CHAPTER 6

INTERVENING VARIABLES AND THEIR INFLUENCE ON PRODUCTION EFFICIENCY AND ADOPTION

6.1 INTRODUCTION

In view of the hypothesis that the influence of intervening variables on the adoption behavior and production efficiency of respondents is higher than that of independent variables, and having discussed the influence of the latter in chapter five, the influence of intervening variables will now be assessed in this chapter. Their influence on production efficiency will first be evaluated followed by a discussion of their influence on adoption. Comparative analyses between the two sets of variables are also made with the object of identifying the most crucial factors to be considered in extension.

Intervening variables considered in this study are either need related (perceived current efficiency, need tension and need compatibility) or perception related (perceptions of technology attributes). These variables do not exist as such, but are related to and have to be assessed in association with the specific activities, technologies or practices under investigation. The variable, need tension, for example, can refer to the need tension of respondents' overall production efficiency in a specific commodity or to the practices under consideration.

6.2 INFLUENCE OF THE PERCEIVED CURRENT EFFICIENCY ON PRODUCTION EFFICIENCY

Production efficiency and adoption behavior are hypothesized to be a function of personal and environmental factors, which in turn are divided into independent and intervening variables. One of the intervening variables identified by Düvel (1975) and regarded to be one of the principal casual factors among the intervening variables in behavior determination is the perceived current efficiency (PCE), which can refer to the overall production efficiency or to the technology or practice adoption. Since this aspect or variable is one dimension of the total problem perception, it is expected to have a significant influence on adoption behavior. As the concept implies, it is the individual's perception of the current efficiency. According to Koch (1987:23) there is a tendency to overrate the current efficiency and it stands to reason that the more the current efficiency is overrated, the smaller the problem scope or need tension becomes and thus the smaller the incentive to change.

The more accurately a farmer perceives his problem, the more likely he is to appreciate the improvement potential, and the more likely he is to alter his behavior and thereby improve his production efficiency. This assumption (Koch, 1987:24; Düvel and Botha, 1999:47) led to the hypothesis that the inaccuracy of PCE, expressed as the degree to which the current efficiency is overrated, is negatively related to the adoption behavior and production efficiency of farmers in the study area.

Maize and dairy farmers were assessed regarding the "correctness" of their perception in respect of their current production efficiency and the efficiency of the production practices promoted through PADETES namely improved seeds, line planting, fertilizer, and spot application in maize, and breed, feed, medical, and housing practices in dairy.

6.2.1 Perception regarding the current production efficiency

As shown in Table 6.1, the overwhelming majority of maize farmers (90.5 percent) do not perceive their efficiency or situation correctly in the sense that they slightly overrated (54 percent) or significantly overrated their production efficiency. In contradiction with the hypothesis, there is no relationship between the PCE and the actual production efficiency ($r = -0.075$, $p = 0.293$) although the χ^2 test reflects highly significant difference between the efficiency categories ($\chi^2 = 46.76$, $df = 8$, $p = 0.000$).

Table 6.1 Relationships between perceived current efficiency (PCE) and production efficiency as reflected in percentage distributions and a test of association

		Percentage distribution of farmers per efficiency category*						Association				
		1	2	3	4	5	Total					
Variable	Category	n=41	n=24	n=43	n=54	n=38	N=200	χ^2	p	df	r	p
Maize												
PCE-efficiency	No discrepancy	22	-	-	3.7	21.1	9.5					
	Slightly over rate	51.2	29.2	79.1	44.4	57.9	54					
	Over rate	26.8	70.8	20.9	51.9	21.1	36.5					
	Total	100	100	100	100	100	100	46.8	0.000	8	-0.08	0.293
PCE-fertilizer	Slightly under rate	-	4.2	20.9	33.3	23.7	18.5					
	No discrepancy	97.6	83.3	58.1	40.7	68.4	66.5					
	Over rate	2.4	12.5	20.9	25.9	7.9	15					
	Total	100	100	100	100	100	100	41.2	0.000	8	-0.10	0.147
PCE-spot	Slightly under rate	-	17	26	26	24	19					
	No discrepancy	95	79	63	52	63	68.5					
	Over rate	4.9	4.2	12	22	13	12.5					
	Total	100	100	100	100	100	100	25.2	0.001	8	-0.06	0.428
PCE-seed	Slightly under rate	-	4.2	16	24	29	16					
	No discrepancy	100	96	84	76	71	84					
	Total	100	100	100	100	100	100	17.7	0.001	4	-0.17	0.018
PCE-line planting	Slightly under rate	7.3	13	16	17	21	15					
	No discrepancy	76	67	70	57	58	65					
	Over rate	17	21	14	26	21	20					
	Total	100	100	100	100	100	100	6.4	0.606	8	-0.03	0.691
Dairy												
PCE-efficiency	Under rate	2.9	2.4	10	13	5.6	7					
	Slightly under rate	20	41	77	68	78	58					
	No discrepancy	77	56	13	20	17	35					
	Total	100	100	100	100	100	100	57.4	0.000	8	-0.43	0.000
PCE-breed	Slightly under rate	49	39	58	43	47	47.5					
	No discrepancy	31	41	33	38	31	35					
	Over rate	20	20	8.3	20	22	17.5					
	Total	100	100	100	100	100	100	6.1	0.636	8	0.02	0.809
PCE-housing	Slightly under rate	14	12	17	18	19	16					
	No discrepancy	26	41	48	23	33	35					
	Over rate	60	46	35	60	47	49					
	Total	100	100	100	100	100	100	10.0	0.267	8	-0.02	0.794
PCE-medical	Slightly under rate	26	37	42	43	36	37					
	No discrepancy	43	44	44	38	47	43					
	Over rate	31	20	15	20	17	20					
	Total	100	100	100	100	100	100	5.5	0.707	8	-0.06	0.382
PCE-feed	Slightly under rate	31	27	35	35	36	33					
	No discrepancy	49	66	58	53	25	51					
	Over rate	20	7.3	6.3	13	39	16					
	Total	100	100	100	100	100	100	25.1	0.002	8	0.05	0.508
	Frequency	35	41	48	40	36	200					

*1 = Least efficient, 5 = Most efficient

On close inspection it appears that the relationship is not linear but parabolic with the most accurate perceptions found in the most efficient and least efficient categories. The latter could be attributed to an attitude of resignation and for that reason an acceptance of the current inefficiency and consequently the more realistic assessment. Dairy farmers, on the other hand, had a better or more realistic perception of their current efficiency. 35 percent had correctly assessed their current production efficiency. 65 percent had underrated or slightly underrated their present level of efficiency. There was no single farmer who had overrated his present efficiency situation. In this case the difference is not in terms of overrating but rather the underrating of the own production efficiency (χ^2 = 57.37, df = 8, p = 0.000). If the degree of overrating is intended to also include the underrating (a negative overrating value), then the hypothesized tendency or correlation is evident (r = -0.430, p = 0.000) thereby supporting a hypothesis (Hypothesis 2.2), which states that not so much the accuracy of assessment (rating) but the degree of overrating of efficiency is negatively related to the real efficiency. The fact that efficient dairy farmers had underrated rather than overrated their current level of efficiency implies that the problem was perceived to be even higher than it really was and consequently the higher incentive to improve.

