationship is of a clear linear nature. Evidence of the negative linear relationship are the mean ages of the different adoption categories. As the mean age decreases, the fertilization improves. In the highest adoption category close to 50 percent (48.4) of the respondents are younger than 36 years of age, while in the lowest adoption category this group of young farmers comprises only 12.9 percent. The negative relationship is also found in other fertilization practices namely phosphate, nitrogen and time of nitrogen fertilization but the influence of age on the total fertilization package seems to be higher than that of individual fertilization practices.

8.2.2 Sex

Table 8.2 provides a summary of the influence of the respondents' sex on the adoption of the total fertilizer package.

Table 8.2: Distribution of respondents according to their sex and the adoption of fertilization (total fertilizer package)

Sex	Fertilization categories							
	<6		6-10		>10		Total	
	n	%	n	%	n	%	N	%
Male	14	20.0	28	40.0	28	40.0	70	61.9
Female	14	32.6	18	41.9	11	25.6	43	38.1
Total	28	24.8	46	40.7	39	34.5	113	100.0

χ^2 =3.323; df=2; p=0.190

r= -0.171; p=0.069

The weak but negative correlation (r= -0.171; p=0.069) between the sex and the adoption of total fertilizer package suggests that the adoption of the recommended fertilizer package is higher among male farmers than among female farmers. This proof is clearly presented by frequencies and percentages of the respondents in Table 8.2 above. As in the case of other fertilization practices this relationship does not necessarily imply that gender has a direct influence on adoption behaviour, but may be could imply that the influence is because of gender related factors like contact with extension or other sources of technology. The influence of sex on the total fertilization package is almost similar to that of nitrogen fertilization but more than that of phosphate (r = -0.116, p= 0.223) and time of nitrogen fertilization (r = -0.053, 0.593).

8.2.3 Formal education

In the analyses carried out to examine the influence of formal education on the adoption of total fertilizer package, the following results obtained (Table 8.3).

Table 8.3: Distribution of the respondents according to their formal education and the adoption of fertilization (total fertilizer package)

Formal education	Fertilization categories							
	<6		6-10		>10		Total	
	n	%	n	%	n	%	N	%
None	12	60.0	8	40.0	0	0.0	20	17.7
1-7	14	21.9	30	46.9	20	31.3	64	56.6
>7	2	6.9	8	27.6	19	65.5	29	25.7
Total	28	24.8	46	40.7	39	34.5	113	100.0

χ^2 =30.977; df=4; p=0.000

r= 0.498; p=0.000

Based on the correlation test carried to test a kind of relationship that exist between formal education and adoption, the results suggest that the tendency to adopt increase in a linear fashion with increasing number of years of schooling. For example, not a single respondent without formal education scored more than ten scale points of total fertilizer package. The percentages increase to 31.3 in the case of farmers with one up to seven years of schooling, to 65.5 percent to in the case of those with more than seven years of schooling. This proof is reflected in a highly correlation coefficient of r = 0.498 at 1 percent level of probability. The correlation between formal education and total fertilization package is more than that of phosphate fertilization and time of nitrogen fertilization and more or less of the same order of nitrogen fertilization (r = 0.510; p = 0.000).

8.2.4 Farm size

An overview of the relationship between farm size and the adoption of total fertilizer package is indicated in Table 8.4.

Table 8.4: Distribution of respondents according to their farm size and the adoption of fertilization (total fertilizer package)

Farm size	Fertilization categories							
	<6		6-10		>10		Total	
	n	%	n	%	n	%	N	%
<3	17	43.6	12	30.8	10	25.6	39	34.5
3-6	8	17.8	24	53.3	13	28.9	45	39.8
>6	3	10.3	10	34.5	16	55.2	29	25.7
Total	28	24.8	46	40.7	39	34.5	113	100.0

χ^2 =16.770; df=4; p=0.002

r= 0.315; p=0.001

As indicated earlier that the farmer's farm size tends to influence his/her decision regarding the adoption of recommended practices, Table 8.4 also provides evidence of this relationship. According to the Table results, the adoption of total fertilizer package seems to be higher among the large farms owners than in the case of those owning small pieces of land. This evidence is clearly reflected in statistically significant relationships (χ^2 =16.770; df=4; p=0.002; r= 0.315; p=0.001) that exist between farm size and the adoption of total fertilizer package. The findings further tell us that only 34.5 percent of the respondents indicated to have high fertilizer package adoption, represented by more than ten points score. This lead into the speculation that poor adoption of the package might be one of the most important cause of low yields observed to the majority of farmers in the Njombe district.

The influence of education is evident in all fertilization practices discussed in chapter six and seven except in the case of time of nitrogen fertilization that proved to have no correlation with this variable. Although farm size seems to have a significant influence on all fertilization practices, the influence seems to be much more with total package (r= 0.315; p=0.001) than other fertilization practices.

8.2.5 Area under maize

The influence of the area under maize on the adoption of total fertilizer package is presented in Table 8.5 below.

Table 8.5: Distribution of respondents according to their area under maize and the adoption of fertilization (total fertilizer package)

Area under maize	Fertilization categories							
	<6		6-10		>10		Total	
	n	%	n	%	n	%	N	%
<=1	11	42.3	6	23.1	9	34.6	26	23.0
1.1-3	17	28.3	29	48.3	14	23.3	60	53.1
>3	0	0.0	11	40.7	16	59.3	27	23.9
Total	28	24.8	46	40.7	39	34.5	113	100.0

χ^2 =20.026; df=4; p=0.000

r= 0.303; p=0.001

As in the case of farm size, the area under maize also found to have a significant influence on the adoption of fertilizer package. This is clearly indicated by the chi-square and correlation analyses results (χ^2=20.026; df=4; p=0.000; r= 0.303; p=0.001) presented in Table 8.6.

The proof of this is reflected in the percentages of farmers not adopting or who had a score of less than 6 scale points of total fertilizer package application. For example none of those owning a farm size of more than three acres scored less than six scale points while the percentage of the respondents with less than 1.1 acres is 42.3 percent.

8.2.6 Total influence of independent variables

The linear regression model was used to determine the total influence of all independent variables discussed above on the adoption behaviour regarding fertilization. In addition, the model was used to assess the contribution of each variable in the adoption of fertilizer package variance. The model results are summarized in Table 8.6

Table 8 6: Regression analysis of the influence of independent variables on the adoption of fertilization (total fertilizer package)

Variable	Beta	t	p
(Constant)		2.578	0.011
Sex	-0.032	-0.357	0.722
Age	-0.235	-2.488	0.014
Formal education	0.324	3.278	0.001
Farm size	0.205	2.019	0.046
Area under maize	0.098	1.064	0.290

R^2 = 0.329, p = 0.000

Formal education has the biggest and most significant contribution (beta = 0.324, p = 0.001) on the adoption of fertilizer package. This is followed by other independent variables like age of the respondents and farm size, which also have significant effects on the adoption behaviour. Area under maize and sex of the respondents have the least influence on the adoption of fertilizer package adoption. Their contributions are still significant at 3 percent and 8 percent levels of probability, respectively.

Despite that the contribution of all independent variables on adoption behaviour is highly significant, the regression coefficient represented by R^2 = 0.329, p = 0.000 is very low. This implies that the independent variables entered into the model account for only 32.9 percent of the adoption behaviour variance. However, this contribution is a little higher compared to that observed in individual practice like phosphate (24.8 percent) and nitrogen fertilization (29.5 percent).

8.1 INTERVENING VARIABLES

8.3.1 Efficiency misperception (EM)

How a farmer perceives the efficiency of fertilizer package adoption is expected to have influence on his/her adoption behaviour in several ways namely; non-or low adoption, medium or full adoption of this practice. The relationship between EM and adoption is summarized in Table 8.7

Table 8.7: Distribution of the respondents according to the efficiency misperception (EM) and the adoption of fertilization (total fertilizer package)

Efficiency perception Assessment	Fertilization categories <6 n	%	6-10 n	%	>10 n	%	Total N	%
Underrate	0	0.0	0	0.0	8	100.0	8	7.1
Slightly underrate	0	0.0	7	35.0	13	65.0	20	17.7
Assess correctly	0	0.0	10	45.5	12	54.5	22	19.5
Slightly overrate	15	33.3	24	53.3	6	13.3	45	39.8
Overrate	13	72.2	5	27.8	0	0.0	18	15.9
Total	28	24.8	46	40.7	39	34.5	113	100.0

χ^2 =66.055; df = 8; p=0.000

r= -0.685; p=0.000

Very few respondents (19.5 percent) assessed their current efficiency of total fertilizer package adoption correctly. The large majority, 55.7 percent overrate or perceive their current situation of phosphate, nitrogen and time of nitrogen fertilizer application to be higher than it really is. This probably contributes to their poor adoption of the package. For example not a single respondent who overrated his/ her adoption efficiency applied the recommended fertilization.

On the other hand, all the respondents who underrated their fertilizer application were among the adopters. This might be due to the fact that they were not satisfied with their fertilizer programmes and perceived them to be inferior to the recommended one. These findings are supported by a highly significant negative correlation (r = -0.685; p = 0.000) between the efficiency misperception and the adoption behaviour. The negative correlation coefficient observed here and in other fertilization practices indicates that the more farmers misperceive or overrate their practice adoption efficiency, i.e. perceive it to be better than it really is, the lower the adoption tends to be. The influence of efficiency misperception is highly significant in all fertilization practices but is more evident in total fertilization package (r= - 0.685, p=0.000) and nitrogen fertilization (r= 0.695, p= 0.000) than in other fertilization practices.

8.3.2 Need tension (NT)

Need tension (NT) is another key intervening variable that has been found to have significant influences on the adoption of the various individual fertilization practices and is expected to have a similar influence on the total fertilization package. Table 8.8 summarizes the results in this regard.

Table 8. 8: Relationship between Need Tension (NT) and the adoption of fertilization (total fertilizer package)

Need tension	Fertilization categories							
	<6		6-10		>10		Total	
	n	%	n	%	n	%	N	%
Low Need tension	27	64.3	15	35.7	0	0.0	42	37.2
Medium Need tension	1	4.5	19	86.4	2	9.1	22	19.5
High Need tension	0	0.0	12	24.5	37	75.5	49	43.4
Total	28	24.8	46	40.7	39	34.5	113	100.0

χ^2 =99.398; df = 4; p=0.000

r= 0.819, p= 0.000

All the respondents (42) with a low need tension, did not adopt the fertilizer package. On the other hand, not a single respondent among the 49 respondents with a high need tension was among the worst adopters (scale point of <6). This is indicative of a very close relationship, as is further supported by the highly significant chi-square and correlation coefficient of χ^2 =99.398; and r=0.819, respectively. This reflects that the adoption of fertilizer package consisting of phosphate, nitrogen and time of nitrogen application in the study area increases with the increase in need tension. In this case the NT seems to contribute more significantly to the adoption behaviour of maize growers as far as the total package is concerned than the individual fertilization practices.

8.3.3 Need compatibility

Table 8. 9: Relationship between need compatibility (NC) and the adoption of fertilization (total fertilizer package)

Need compatibility	Fertilization categories							
	<6		6-10		>10		Total	
	n	%	n	%	n	%	N	%
Low need compatibility	20	35.7	33	58.9	3	5.4	56	49.6
Medium need compatibility	1	3.8	8	30.8	17	65.4	26	23.0
High need compatibility	7	22.6	5	16.1	19	61.3	31	27.4
Total	28	24.8	46	40.7	39	34.5	113	100.0

χ^2 =44.572; df = 4; p=0.000

r= 0.429, p= 0.000

The majority of the respondent farmers (49.6 percent) perceive a low need compatibility between the suggested fertilization package and their need situation and hence have a low level of adoption. Only 5.4 percent of these respondents applied the recommended fertilizer package while 61.3 percent of those with high need compatibility had adopted.