6.2.2 Perception regarding efficiency of production practices

Maize and dairy farmers have perceived their current efficiency of production practices more accurately than their production efficiency (Table 6.1). In both maize and dairy farming, they either underrate or slightly underrate their practice adoption efficiency. Only 12.5 to 20 percent of them overrated their current adoption level of these practices. The less efficient and efficient farmers are also significantly different in their problem perception of the majority of the practices included in maize package and to a lesser degree in the dairy package. The difference lies mainly in the phenomenon that the more efficient respondents tend to underrate their efficiency more than the less efficient producers do. For example, as far as the perception of seed adoption is concerned, there is a significant negative relationship (r = -0.167, p = 0.018) between perception of the efficiency of seed used (PCE-seed) and the production efficiency of maize farmers, implying that the more the respondents underrate the effectiveness or efficiency of their seed use, the better their adoption of recommended seed and production efficiency. The χ^2 analysis also reveals similar relationships. As far as perceived current efficiency regarding line planting is concerned, for example, there is significant variation among the various efficiency groups ($\chi^2 = 17.67$, df = 4, p = 0.001). While 15 percent of efficient farmers slightly underrate their efficiency, only 7.3 percent of the less efficient maize farmers slightly underrate their current line planting adoption efficiency implying that they have overrated their practice adoption efficiency more than the efficient ones.

6.3 INFLUENCE OF NEED TENSION ON PRODUCTION EFFICIENCY

The incentive or need related motive of a problem lies primarily in the perceived discrepancy between the current and the desired or potential situation. This problem scope is referred to as need tension (Düvel, 1991:80) and its assumed influence is based on various research findings (Koch, 1985:15; Düvel & Scholtz, 1986:4; Koch, 1987:24; Louw & Düvel, 1993:37; Botha, 1999:51; Düvel & Botha, 1999:47) and has led to the hypothesis that need tension is positively related to the adoption behavior and production efficiency of farmers in the study area.

6.3.1 Need tension regarding production efficiency

The need tension or need potential of maize farmers in the study area regarding production efficiency is quite appreciable, leaving some potential to be exploited. 53.5 percent of them were assessed to have a medium need tension while 30.5 percent have a high need tension or need potential. The need potential of dairy farmers on the other hand, was somewhat less in that 68 percent of the respondents were found to have a low need tension (Table 6.2). In the case of maize production efficiency there is a clear indication of a higher need tension among the low efficiency respondents ($\chi^2 = 26.44$, df = 8, p = 0.001; r = -0.329, p = 0.000). This negative correlation, also in the case of dairy farming efficiency (r = -0.234, p= 0.001) is opposite of what has been hypothesized

(Hypothesis 2.2, but could indicate that the need tension of the more efficient farmers had been higher but was partially satisfied with the subsequent increased production.

6.3.2 Need tension regarding production practices

As far as the need tension in respect of production practices is concerned, the same negative correlation is found with production efficiency at least as far as the great majority of maize production practices are concerned (Table 6.2). The absence of this tendency in dairy farming, namely that higher efficiency is associated with a lower need tension, may be attributable to the possible phenomenon that the practices analyzed are not perceived to be all that important in achieving higher efficiency.

Although not in accordance with the hypothesis (Hypothesis 2.2), the need tension can't be discarded as a poor predictor of production efficiency. A complication is that it is valid before behavior change, but that it disappears or decreases with need accomplishment or behavior change. Another complicating factor is that the need tension is not independent of the perceived current efficiency, which the less efficient farmers tend to overrate more than the more efficient ones, thus undermining or significantly reducing the present need tension.

Table 6.2 Relationship between need tension (NT) and production efficiency as reflected in percentage distributions and a test of association

		Percentage distribution of farmers per efficiency category*						Association				
		1	2	3	4	5	Total					
Variable	Category	n=41	n=24	n=43	n=54	n=38	N=200	χ^2	P	df	r	p
Maize												
NT-efficiency	Low	7.3	13	19	24	13	16					
	Medium	39	38	58	54	74	53.5					
	High	54	50	23	22	13	30.5					
	Total	100	100	100	100	100	100	26.4	0.000	8	-0.33	0.000
NT-fertilizer	Low	4.9	17	40	37	55	32					
	Medium	2.4	25	40	46	32	30.5					
	High	93	58	21	17	13	37.5					
	Total	100	100	100	100	100	100	86.7	0.000	8	-0.65	0.000
NT-spot	Low	7.3	21	42	48	53	36					
	Medium	12	8.3	37	39	39	29.5					
	High	80	71	21	13	7.9	34.5					
	Total	100	100	100	100	100	100	79.7	0.000	8	-0.52	0.000
NT-seed	Low	4.9	21	26	31	55	28					
	Medium	17	8.3	26	46	34	29					
	High	78	71	49	22	11	43					
	Total	100	100	100	100	100	100	61.4	0.000	8	-0.51	0.000
NT-line planting	Low	49	79	53	56	55	56.5					
	High	51	21	47	44	45	43.5					
	Total	100	100	100	100	100	100	6.2	0.184	4	-0.12	0.082
Dairy												
NT-efficiency	Low	51	71	63	73	83	68					
	High	49	29	38	28	17	32					
	Total	100	100	100	100	100	100	9.5	0.050	4	-0.23	0.001
NT-breed	Low	37	51	40	48	61	47					
	High	63	49	60	53	39	53					
	Total	100	100	100	100	100	100	5.6	0.231	4	-0.18	0.010
NT-housing	Low	43	49	31	38	39	39.5					
	Medium	49	41	48	45	47	46					
	High	8.6	9.8	21	18	14	14.5					
	Total	100	100	100	100	100	100	5.2	0.733	8	0.1	0.145
NT-medical	Low	29	46	29	40	33	35.5					
	Medium	37	34	46	38	47	40.5					
	High	34	20	25	23	19	24					
	Total	100	100	100	100	100	100	6.2	0.621	8	-0.05	0.472
NT-feed	Low	8.6	17	15	7.5	5.6	11					
	Medium	71	63	52	78	86	69					
	High	20	20	33	15	8.3	20					
	Total	100	100	100	100	100	100	14.9	0.061	8	-0.03	0.673
	Frequency (N)	35	41	48	40	36	200					

*1 = Least efficient, 5 = Most efficient

6.4 INFLUENCE OF NEED COMPATIBILITY (NC) ON PRODUCTION EFFICIENCY

Needs are accepted to be compatible if the realization of one will simultaneously or indirectly lead to the realization of another (Düvel, 1994:31). A specific innovation or practice is not compatible with the individual's need, if it is not perceived as need related, or a means towards achieving it (Düvel, 1991:80). Need compatibility, is therefore, assumed to be positively related with adoption behavior and the corresponding production efficiency (Hypothesis 2.2). Evidence of this relationship, namely that non-adoption or low efficiency by farmers in the study area is related to need incompatibility, has been provided by (Düvel & Botha, 1999:56).