This is indicative of a highly significant positive correlation (r = 0.429, p = 0.000) between need compatibility and adoption behaviour (Table 9.9), implying that the more fertilizer package is perceived to be compatible with the farmers needs the higher the adoption tends to be. The low adoption observed in the study could largely be attributed to the fact that the package is not perceived as a means of improving maize yield.

8.3.4 Awareness

According to Table 8.10 below, awareness is another intervening variable that seems to have influence on adoption of total fertilizer package in the Njombe district.

Table 8. 10: Relationship between awareness and the adoption of fertilization (total fertilizer package)

Awareness	Fertilization categories							
	<6		6-10		>10		Total	
	n	%	n	%	n	%	N	%
Not aware	23	41.8	25	45.5	7	12.7	55	48.7
Aware	5	8.6	21	36.2	32	55.2	58	51.3
Total	28	24.8	46	40.7	39	34.5	113	100.0

χ^2 =27.885; df = 2; p=0.000

r= 0.495, p= 0.000

Almost half of the respondents (48.7 percent) lack knowledge of the recommended fertilizer package in their area, signifying that only 51.3 percent of the respondents seem to be aware of the recommended package. The results show that there is a highly significant positive correlation (r=0.495, p=0.000) between awareness of the recommended fertilization package and its adoption, implying that awareness of required fertilizer package in maize production tends to lead to a higher adoption.

For example 55.2 percent of the respondents that are aware of the fertilization package needed to fertilize maize fields in their area had adopted but only 12.7 percent of those who had no knowledge did so. As in the case of NT the awareness of solutions seem to be more important in determining the adoption of total fertilization package than in the case of individual fertilization practices.

8.3.5 Prominence

The study model contends that the more the total fertilizer package is perceived to be relatively better than the traditional practices the higher its adoption is likely to be. The findings relating to the relationship between awareness and farmers adoption behaviour are represented in Table 8.11

Table 8. 11: Relationship between prominence and the adoption of fertilization (total fertilizer package)

Prominence	Fertilization categories							
	<6		6-10		>10		Total	
	n	%	n	%	n	%	N	%
Low prominence	22	71.0	9	29.0	0	0.0	31	27.4
Medium prominence	3	11.1	23	85.2	1	3.7	27	23.9
High prominence	3	5.5	14	25.5	38	69.1	55	48.7
Total	28	24.8	46	40.7	39	34.5	113	100.0

χ^2 =91.495; df = 4; p=0.000

r= 0.748, p= 0.000

As shown in Table 8.11, the majority of the respondents (72.6 percent) perceived the recommended fertilizer package to have a medium or high prominence relative to their own practices. None of the 27.4 percent respondents regarding the package to have low prominence (in other words not perceiving the recommended package to be better than the own or traditional fertilization), adopted it.

This clear relationship between perceived prominence and adoption is also reflected in the highly significant correlation coefficient (r=0.637, p=0.000), signifying that the perceived prominence clearly seems to have an influence on the adoption of recommended fertilizer package in the study area.

8.3.6 Perceived advantages and disadvantages of fertilization

The perceived advantages and disadvantages of the recommended fertilizer package are assumed to have a significant influence on farmer's adoption decision or behaviour. The perceived advantages are discussed first followed by the perceived disadvantages.

8.3.6.1 Perceived advantages

Farmers were asked to list the advantages of the recommended fertilizer application in their maize fields. The most important advantages mentioned are high yield, growth facilitation, good grain quality and high yield of maize plant residues (Table 8.12).

The perception of the various attributes vary form strongly positive to negative, meaning that certain attributes are seen as highly positive by some respondents while others perceive the same as negative. In both cases this perception influences the adoption behaviour. For example, the negative interpretations of attributes are only found among the non-adopters or those at a low level of adoption. This applies to high or increased yield, growth facilitation and good grain quality. The opposite also applies, namely that none of the low adopters perceived any of the mentioned attributes as highly positive.

From the distributions in Table 8.12 is can further be concluded that the more positive the attributes are assessed, the higher is the level of adoption. This applies more specifically to the major advantages of higher yield and growth facilitation, but is a little less conspicuous in the case of grain quality and high yield of maize plant residues. These clear relationships also find manifestation in the correlation coefficients, which are all highly significant.

Table 8. 12: Relationship between perceived advantages and the adoption of fertilization (total fertilizer package)

Attributes forces (strength)	Fertilization categories <6		6-10		>10		Total	
	n	%	n	%	n	%	N	%
High yield								
Negative	11	39.3	3	6.5	0	0.0	14	12.4
Low positive	16	57.1	24	52.2	0	0.0	40	35.4
Med positive	1	3.6	7	15.2	2	5.1	10	8.8
High positive	0	0.0	12	26.1	37	94.9	49	43.4
Total	28	24.8	46	40.7	39	34.5	113	100.0
χ^2 =86.431; df = 6; p=0.000; r= 0.795, p= 0.000								
Growth facilitation								
Negative	3	10.7	1	2.2	0	0.0	4	3.5
Low positive	21	75.0	28	60.9	2	5.1	51	45.1
Med positive	4	14.3	4	8.7	1	2.6	9	9.0
High positive	0	0.0	13	28.3	36	92.3	49	43.4
Total	28	24.8	46	40.7	39	34.5	113	100.0
χ^2 =66.552; df = 6; p=0.000; r= 0.711, p= 0.000								
Good grain quality								
Negative	2	7.1	0	0.0	0	0.0	2	1.8
Low positive	21	75.0	35	76.1	8	20.5	64	56.6
Med positive	5	17.9	9	19.6	7	17.9	21	18.6
High positive	0	0.0	2	4.3	24	61.5	26	23.0
Total	28	24.8	46	40.7	39	34.5	113	100.0
χ^2 =58.404; df = 6; p=0.000; r= 0.612, p= 0.000								
High yield of maize plant residues								
Low positive	28	100.0	46	100.0	33	84.6	107	94.7
Med positive	0	0.0	0	0.0	4	10.3	4	3.5
High positive	0	0.0	0	0.0	2	5.1	2	1.8
Total	28	24.8	46	40.7	39	34.5	113	100.0
χ^2 =12.023; df =4; p=0.017; r= 0.263, p= 0.005								