Participants were asked what their present level of production efficiency would have been if they had adopted each of the recommended maize and dairy production practices in an attempt to determine the perceived compatibility of the recommended practices with their felt need, namely, increased production. The need compatibility score of the great majority (50-75 percent) of maize and dairy farmers ranged from medium to high on the need compatibility scale (Table 6.3). The extremely close relationship between need compatibility and production efficiency in the case of both commodities provides clear supportive evidence of hypothesis 2.2. Evidence can be found, for example, in spot application of fertilizer. Regarding this practice, while no single farmer from the efficient category was found to score low on the need compatibility scale, 64 percent of them scored high. Conversely, while 66 percent of the less efficient farmers scored low, not a single farmer scored high. The difference is highly significant ($\chi2$ = 292, df = 8, p = 0.000; r = 0.980, p = 0.000).

The close to perfect correlation as reflected in the highly significant statistical tests (chi-square and correlations) makes need compatibility an indispensable and accurate predictor of adoption behavior and the subsequent production efficiency.

Table 6.3 Relationships between need compatibility (NC) and production efficiency as reflected in percentage distributions and a test of association

		Percentage distribution of farmers per efficiency category*						Association				
		1	2	3	4	5	Total					
Variable	Category	n=41	n=24	n=43	n=54	n=38	N=200	χ^2	P	df	r	p
Maize												
NC-fertilizer	Low	100	41.7	32.6	-	2.6	33					
	Medium	-	37.5	62.8	25.9	2.6	25.5					
	High	-	20.8	4.7	74.1	94.7	41.5					
	Total	100	100	100	100	100	100	201.0	0.000	8	0.88	0.000
NC-spot	Low	100	91.7	7	-	-	33					
	Medium	-	8.3	93	51.9	-	35					
	High	-	-	-	48.1	100	32					
	Total	100	100	100	100	100	100	292.0	0.000	8	0.98	0.000
NC-seed	Low	100	54.2	4.7	-	-	28					
	Medium	-	45.8	95.3	59.3	5.3	43					
	High				40.7	94.7	29					
	Total	100	100	100	100	100	100	267.0	0.000	8	0.96	0.000
NC-line planting	Low	100	87.5	9.3	1.9	-	33.5					
	Medium	-	12.5	90.7	35.2	-	30.5					
	High				63	100	36					
	Total	100	100	100	100	100	100	282.0	0.000	8	0.96	0.000
Dairy												
NC-breed	Low	80	34.1	4.2	-	-	22					
	Medium	20	63.4	72.9	52.5	25	49					
	High	-	2.4	22.9	47.5	75	29					
	Total	100	100	100	100	100	100	149.0	0.000	8	0.97	0.000
NC-housing	Low	97.1	65.9	52.1	27.5	5.6	49.5					
	High	2.9	34.1	47.9	72.5	94.4	50.5					
	Total	100	100	100	100	100	100	71.9	0.000	4	0.5	0.000
NC-medical	Low	74.3	48.8	29.2	32.5	-	36.5					
	Medium	25.7	51.2	60.4	32.5	50	45					
	High	-	-	10.4	35	50	18.5					
	Total	100	100	100	100	100	100	77.3	0.000	8	0.53	0.000
NC-feed	Low	77.1	51.2	33.3	10	2.8	34.5					
	Medium	22.9	29.3	43.8	50	44.4	38.5					
	High	-	19.5	22.9	40	52.8	27					
	Total	100	100	100	100	100	100	66.4	0.000	8	0.48	0.000
	Frequency (N)	35	41	48	40	36	200					

*1 = Less efficient, 5 = Most efficient

6.5 INFLUENCE OF PERCEPTIONS OF TECHNOLOGY ATTRIBUTES ON PRODUCTION EFFICIENCY

Perception is a key dimension in the process of behavior change. According to Düvel (1975:8), all causes of negative decision making as well as all the forces or potential forces of change, can be directly traced back to perception or the psychological field. Several research studies (Louw & Düvel, 1973: 37; Düvel, 1975: 8; Koch, 1985:15; Botha, 1986:29; Koch, 1986:21; Botha, 1999:51) provide evidence of this and led to the hypothesis, (Hypotheses 2.2) that production efficiency in the study area is positively related with their perception of recommended technology attributes.

Perception of technology attributes is treated as a composite variable computed by adding the difference between behavior positive and negative psychological field forces or by aggregating the net perception scores of respondents on the attributes of each and every practice of the recommended technology package including perceived relative advantages and disadvantages of fertilizer, spot application of fertilizer, improved cultivars and line planting for maize and perceived relative advantages and disadvantages of recommended breeds, housing, medical and feeding practices for dairy .

Table 6.4 provides the detail information on the overall perception profile of maize and dairy farmers. According to Table 6.4, respondents are normally distributed across all perception categories of low, medium and high. With respect to one of the causal factors, technology attributes for fertilizer, for example, the number of farmers in the three categories vary only between 32 percent and 36 percent. In contrast to expectations, however, perception is not found to be significantly associated with the production efficiency of both maize and dairy farmers in many of the practices incorporated into the packages of the two commodities. Regarding maize farmers' perception of line planting for example, while the number of efficient dairy farmers was about 30 percent both in the low and high perception categories, the number of the less efficient ones also varies only from 36.6 percent to 39 percent with changes in their perception from low to high without showing any significant variation ($\chi^2 = 8.4$, df = 8, p = 0.396; r = 0.04, p = 0.541).

Table 6.4 Relationships between perception of technology attributes (PTA) and production efficiency as reflected in percentage distributions and a test of associations

		Percentage distribution of respondents per efficiency category*						Association				
		1	2	3	4	5	Total					
Variable	Category	n=41	n=24	n=43	n=54	n=38	N=200	χ^2	P	df	r	p
Maize												
PTA-fertilizer	Low	31.7	8.3	25.6	44.4	39.5	32.5					
	Medium	19.5	50.0	32.6	31.5	31.6	31.5					
	High	48.8	41.7	41.9	24.1	28.9	36.0					
	Total	100	100	100	100	100	100	17.5	0.03	8	-0.11	0.11
PTA-spot	Low	29.3	41.7	39.5	29.6	31.6	33.5					
	Medium	36.6	45.8	34.9	29.6	42.1	36.5					
	High	34.1	12.5	25.6	40.7	26.3	30.0					
	Total	100	100	100	100	100	100	8.3	0.41	8	-0.03	0.71
PTA-seed	Low	39.0	33.3	23.3	35.2	34.2	33.0					
	Medium	26.8	33.3	46.5	29.6	23.7	32.0					
	High	34.1	33.3	30.2	35.2	42.1	35.0					
	Total	100	100	100	100	100	100	6.7	0.57	8	0.08	0.26
PTA-line planting	Low	36.6	50.0	44.2	25.9	28.9	35.5					
	Medium	24.4	20.8	27.9	33.3	39.5	30.0					
	High	39.0	29.2	27.9	40.7	31.6	34.5					
	Total	100	100	100	100	100	100	8.4	0.40	8	0.04	0.54
Dairy												
PTA-breed	Low	34.3	39.0	39.6	37.5	19.4	34.5					
	Medium	22.9	36.6	33.3	32.5	36.1	32.5					
	High	42.9	24.4	27.1	30.0	44.4	33.0					
	Total	100	100	100	100	100	100	8.4	0.39	8	0.07	0.33
PTA-housing	Low	34.3	39.0	43.8	27.5	19.4	33.5					
	Medium	28.6	34.1	33.3	42.5	27.8	33.5					
	High	37.1	26.8	22.9	30.0	52.8	33.0					
	Total	100	100	100	100	100	100	12.5	0.13	8	0.14	0.04
PTA-medical	Low	17.1	22.0	43.8	42.5	27.8	31.5					
	Medium	40.0	36.6	27.1	27.5	38.9	33.5					
	High	42.9	41.5	29.2	30.0	33.3	35.0					
	Total	100	100	100	100	100	100	11.2	0.19	8	-0.13	0.07
PTA-feed	Low	22.9	26.8	41.7	25.0	19.4	28.0					
	Medium	34.3	34.1	35.4	40.0	44.4	37.5					
	High	42.9	39.0	22.9	35.0	36.1	34.5					
	Total	100	100	100	100	100	100	8.3	0.41	8	0.03	0.67
	Frequency (N)	35	41	48	40	36	200					

*1 = Least efficient, 5 = Most efficient

The possible explanation for the unexpected finding against the hypothesized association (Hypothesis 2.2) could partly be attributed to the late development of behavior negative psychological field forces (awareness of disadvantages). Although behavior positive psychological field factors are well developed both with respect to dairy and maize practices, their power to influence the dependent variable, production efficiency is underestimated in view of the relatively large number of behavior negative psychological field forces, which could have been evoked by persuasion efforts regarding the advantages and could largely represent more knowledge or only weak forces. This also indicates at the close relationship between perception and knowledge primarily in terms of the advantages and disadvantages.

This finding would imply that knowledge in terms of its influence is a less important intervening variable and would explain why a mere dissemination of knowledge is seldom effective or why it is often maintained "knowledge does not sell itself". In other words an individual may be knowledgeable of an advantage or disadvantage but it need not have significant influence on him.

Perhaps the most likely explanation, and not unrelated to the above, is that an individual could adopt a practice because of one or more attributes perceived positively, depending on which are important for him/her. These differences were not accurately measured, and in fact this represents an important focus for future research.

6.6 CONTRIBUTIONS OF INTERVENING VARIABLES TO PRODUCTION EFFICIENCY VARIANCE

Multiple regression models were used to estimate the effects of the intervening variables on production efficiency of maize and dairy farmers. Predictor variables included in the model as were based on the results of the bivariate analysis of section 6.2 and are given in Table 6.5. Theoretically expected signs for the variables included in the developed regression model are also specified in this Table. Need compatibility regarding seed, line planting, and spot application of fertilizer are excluded from the regression model since they are all found to be multicollinear with need compatibility of fertilizer use.

Table 6.5 Model specification for intervening variables affecting the production efficiency of maize and dairy farmers

Variable	Expected sign	Variable description (operational definition)
Maize		
PCE (seed)	-	Perceived current efficiency score regarding improved seed and its sourc
NT (efficiency)	+	Need tension score regarding production efficiency (yield per unit)
NT (fertilizer)	+	Need tension score regarding the type and rate of fertilizer used
NT (spot)	+	Need tension score regarding spot application
NT (seed)	+	Need tension score regarding the use and source of improved seed
NC (fertilizer)	+	Need (in) compatibility score regarding the type and rate of fertilizer
Dairy		
PCE (efficiency)	-	Perceived current efficiency core regarding yield per unit
NT (efficiency)	+	Need tension score regarding production efficiency
NT (breed)	+	Need tension score regarding the use of improved breed
NC (breed)	+	Need (in) compatibility score regarding the use of improved breeds
NC (housing)	+	Need (in) compatibility score regarding the use of housing practices
NC (medical)	+	Need (in) compatibility score regarding adoption of medical practices
NC (feed)	+	Need (in) compatibility score regarding the use of feed practices
PTA (feed)	+	Perceived total attribute regarding feed practices

Table 6.6 provides the results of multiple regression analysis regarding the contributions of intervening variables to the variations in the production efficiency of maize and dairy farmers.

The effect of intervening variables on production efficiency of maize and dairy farmers is characterized by a high R^2 value where most of the variables are significantly associated with the regressand. Contribution of the intervening variables to the variance of the production efficiency of maize and dairy farmers is as high as 87.5 percent for maize and 80.9 percent for dairy (Table 6.6). The result is in agreement with the findings of earlier research (Düvel, 1975; Koch, 1986: 21; Koch, 1987:24; Düvel & Botha, 1999:47). An important observation worth mentioning here is that most of the need related factors appear to be highly significantly related with production efficiency regarding both maize and dairy farming. This indicates at the crucial role of needs in behavior determination and suggests that needs are, as defined and categorized in this study more important than perceptions. This, however, needs further verification and calls for more research

Table 6.6 Multiple regression (standard) estimates of the effects of intervening variables on the production efficiency of maize and dairy farmers

Variable*	Beta	t	p	Variable	Beta	t	p
Constant	-	5.782	0.000	Constant	-	6.59	0.000
PCE-seed	-0.040	-1.519	0.130	PCE-efficiency	-0.128	-3.300	0.001
NT-efficiency	-0.048	-1.612	0.109	NT-efficiency	-0.118	-3.224	0.001
NT-fertilizer	-0.381	-9.970	0.000	NT-breed	-0.083	-2.538	0.012
NT-spot	0.012	0.351	0.726	NC-breed	0.564	13.977	0.000
NT-seed	0.033	1.009	0.314	NC-housing	0.114	3.036	0.003
NC-fertilizer	0.749	24.864	0.000	NC-medical	0.221	5.681	0.000
				NC-feed	0.190	5.160	0.000
				PTA-housing	-0.001	-0.020	0.984
Maize (R^2=0.875)				Dairy (R^2=0.809)			

*(PCE = Perceived current efficiency, NT = Need tension, NC = Need compatibility, PTA = Perceived total attribute)

Top of the list in both commodities is need compatibility (need compatibility for breed and fertilizer), which, also from a theoretical point of view and understanding of needs, is almost a precondition for change, since it is difficult to visualize an action or a behavior of an individual that is in contradiction with his/her needs.