8.3.6.2 Perceived disadvantages

It is expected that the perceived disadvantages associated with the implementation of the fertilizer package will hinder its adoption. Farmers were therefore asked to list the disadvantages of applying phosphate, nitrogen and time of nitrogen fertilization in the maize fields. The most important disadvantages mentioned are poor grounding quality of grain, high labour requirements, pest attack and wastage of money (Table 8.13).

Table 8. 13: Relationship between perceived disadvantages and the adoption of fertilization (total fertilizer package)

	Fertilization categories							
	<6		6-10		>10		Total	
Attributes forces (strength)	**n**	**%**	**n**	**%**	**n**	**%**	**N**	**%**
Poor grounding quality								
Low negative	26	92.9	46	100.0	39	100.0	111	98.2
High negative	2	7.1	0	0.0	0	0.0	2	1.8
Total	28	24.8	46	40.7	39	34.5	113	100.0
χ^2 =6.181; df = 2; p=0.045; r= -0.193, p= 0.041								
High labour requirement								
Low negative	25	89.3	42	91.3	39	100.0	106	93.8
High negative	3	10.7	4	8.7	0	0.0	7	6.2
Total	28	24.8	46	40.7	39	34.5	113	100.0
χ^2 =4.055; df = 2; p=0.132; r= -0.177, p= 0.061								
Pest attack								
Low negative	25	89.3	42	91.3	38	97.4	105	92.9
High negative	3	10.7	4	8.7	1	2.6	8	7.8
Total	28	24.8	46	40.7	39	34.5	113	100.0
χ^2 =1.954; df = 2; p=0.376; r= -0.126, p= 0.185								
Wastage of money								
Low negative	21	75.0	34	73.9	36	92.3	91	80.5
High negative	7	25.0	12	26.1	3	7.7	22	19.5
Total	28	24.8	46	40.7	39	34.5	113	100.0
χ^2 =5.281; df =2; p=0.071; r= -0.180, p= 0.057								

Except poor grounding quality that signifies that adopters and non-adopters perceive this attribute completely differently, other disadvantages like high labour requirement and pests attack perceived by both groups of farmers as important factors that influence adoption. The difference lies in the fact that the adopters are more inclined to rate the negative attributes as low negative, whilst the non-adopters or low adopters are more inclined to perceive certain disadvantage as highly negative. This seems to indicate that the adopters are equally aware of disadvantages but they have overcome them, and although they may have been critical in terms of adoption behaviour, they no longer play a critical role. It would appear that those respondents who assess an attribute as highly negative, that perception is likely to be critical as far as their decision-making or adoption is concerned.

A further analysis was carried out to determine the influence of the total attributes of recommended maize varieties in terms of their total numbers and total weightings on adoption behaviour. The attributes considered include total number of advantages, total number of disadvantages, the difference between total number advantages and total number disadvantages, total number positive forces, total number negative forces, the difference between total number positive and total number negative forces (Table 8.14).

The findings in Table 8.14 indicate a highly significant correlation (r= 0.648, p=0.000) between the adoption and the total numbers and weightings of advantages represented by the correlation coefficient of r = 524 and r = 577, respectively. This clearly shows that the awareness of advantages is closely related to adoption. In other words, the more farmers are aware and even perceive the advantages of the fertilizer package as important in their adoption decision- making, the higher its adoption tends to be.

As far as the disadvantages expressed as the total numbers and total fertilizer package adoption are concerned, there is no correlation (r = 0.028; p=0.770) between the two variables. The reason for this non-significant correlation is a non-linear distribution with the middle adoption group being aware of the most disadvantages, followed by the group with the highest level of adoption. When expressed as total forces, this correlation even becomes negative (r = -0.006; p=0.951), which is indicative of the

Table 8. 14: Relationship between different categories of adoption and the total numbers and weightings of advantages and disadvantages of the fertilizer package

Total attributes	Perceived total numbers of advantages/disadvantages			Perceived total weightings of advantages/disadvantages		
	<6	**6-10**	**>10**	**<6**	**6-10**	**>10**
Total advantages	50	119	133	102	427	557
	r = 0.524 ; p=0.000			r = 0.577; p=0.000		
Total disadvantages	102	175	147	384	747	612
	r = 0.028; p=0.770			r = 0.104; p=0.271		
Total advt.- disadvt.	-52	-56	-14	-282	-320	-55
	r = -0.291; p=0.002			r = -0.353; p=0.000		
Total positive forces	47	119	132	8	275	539
	r = 0.532; p=0.000			r = 0.764; p=0.000		
Total negative forces	104	171	144	351	581	344
	r = -0.006 ; p=0.951			r = -0.259; p=0.006		
Total(+)-(-) forces	-57	-52	-12	-343	-306	195
	r = 0.322; p=0.001			r = 0.647; p=0.000		

phenomenon that adopters are as aware, if not more aware of the disadvantages than the non-adopters, probably because they have gone through the adoption process and are still fully aware of the constraints, but have probably overcome them. This could imply that to them these disadvantages are mere disadvantages and no longer represent forces of change.