Need tension is another significant predictor (next to need compatibility), although it's nature (whether negative or positive) is not according to expectations. This could be attributed to the fact that the perceived current efficiency, which is an integral part of the need tension, has a counter-effect in terms of influence*, and because of possible changes in the need tension after the change in adoption behavior.

A noteworthy finding is that perception does not appear to be as important as needs especially with regard to maize production. This may be attributable to the following

* There is a tendency of overrating the current level of efficiency, especially by the less efficient farmers, which lowers the need scope and ultimately distorts the findings related to need tension.

reasons. One of them has to do with measurement. The five-point scale measurement instrument employed in this study showed a lacking sensitivity and accuracy to successfully measure the more abstract concept of perception. The result is an inaccurate assessment of the psychological field or field forces, namely because of the inability to distinguish between the mere knowledge of advantages and disadvantages and those perceived to represent strong forces.

Outstanding challenges in this regard lie in employing a finer and more accurate measurement instrument to further investigate the key role of perceptions as behavior determinants. Secondly, emerging perceived negative psychological field forces are not necessarily related to the technology itself but are mostly associated with compatibility aspects such as policy issues. Based on the dynamics of forces, elimination or reduction of these forces by concerned parties could reactivate the sluggish behavior change process and redress the current problem facing farmers in the study area.

A finding emerging from this study is that need related factors seem to play a more important role in predicting production efficiency than perceptions of technology attributes, with need compatibility being the most prominent. However, these variables especially need tension, is more liable to distortions, which can be attributed to the time of assessment and is particularly relevant in ex post facto research. The reason for this is that, while the needs influence the adoption behavior and consequently the efficiency, the changed behavior will again change the need situation, which will no longer reflect what gave rise to the original change. In other words since behavior aimed at realizing the need will change the need tension, it is near impossible to accurately measure or assess the influence of need tension on an ex post facto base.

6.7 COMPARATIVE CONTRIBUTION OF INTERVENING VARIABLES TO VARIANCE IN PRODUCTION EFFICIENCY

Table 6.7 depicts the overall contributions of independent (1), and intervening (2) variables on production efficiency and both the independent and intervening variables (1+2). From the findings it is evident that the contribution of the intervening variables is much higher than that of all the independent variables. This applies to both maize and dairy where the value of the coefficient of determination is 87.5 percent in the case of maize and 80.9 percent in dairy. Their effect is almost equal to the combined effect of the two sets of variables, which is 88.8 percent in maize and 81.9 percent in dairy. The comparative small influence of independent variables is evident from the coefficients of variation, which are only 25.1 percent in maize and 19.3 percent in dairy.

Table 6.7 Comparison of coefficient of determination based on standard multiple regression estimation

Category of variables	Maize			Dairy		
	R^2	F	Total P	R^2	F	Total P
1 (Independent)	0.251	13.036	0.000	0.193	11.67	0.000
2 (Intervening)	0.875	224.8	0.000	0.809	101.44	0.000
1+2 (independent+ intervening)	0.888	135.315	0.000	0.819	70.00	0.000

According to standard multiple regression procedure, all variables are entered into the equation simultaneously without controlling for the possible effects of the second set of variables on the others. It is therefore required to subtract the R^2 values of one from the R^2 value of the other set of variables to determine the net contributions (R^2 change) of the second categories of variables and establish which category is relatively more important in predicting production efficiency. In view of this, the contribution of the intervening variables alone, when the possible effect of the independent variables is controlled, is 0.637 (0.888-0.251) in maize and 0.626 (0.819-0.193) in dairy. According to Pallant (2001:147), however, hierarchal multiple regressions procedure is used to simplify the process and answer the question "if the possible effects of a set of predictor variables (independent variables, in this case) is controlled, is our second set of variables (intervening variables) still able to predict a significant amount the variance of the dependent variable?" Hence, this procedure was applied to evaluate and compare the influences of the two sets of independent and intervening variables on production efficiency of farmers after the possible effects of the predictor independent variables were controlled (see Table 6.2 below).

Table 6.8 Hierarchal multiple regression estimation of the comparative influence of independent and intervening variables on efficiency

	Maize				Dairy			
Model-1	**Variable**	**Beta**	**t**	**p**	**Variable**	**Beta**	**t**	**p**
	Constant		4.958	0.000	Constant	-	3.217	0.002
	Agro-ecology: dummy	0.333	4.345	0.000	Age	0.173	2.569	0.011
	Age	-0.095	-1.270	0.216	Education	0.243	3.146	0.002
	Education	0.200	2.454	0.015	Farm size	0.275	4.183	0.000
	Farm size	0.276	3.646	0.000	Modernity	0.069	0.902	0.368
	Media: dummy	0.196	2.658	0.009				
	R^2=0.251; R^2 change=0.251; F=13.04; P=0.000				R^2=0.193; R^2 change=0.193; F=11.67; P=0.000			
Model-2	Constant	-	3.162	0.002	Constant	-	3.734	0.000
	Agro ecology: dummy	0.110	2.923	0.004	Age	0.031	0.892	0.373
	Age	-0.032	-1.050	0.295	Education	0.080	2.076	0.039
	Education	0.010	0.301	0.764	Farm size	0.052	1.524	0.129
	Farm size	0.080	2.601	0.010	Modernity	0.017	0.439	0.661
	Media: dummy	0.078	2.519	0.013				
	PCE-seed	-0.010	-0.367	0.714	PCE-efficiency	-0.128	-3.300	0.001
	NT-efficiency	-0.007	0.233	0.816	NT-efficiency	-0.118	-3.224	0.001
	NT-fertilizer	-0.367	-9.610	0.000	NT-breed	-0.083	-2.538	0.012
	NT-spot	0.048	1.349	0.179	NC-breed	0.564	13.977	0.000
	NT-seed	0.045	1.389	0.166	NC-housing	0.114	3.036	0.003
	NC-fertilizer	0.717	23.527	0.000	NC-medical	0.221	5.681	0.000
					NC-feed	0.190	5.160	0.000
					PTA-housing	-0.001	-0.020	0.984
	R^2=0.888; R^2 change=0.636; F=135.3; P=0.000				R^2=0.819; R^2 change=0.626; F=70.74; P=0.000			

(PCE = Perceived current efficiency, NT = Need tension, NC = Need compatibility, PTA = Perceived total attribute)

As can be seen in Table 6.8, the R^2 change value or the net effect of intervening variables is 0.636 (viz. 0.888-0.251) in maize and 0.626 (viz. 0.819-0.193) in dairy. The results obtained by employing hierarchical multiple regression models are similar to the results of standard multiple regression models employed earlier. The second procedure is used in this study to simplify the process, especially to assess the specific influence of each of the intervening variables when the possible effects of the independent variables are controlled.