Ultimately the combination of positive and negative forces should determine whether or not change (adoption) will take place. Where these are combined, the correlations are highly significant, both as far as the number of advantages/disadvantages ($r = 0.322$; $p=0.001$) and weighted values ($r = 0.647$; $p=0.000$) are concerned, which further confirms the relationship between the perceived advantages and disadvantages and the adoption behaviour. For full adoption there needs to be a positive imbalance of positive over negative forces and this in fact the case with weighted forces. Only the full adopters have a positive imbalance of positive over negative forces, namely 195, while all the other categories have a very strong negative imbalance. This does indicate that the non-adopters still need much persuasion before deciding to fully adopt.

8.3.7 Total influence of intervening variables

The total influence of all tested intervening variables is assessed here by means of showing not only the influence of the individual intervening variable, but also their total or aggregate influence on the adoption behaviour. The results of the linear regression model used for this purpose are presented in Table 8.15 below.

Table 8. 15: Linear regression analysis showing the relationship between intervening variables and adoption

Variable	Beta	t	p
Constant		0.474	0.637
Efficiency misperception	-0.148	-2.294	0.024
Need tension	0.348	4.370	0.000
Need compatibility	-0.123	-2.314	0.023
Awareness	0.075	1.444	0.152
Prominence	0.155	2.135	0.035
High yield	0.210	2.273	0.025
Facilitate growth	0.149	2.127	0.036
High stover yield	0.073	1.621	0.108
Good grain quality	0.065	1.110	0.270
Poor hauling quality of grain	-0.037	-0.818	0.415
High labor requirement	0.002	0.040	0.968
Pests attack	0.120	2.496	0.014
Wastage of money	-0.055	-1.139	0.257

R^2 =0.82, p=0.000

The intervening variables entered into the model contribute very significantly to the adoption of total fertilizer package. According to Table 8.15 they explain 82 percent of the variation in adoption (R^2 =0.82, p=0.000). As far as the individual intervening variables are concerned, most of them as clearly seen in Table 8.15 contribute significantly to the adoption behaviour but the need tension (Beta 0.348, p=0.000) makes the biggest contribution. Although the intervening variables demonstrate high contribution to the adoption of each fertilization practice, the contribution is even more in the case of the total fertilization package.

8.4 COMPARISONS BETWEEN INDEPENDENT AND INTERVENING VARIABLES

Compared to individual independent variables each intervening variable has a significantly bigger influence on adoption behaviour if the correlation coefficients are used as criterion. In addition, the total influence of intervening variables on the adoption behaviour far outweighs that of the independent variables in terms of the percentage variation explained. The intervening variables explain 82 percent of the variation in total fertilizer package adoption as opposed to the 32.9 percent contributed by the independent variables (Fig 8.2).

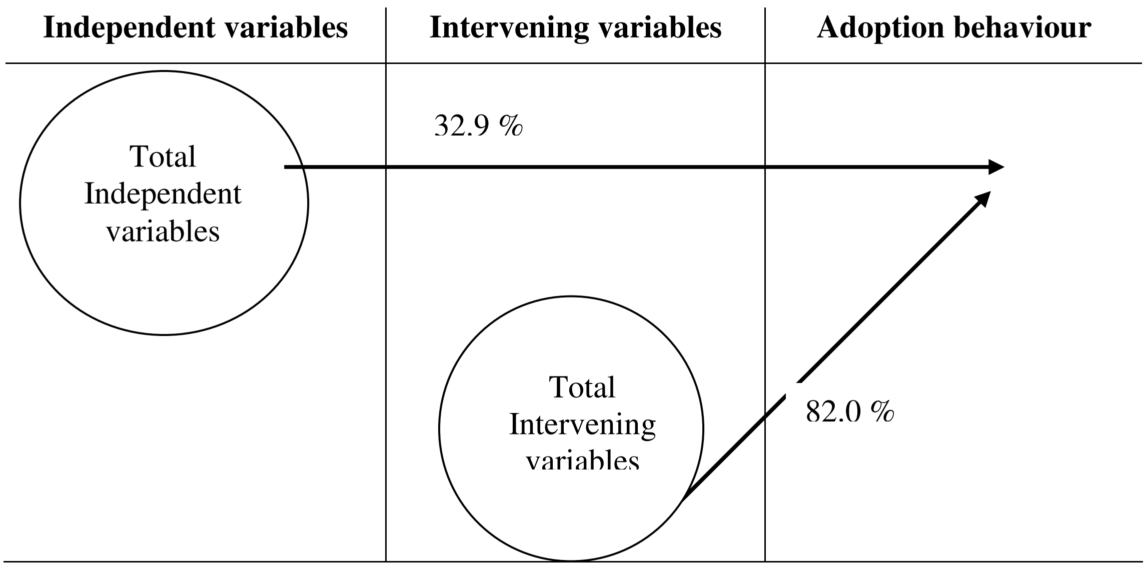

Figure 8. 1: Comparative contribution of independent and intervening variables on adoption behaviour in respect of fertilization

CHAPTER 9

THE ROLE OF INDEPENDENT AND INTERVENING VARIABLES ON THE ADOPTION OF SEED SPACING

9.1 INTRODUCTION

The seed spacing as measured in this study does not significantly influence the production efficiency or yield (see Chapter 4). As said earlier, the results might be inaccurate either because of 1) the wrong estimations of the seed spacing used due to the fact that most of the respondents use step or foot measures estimations instead of the recommended rope or stick. 2) the inappropriateness of the seed spacing recommendations 3) the scale used for its measurement.

The recommended spacing for full season varieties of maize is 25-30 cm by 75-90 cm with one plant per hill or 25-30 cm by 75-90 cm planting two plants of maize per hill but most of the surveyed respondents used one seed. Due to this the analyses and discussion focus on the independent and intervening factors or variables that influence the adoption of seed spacing among this group of farmers only.

9.2 INDEPENDENT FACTORS

9.2.1 Age

Table 9.1 shows the survey results of the relationship between age of the respondents and their adoption of seed spacing.

Although the results show significant differences between the age groups in terms of adoption of seed spacing (χ^2 = 9.750; df=4; p=0.045), the correlation is not significant at ($p > 0.05$), and can be attributed to the fact that the relationship is not quite linear as seen in Table 9.1. It is only among the youngest group of farmers where there is an increased tendency towards a higher plant population or seeding rate, while there is no difference between the groups above the age of 36 years.

For example, 12 percent of the youngest group of farmers opted for the highest plant population, while none of the older farmers made this choice.

Table 9. 1: Distribution of respondents according to their age and their adoption of seed spacing

Seed spacing (cm)	Population/ acre (x 1000)	Age (years) <36 n	%	36-56 n	%	>56 n	%	Total N	%
<20 x <60	40-45	3	12.5	0	0.0	0	0.0	3	3.2
20-25 x 60-75	30-35	13	54.2	26	52.0	11	52.4	50	52.6
25-30 x 75-90	20-25	8	33.3	24	48.0	10	47.6	42	44.2
Total		24	25.3	50	52.6	21	22.1	95	100.0

χ^2 = 9.750; df=4; p=0.045

r = 0.173; p=0.094

9.2.2 Sex

An analysis of the relationship between sex and the adoption of seed spacing is provided in Table 9.2.

Table 9. 2: Distribution of respondents according to their sex and the adoption of seed spacing

Seed spacing (cm)	Population/acre (x 1000)	Sex Male n	%	Female n	%	Total N	%
<20 x <60	40-45	0	0.0	3	8.1	3	3.2
20-25 x 60-75	30-35	29	50.0	21	56.8	50	52.6
25-30 x 75-90	20-25	29	50.0	13	35.1	42	44.2
Total		58	61.1	37	38.9	95	100.0

χ^2 = 6.028; df=2; p=0.049

r = -0.203; p=0.049

According to Table 9.2 there is a negative correlation (r=-0.203; p=0.049) between sex of the respondents and adoption. The negative correlation suggests that male farmers tend to have higher adoption rates as far as seed spacing or plant population is concerned. For example 50.0 percent male farmers used the required spacing with 20 000 - 25 000 plants population per acre compared to only 35.1 percent female farmers. Similarly amongst the lowest adopters is not a single male farmer but 8.1 percent female farmers.

9.2.3 Formal education

Table 9.3 summarizes the distribution of the respondent farmers according to their formal education and maize seed spacing.

Table 9. 3: Distribution of respondents according to their formal education and seed spacing

Seed spacing (cm)	Population/ acre (x 1000)	Formal education							
		None		1-7		>7		Total	
		n	%	n	%	n	%	N	%
<20 x <60	40-45	0	0.0	1	1.8	2	9.1	3	3.2
20-25 x 60-75	30-35	9	52.9	35	62.5	6	27.3	50	52.6
25-30 x 75-90	20-25	8	47.1	20	35.7	14	63.6	42	44.2
Total		17	17.9	56	58.9	22	23.2	95	100.0

χ^2 = 9.871; df=4; p=0.043
r = 0.058; p=0.576

Although the chi-square test on this variable is statistically significant at five percent probability level, the correlation is not significant (r= 0.058; p=0.576) meaning that there is no relationship between formal education and the adoption behaviour. This can be attributed to the fact that the relationship is not linear.

This non-linear relationship is evident in the fact that both the lowest and highest qualification groups have higher adoption rates than the middle group. Evidence of the non-linear relationship is the percentages of the different age groups who used the proper seed spacing and number of plant population (Table 9.3).

This is in support of inconsequent influence of education referred to by CIMMYT (1993), namely that "the adoption of an innovation or technology among farmers may not depend at all on their education level, while the adoption of a chemical input (if it needs computations) may be rapid among farmers who have a certain minimum level of education." However, if there are question marks regarding the appropriateness of the seed spacing recommendations, it cannot be expected that education will correlate significantly with seeding rate.

9.2.4 Farm size

Table 9.4 summarizes the survey results regarding the relationship between farm size and the adoption of seed spacing.

Table 9. 4 Distribution of respondents according to their farm size and the adoption of seed spacing

Seed spacing (cm)	Population/ acre (x 1000)	Farm size <3		Farm size 3-6		Farm size >6		Total	
		n	%	n	%	n	%	N	%
<20 x <60	40-45	2	6.7	1	2.4	0	0.0	3	3.2
20-25 x 60-75	30-35	14	46.7	26	63.4	10	41.7	50	52.6
25-30 x 75-90	20-25	14	46.7	14	34.1	14	58.3	42	44.2
Total		30	31.6	41	43.2	24	25.3	95	100.0

χ^2 = 5.714; df=4; p=0.222

r = 0.113; p=0.275

Also in the case of farm size there is no significant relationship with seed spacing. It is perhaps worth noting not a single farmer in the biggest farm size category applied the high seeding rate, which is the least recommended one.

9.2.5 Area under maize

The area under maize is closely correlated with farm size (r = 0.471, p = 0.000) and consequently similar results are expected. These results are summarised in Table 9.5 and show the relationship between the area under maize production and seed spacing.

Table 9.5: Distribution of respondents according to their area under maize and the adoption of seed spacing

Seed spacing (cm)	Population/ acre (x 1000)	Area under maize 0.1-1		1.1-3		>3		Total	
		n	%	n	%	n	%	N	%
<20 x <60	40-45	0	0.0	3	5.5	0	0.0	3	3.2
20-25 x 60-75	30-35	7	38.9	34	61.8	9	40.9	50	52.6
25-30 x 75-90	20-25	11	61.1	18	32.7	13	59.1	42	44.2
Total		18	18.9	55	57.9	22	23.2	95	100.0

χ^2 = 8.189; df=4; p=0.085

r = 0.011; p=0.919

These findings (Table 9.5) resemble those of farm size (Table 9.4) in that area under maize also reveals no linear relationship with seed spacing, when using the correlation coefficient as criterion (r = 0.011; p=0.919). In this case the non-linear distribution is even more pronounced, which becomes evident if the significantly poorer adoption of the middle group (with 1 to 1.3 acres under maize) is compared with the groups with less and more maize. An alternative explanation for the absence of a relationship is the possible inappropriateness of seed spacing recommendations as manifested in the scale used to assess the efficiency of seed spacing as a production practice in maize production.