Hierarchical multiple regression analysis showed that the contribution of intervening variables alone, 63.6 percent (R^2 change = 63.6) in maize and 62.6 percent (R^2 change = 62.6) in dairy is still higher than the direct effect of independent variables, which is 25 percent and 19 percent, respectively. Moreover, factors associated with needs (need compatibility and need tension regarding fertilizer) in maize and all of the intervening variables with the exception of perceived total attribute of housing practice in dairy, have a significantly higher contribution to the variation in production efficiency. This finding reveals the important role of needs in behavior determination when their effect is compared against the effect of the rest of the intervening variables included in the regression model.

On the other hand, the contribution of independent variables to the variance of production efficiency is not only direct. There is also an indirect influence (via the intervening variables), which can increase their total influence. Employing path analysis assesses this effect (Fig. 6.1). A path diagram is developed in order to elaborate the influence relationships of the various variables by taking the case of maize farmers as an example.

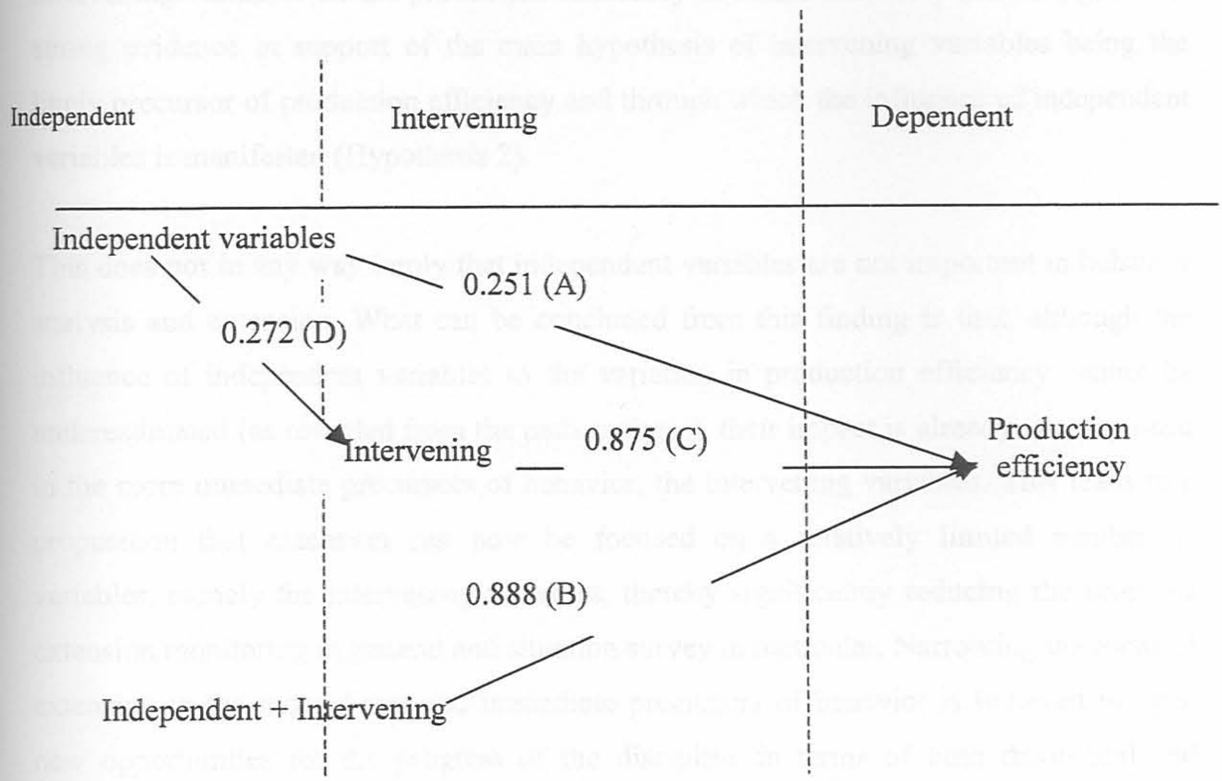

Fig. 6.1 Path diagram showing the relationship between independent, intervening variables and production efficiency of maize farmers*

The indirect effect of independent variables on the production efficiency of maize farmers (their effect manifested through the intervening variables) is the effect of intervening variables on the dependent variable before the possible effect of independent variables is controlled less the effect of intervening variables after the influence of independent variables is controlled (87.5 percent-63.6 percent), which gives 23.9 percent. The aggregate effect of independent variables is the sum total of their indirect and direct effects (23.9 percent + 25 percent), which equals 48.9 percent. This figure is still less compared against the effect of intervening variables even after the possible effect of independent variables is controlled (63.6 percent). However, the path analysis (Fig. 6.1) shows that the effect of independent variables becomes sizeable (48.9 percent) when their indirect effect is considered. This, together with the highly significant contribution of

* The values, 'A', 'B' & 'C' are based on the regression model (Table 6.8). 'D' is obtained by calculation, i.e. D= .238/. 875= .272

intervening variables on the production efficiency of maize and dairy farmers, provides strong evidence in support of the main hypothesis of intervening variables being the likely precursor of production efficiency and through which the influence of independent variables is manifested (Hypothesis 2).

This does not in any way imply that independent variables are not important in behavior analysis and extension. What can be concluded from this finding is that, although the influence of independent variables to the variation in production efficiency cannot be underestimated (as revealed from the path analysis), their impact is already encompassed in the more immediate precursors of behavior, the intervening variables. This leads to a proposition that extension can now be focused on a relatively limited number of variables, namely the intervening variables, thereby significantly reducing the scope of extension monitoring in general and situation survey in particular. Narrowing the focus of extension to the more direct and immediate precursors of behavior is believed to open new opportunities for the progress of the discipline in terms of both theoretical and practical grounds. It provides an epistemological base and offers opportunities for a more rigorous assessment of the relevant variables associated with behavior analysis, which can be changed by extension as opposed to the more static independent variables. The shift in the emphasis of extension to the more flexible and relevant factors is also believed to reduce survey costs since the time that has been used by traditional situation surveys could now be dramatically reduced.

6.8 THE INFLUENCE OF INTERVENING VARIABLES ON MAIZE PRACTICE ADOPTION

Intervening factors assumed to affect the practice adoption behavior of maize farmers include perceived current efficiency and need tension regarding the overall production efficiency and perceived current efficiency, need tension, need compatibility, and perceptions of technology attributes regarding each practice. Fertilizer adoption, for example, is assumed to be affected by the perceived current efficiency and need tension regarding the overall production efficiency and perceived current efficiency, need tension, need compatibility, and perceived attributes regarding fertilizer. The influence of these factors on the adoption of each technology or production practice included in maize package i.e. seed, line planting, fertilizer and spot application of fertilizer will be analyzed in the following sections.

6.8.1 Influence of intervening factors on improved seed adoption

As far as the perceptions of attributes are concerned, seed adoption is affected by both positive (perceived relative advantages) and negative (perceived relative disadvantages) attributes of improved seeds. The influence of each of the perceived positive and negative improved seed attributes will first be assessed followed by evaluation of the influence of the intervening variables in general.

The perception of farmers regarding the advantages of improved cultivars is associated either with economical or technical attributes. High productivity, early maturity, quality of grain and high green cob price were some of the economical advantages attributed to the use of improved cultivars while disease resistance, lodging resistance, good husk cover, and high harvest index were regarded as technical advantages.

In an attempt to identify the critical attributes associated with improved seed, farmers were asked to choose five of the most important advantages of using improved seed and rank them in order of importance. The fact that high production is perceived to be an important attribute by both parameters, measure of association and rank (weighted score) (Table 6.9), indicates how farmers regard economical advantages as important criteria during variety choice. The highly significant association of the relative advantages, early maturity, high harvest index and high productivity to seed adoption and the fact that high productivity and early maturity are the first and second most important attributes has also an important implication for research and extension. It is evident from this that farmers are willing and eager to increase their productivity but this goal is associated with a major problem of drop in market price at time of harvest, which is the third most important among the five problems mentioned (Table 6.9). The finding, therefore, suggests that early maturing varieties are critical for farmers so that they can either sell their produce while the price is still high and/or they can sell it while it is green. They can fetch a higher price in either case. Table 6.9 and appendix 6a provide detail information on the relative importance of each of the perceived advantages of improved seeds.

Table 6.9 Relationships between perceived technology attributes of improved seeds and adoption behavior as expressed by weighted mean and percentage scores*

Attribute	Parameters	Distributions of scores according to seed adoption categories			
		Non (N=102)	Low (N=27)	High (N=71)	Total (N=200)
Relative advantages					
High productivity	Weighted average score	3.62	3.37	3.73	3.63
	Weighted percentage	72.35	67.41	74.65	72.50
	Association	$r_s = 0.091, p = 0.199$			
Early maturity	Weighted average score	2.37	2.81	2.41	2.45
	Weighted percentage	47.45	56.30	48.17	48.90
	Association	rs = 0.248, p = 0.000			
Grain quality	Weighted average score	1.01	0.30	0.77	0.83
	Weighted percentage	20.20	5.93	15.49	16.60
	Association	$r_s = 0.113, p = 0.110$			
Resistance to lodging	Weighted average score	0.65	0.26	0.04	0.38
	Weighted percentage	12.94	5.19	0.85	7.60
	Association	$r_s = 0.076, p = 0.286$			
High harvest index	Weighted average score	0.22	0.44	0.72	0.43
	Weighted percentage	4.31	8.89	14.37	8.50
	Association	$r_s = 0.295, p = 0.000$			
Relative disadvantages					
Low storability	Weighted average score	0.83	0.26	0.38	0.60
	Weighted percentage	16.67	5.19	7.61	11.90
	Association	$r_s = 0.113, p = 0.111$			
Certified seed	Weighted average score	1.31	0.33	0.32	0.83
	Weighted percentage	26.27	6.67	6.48	16.60
	Association	$r_s = 0.037, p = 0.607$			
Cost	Weighted average score	3.29	3.04	3.04	3.17
	Weighted percentage	65.88	60.74	60.85	63.40
	Association	$r_s = -0.020, p = 0.774$			
Unavailability	Weighted average score	0.75	0.89	1.46	1.02
	Weighted percentage	14.90	17.78	29.30	20.40
	Association	$r_s = -0.268, p = 0.000$			
Market	Weighted average score	0.70	0.89	0.65	0.71
	Weighted percentage	13.92	17.78	12.96	14.10
	Association	$r_s = 0.238, p = 0.001$			

* Weighted average score is the sum of the rank order frequencies multiplied respectively by 5 for 1st position, 4 for 2nd position, 3 for 3rd position, 2 for 4th position, 1 for 5th position and divided by the number of farmers in that category

Perceived relative disadvantages of using improved maize cultivars are associated with either technical (inherent to the variety itself) or compatibility aspects. Low storability, low ear placement (short stalk), regular need for a certified seed and contamination or total elimination of local varieties by pollination are some of the technical disadvantages associated with the inherent characteristics of improved varieties, while drop in market price at time of harvest, high seed cost, seed unavailability (at the right time, quantity, place and type), unavailability of credit, and bureaucratic credit and input administration are some of the compatibility aspects perceived to be the relative disadvantages of using improved maize cultivars (Table 6.9 and Appendix 6.1b).

High seed cost, seed unavailability, regular need for a certified seed, drop in market price at time of harvest and low storability are rated as the five most important perceived relative disadvantages in order of their importance. The weighted average score and weighted percentage regarding some of the negative attributes of improved seed, indicate a positive relationship between perceived negative attributes and adoption. Regarding perception of seed unavailability (at the right time, place and quantity), for example, the weighted average percentage score of non-adopters is 14.9. This percentage increases in an almost linear fashion with increasing adoption to 29.3 percent in the higher adopters category. The same applies regarding the other most important attribute, which is drop in market price at the time of harvest. The findings of the weighted rank order is supported by the highly significant correlation coefficient especially concerning the attribute drop in market price at time of harvest ($r_s = 0.238$, $p = 0.001$). The implication of a positive relationship between negative attributes and seed adoption is that adopters had felt the seriousness of these problems more than the non-adopters or these problems are more important for adopters than for non-adopters.

In general, as indicated in Table 6.9, most of the perceived relative advantages and disadvantages are positively related with improved seed adoption. This positive association especially with respect to the negative attributes is an indication of the fact that adopters are more aware or knowledgeable of the negative attributes than the non-adopters. This seems to be logical since non-adopters lack the exposure to improved seeds and as a result may not know most of the disadvantages.

Having assessed the relationship between each of the specific attributes of improved seed and the adoption behavior of farmers, the influence of the net perceived total attribute of improved seed (sum of total positive lees negative attributes score-PTA), and the rest of the intervening variables assumed to have an influence on adoption is evaluated here.

The relationship between intervening variables and improved seed adoption is mostly significant and in accord wit expectations (Table 6.10), but the influence of need compatibility, perceived current efficiency and need tension regarding the practice, improved seed is comparatively higher.

Table 6.10 Relationship between intervening variables and seed adoption

Intervening Variable	r_s	p
Perceived current efficiency regarding production efficiency	.161	.023
Need tension regarding production efficiency	-.301	.000
Perceived current efficiency regarding improved seed	-.407	.000
Need tension regarding improved seed	-.853	.000
Need compatibility regarding improved seed	.443	.000
Perceived total attribute (PTA) regarding improved seed	.012	.864

The lack of significant relationship between seed adoption and PTA is not attributable to the absence of behavior positive psychological field factors (awareness of advantages). It is rather related with an equal awareness of behavior negative psychological field factors (awareness of disadvantages). As indicated in earlier sections, the lack of relationship can also be attributed to problems in measurement (the weakness of a five-point measurement scale and failure of farmers to distinguish values in a more sensitive scale) and thus also to the inability to distinguish between the mere awareness and knowledge of advantages and disadvantages and the actual psychological forces in that regard.