9.2.6 Total influence of all independent variables

The comparative and total influence of the different independent variables on seed spacing are reflected in Table 9.6.

Table 9.6: Total influence of all independent variables on adoption of seed spacing

Variable	Beta	t	p
(Constant)		6.465	0.000
Sex	-0.138	-1.164	0.247
Age	0.148	1.165	0.247
Formal education	0.066	0.525	0.601
Farm size	0.028	0.223	0.824
Area under maize	-0.014	-0.121	0.904

$R^2 = 0.060$, p = 0.343

The total contribution of the tested independent variables on the adoption behaviour variance is only 6.0 percent and also not significant (p = 0.343). This seems to imply that the independent variables investigated are not very much important in determining the adoption behaviour as far as seed spacing is concerned.

9.3 INTERVENING VARIABLES

9.3.1 Efficiency misperception (EM)

In order to have a better understanding of farmers' perception of their current efficiency of practice adoption in this case the proper seed spacing, farmers were asked to indicate their current efficiency regarding this practice. This assessment was then compared with the adoption score in order to establish whether or not and to what degree they tend to overrate their current seed spacing efficiency. The assumption here is that the efficiency misperception (EM) could lead to non-adoption or irrational decision making. Table 9.7 summarizes the findings.

About 44 percent of the respondents perceived their current situation of practice adoption correctly, meaning that their responses agreed with the assumed "objective" assessment based on the adoption scale, while 41.1 percent tend to overrate their efficiency. What is conspicuous is that none of the respondents overrating their efficiency, adopted the recommended seeding rate, while 75 percent of those

Table 9.7: Distribution of respondents according to their efficiency misperception (EM) and the adoption of seed spacing

Seed spacing (cm)	Population/ acre (x 1000)	Efficiency perception assessment											
		Underrate		Slightly underrate		Assess correctly		Slightly overrate		Overrate		Total	
		n	%	n	%	n	%	n	%	n	%	N	%
<20x<60	40-45	0	0.0	0	0.0	0	0.0	2	5.3	1	100.0	3	3.2
20-25x 60-75	30-35	1	25.0	4	40.0	9	21.4	36	94.7	0	0.0	50	52.6
25-30x 75-90	20-25	3	75.0	6	60.0	33	78.6	0	0.0	0	0.0	42	44.2
Total		4	4.2	10	10.5	42	44.2	38	40.0	1	1.1	95	100.0

χ^2 = 83.859; df=8; p=0.000

r = -0.586; p=0.000

underrating their own seeding rate efficiency, adopted the recommended seeding rate. This is an indication of a significant relationship between the EM and adoption and is supported by the highly significant correlation coefficient (r = -0.586; p=0.000). The more farmers misperceive or overrate their efficiency of practice adoption to be better than it really is, the lower the incentive to change their behaviour towards what is recommended.

9.3.2 Need tension (NT)

Need tension is not independent of the perceived current efficiency (PCE) in that it refers to the total discrepancy or difference between the potential and the current efficiency or PCE. It is therefore expected that the more farmers overrate their current situation of seed spacing to be better than the factual the more the need tension is reduced and consequently the lower the adoption, and *visa versa*. The results of the relationship between need tension and seed spacing are presented in Table 9.8.

Table 9 8: Distribution of respondents according to their Need tension (NT) and the adoption of seed spacing

Seed spacing (cm)	Population/ acre (x 1000)	Need tension (NT) categories							
		Low NT		Medium NT		High NT		Total	
		n	%	n	%	n	%	N	%
<20 x <60	40-45	3	100.0	0	0.0	0	0.0	3	3.2
20-25 x 60-75	30-35	0	0.0	49	98.0	1	2.4	50	52.6
25-30 x 75-90	20-25	0	0.0	1	2.0	41	97.6	42	44.2
Total		3	3.2	50	52.6	42	44.2	95	100.0

χ^2 =181.859; df=4; p=0.000

r = 0.966; p=0.000

As shown in Table 9.8 the need tension or problem scope, as far as seed spacing is concerned, is reasonably high in that about 52.6 percent and 44.2 percent of the respondents seem to have medium and high need tensions respectively. Both the chi-square and correlation analyses indicate that there is a highly significant association between NT and adoption of the recommended seed spacing.

This almost perfect linear relationship is reflected in the correlation of 0.966, signifying that the higher the need tension the higher the adoption rates tend to be. This close relationship is further supported by the fact that 97.6 percent of the respondent with high NT had adopted while the percentage of those with medium and low NT is 0.0 percent and 2.0 percent respectively. On the other hand, all the respondents with a low NT seem to have a poor seeding rate adoption, namely a high plant population of more than 40 000 plants per acre.

9.3.3 Awareness

The surveys went further to investigate whether farmers had knowledge or were aware of the recommendation regarding the plant population per acre. The responses are summarized in Table 8.9 below.

Table 9.9: Distribution of respondents according to their awareness of the recommendation and their adoption of seed spacing

Seed spacing (cm)	Population/acre (x 1000)	Awareness: Not aware n	%	Aware n	%	Total N	%
<20 x <60	40-45	3	4.9	0	0.0	3	3.2
20-25 x 60-75	30-35	41	67.2	9	26.5	50	52.6
25-30 x 75-90	20-25	17	27.9	25	73.5	42	44.2
Total		61	64.2	34	35.8	95	100.0

χ^2 = 18.853; df = 2; p=0.000

r = 0.439; p=0.000

According to Table 9.9 the overwhelming majority (64.2 percent) of maize growers in the Njombe district are not aware of the number of maize plants per acre recommended for that area and thus can hardly be expected to implement it. This unawareness finds its expression in a highly significant correlation of $r = 0.439$ ($p = 0.000$) showing that there is a positive relationship between awareness and adoption decision or behaviour. For example 73.5 percent of the respondents that were aware of recommended seed spacing had adopted while only 27.9 percent who had no knowledge of it did so.

9.3.4 Prominence

An overview of how prominent or how relatively more advantageous farmers perceive the recommended seed spacing to be in comparison with their own practice is summarized in Table 9.10.

Table 9.10: Distribution of respondents according to their perceived prominence of the recommended seed spacing and their adoption of it.

Seed spacing (cm)	Population/ acre (x 1000)	Prominence							
		Low prominence		Medium prominence		High prominence		Total	
		n	%	n	%	n	%	N	%
<20 x <60	40-45	2	28.6	1	2.2	0	0.0	3	3.2
20-25 x 60-75	30-35	4	57.1	43	93.5	3	7.1	50	52.6
25-30 x 75-90	20-25	1	14.3	2	4.3	39	92.9	42	44.2
Total		7	7.4	46	48.4	42	44.2	95	100.0

$\chi^2 = 87.338$; df=4; p=0.000

r = 0.792; p=0.000

The large percentage (44.2) regard low plant populations (20 000 to 25 000 plants per acre) as more prominent and thus better than high plant populations for improving maize yields. 92.9 percent of them are implementing these low plant populations, which indicate at the close relationship between the perceived prominence and adoption. Furthermore, not a single respondent with a high prominence, had a high plant population. This close relationship is further supported by the highly significant correlation coefficient of 0.792 ($p = 0.00$) between the perceived prominence and adoption.

9.3.5 Total influence of intervening variables

The results of all the intervening variables entered into the regression model are presented in Table 9.11 below.

Table 9.11: Influence of intervening variables on adoption of seed spacing

Variable	Beta	t	p
(Constant)		9.896	0.000
Efficiency misperception	-0.067	-2.047	0.044
Need tension	0.923	17.261	0.000
Awareness	-0.038	-1.181	0.241
Prominence	0.028	0.557	0.579

$R^2 = 0.936$; $p = 0.000$

According to Table 9.11 the greatest contribution to the adoption behaviour (beta = 0.923; p = 0.000) comes from the NT. In totality, all the intervening variables contribute highly significantly and explain as high as up to 93.6 percent of the variation in the adoption behaviour. Based in these findings, the following part provides a brief summary of the relative importance of the independent and intervening variables in explaining the adoption behaviour of the respondent farmers as far as seed spacing is concerned.

9.4 COMPARISONS BETWEEN INDEPENDENT AND INTERVENING VARIABLES

Figure 9.1 demonstrates the overall contributions of independent and intervening variables on the adoption behaviour of maize growers.

It is apparent that the contribution from the independent variables is not significant and yet very small (6.0 percent) when compared to the close and highly significant contribution of the intervening variables (93.6 percent). This implies that the intervening variables seem to have a very high influence on the adoption of seed spacing in the study area.

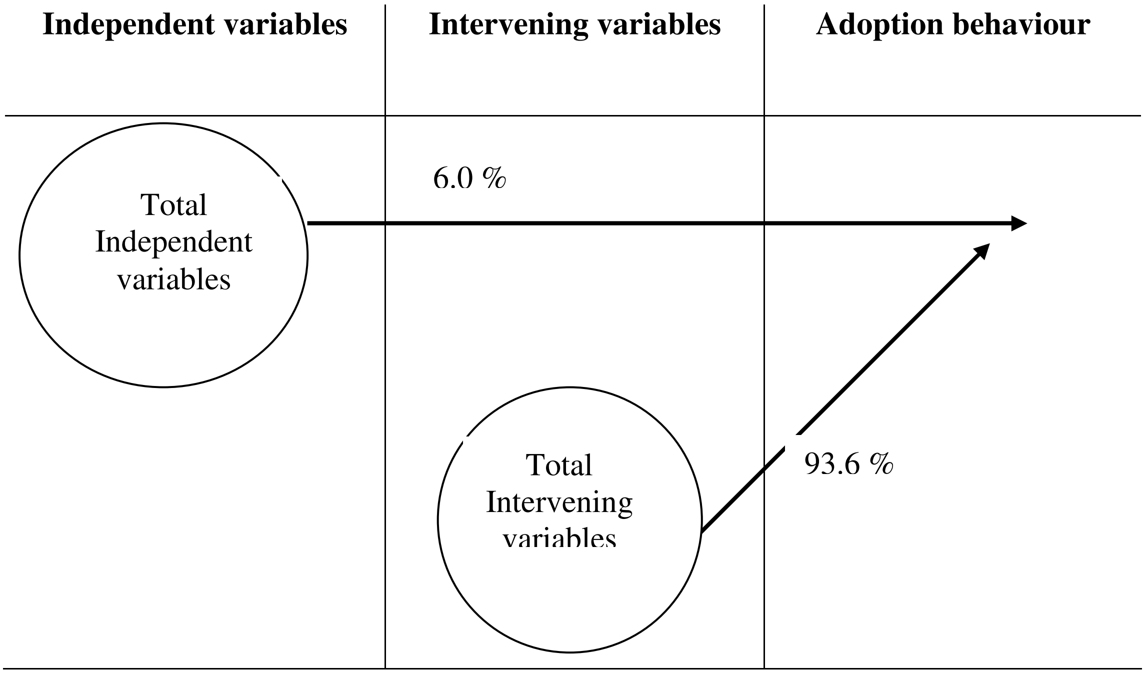

Figure 9.1: Comparative contribution of independent and intervening variables on adoption behaviour