6.8.2 Influence of intervening variables on line planting

Relative advantages of line planting are attributed to either economical advantage (high yield) or technical advantages such as ease of weeding, improving the vigor of stand, permission of good light interception, improving fertilizer use efficiency, convenience for field inspection, simplicity of shilshalo (cultivation) and controlling plant population (allowing exact seed rate application).

The correlation between adoption of line planting practice and its attributes is mostly significant and positive. The relationship between the attribute of improving vigor and adoption, for example, is positive and significant at the 1percent level of probability (r_s = 0.171, p = 0.015). This result is supported by the distribution of respondents measured by the weighted average score. The average score of non-adopters regarding this attribute is 0.80 while that of the higher adopters is 1.06 indicating that adopters tend to be more aware this disadvantage. Shilshalo, yield increase and ease of weeding are comparatively more important than the other two perceived attributes namely permitting light interception and improving vigor (Table 6.11 and Appendix 6.2A), but they are not related to adoption.

Some of the perceived disadvantages attributed to line planting are wastage of land (farmers perceive that the open space between rows is a wasted land), incompatibility of line planting with beliefs and traditions (sowing by broadcasting is considered as one of the most esteemed event and important part of the whole farming practices performed by respected elderly unlike line planting which is a common practice of children) and requirement of skill. However, it is only requirement of skill, which become a major problem for not less than half of the whole sample farmers. Waste of land and incompatibility are concerns only for a very few number of farmers (Tables 6.11 and appendix 7b). As far as this particular attribute is concerned, both the correlation and distribution tests indicate a tendency of positive relationship (r_s = 0.132, p = 0.062).

Table 6.11 Relationships between perceived technology attributes of line planting and adoption behavior as expressed by weighted mean and percentage score*

Attribute	Parameters	Distributions of scores according to line planting adoption categories				
		None (N=20)	Low (N=84)	Medium (N=61)	High (N=35)	Total (N=200)
Relative advantages						
Weeding	Weighted average score	-	1.68	2.00	0.26	1.35
	Weighted percentage	-	33.57	40.00	5.14	27.00
	Association	**r_s = 0.124, p = 0.080**				
Vigor	Weighted average score	0.80	0.29	2.23	1.06	1.07
	Weighted percentage	16.00	5.71	44.59	21.14	21.30
	Association	**r_s = 0.171, p = 0.015**				
Light	Weighted average score	2.15	0.93	1.77	1.00	1.32
	Weighted percentage	43.00	18.57	35.41	20.00	26.40
	Association	**r_s = 0.073, p = 0.307**				
Shilshalo	Weighted average score	0.50	2.60	0.62	1.17	1.54
	Weighted percentage	10.00	51.90	12.46	23.43	30.70
	Association	**r_s = 0.055, p = 0.436**				
Yield	Weighted average score	2.85	1.58	0.08	2.63	1.44
	Weighted percentage	57.00	31.67	1.64	52.57	28.70
	Association	**r_s = -0.141, p = 0.047**				
Relative disadvantages						
Waste land	Weighted average score	0.20	-	-	-	-
	Percentage	4.00	-	-	-	-
	Association	**r_s = -0.144, p = 0.041**				
Incompatibility	Weighted average score	-	-	-	-	-
	Weighted percentage	-	-	-	-	
	Association	**r_s = 0.110, p = 0.122**				
Skill	Weighted average score	0.35	1.31	3.10	0.14	1.56
	Weighted percentage	7.00	26.19	61.97	2.86	31.10
	Association	**r_s = 0.132, p = 0.062**				

Regarding the relationships between intervening variables and the practice of line planting, the need compatibility and need tension associated with the practice and need tension associated with production efficiency are significantly related. Need compatibility being the top among the list (Table 6.12). Again, and for the reasons already mentioned, the perceptions of practice attributes show little or no relationship with adoption behavior.

* Weighted average score is the sum of the rank order frequencies multiplied respectively by 5 for 1st position, 4 for the 2nd position, 3 for the 3rd position, 2 for the 4th position 1 for the 5th position and divided by the number of farmers in that category

Table 6.12 Relationship between intervening variables and adoption of line planting practice

Variable	r_s	p
Perceived current efficiency regarding production efficiency	-.002	.979
Need tension regarding production efficiency	-.195	.006
Perceived current efficiency regarding line planting	-.045	.526
Need tension regarding line planting	-.146	.038
Need compatibility regarding line planting	.476	.000
Perceived total attribute regarding line planting	-.002	.974

6.8.3 Influence of intervening variables on fertilizer adoption

The relationship between fertilizer technology attributes and fertilizer adoption is first assessed followed by analysis of the effect of intervening factors associated with fertilizer adoption.

Fertilizer application was the major and most important activity for improving productivity as perceived by all maize-producing farmers, irrespective of their level of adoption. Participant farmers are attributing the relative advantages of fertilizer application mainly to economical advantages (high grain and Stover yield) and to a lesser extent to technical advantages (facilitate maturity, and improve the crop stand to look dark and green). Most farmers' (80 percent) primary reason for using fertilizer is an increased yield. The other three are either the second, third or fourth important advantages for only about 20 percent to 40 percent of the sample farmers (See Table 6.13 and Appendix 6.3A). In general, based on the total weighted average score, yield is found to be the primary reason for almost all adoption categories of maize farmers for using fertilizer followed by it's potential to facilitate maturity, increase stover yield and improve crop stand in that order. Due to the lack in variability of distribution (most farmers value fertilizer attributes very high on the scale), the association is usually not found to be significant at the less than 5 percent level of probability.

Table 6.13 Relationships between perceived technology attributes of fertilization and adoption of fertilization as expressed by weighted mean and percentage score*

Attribute	Parameters	Distributions of scores according to fertilizer adoption categories: None (N=47)	Medium (N=61)	High (N=92)	Total (N=200)
Relative advantages					
Yield (grain)	Weighted average score	3.81	3.93	3.68	3.79
	Weighted percentage	76.17	78.69	73.70	75.80
	Association	**$r_s = 0.139, p = 0.050$**			
Yield (stover)	Weighted average score	2.02	2.23	1.96	2.06
	Weighted percentage	40.43	44.59	39.13	41.10
	Association	**$r_s = 0.138, p = 0.052$**			
Maturity	Weighted average score	2.60	1.89	2.60	2.38
	Weighted percentage	51.91	37.70	51.96	47.60
	Association	**$r_s = 0.033, p = 0.643$**			
Stand	Weighted average score	1.57	1.95	1.76	1.78
	Weighted percentage	31.49	39.02	35.22	35.50
	Association	**$r_s = 0.100, p = 0.159$**			
Relative disadvantages					
Cost	Weighted average score	3.94	3.84	3.85	3.87
	Weighted percentage	78.72	76.72	76.96	77.30
	Association	**$r_s = 0.008, p = 0.908$**			
Access	Weighted average score	2.47	2.54	2.46	2.49
	Weighted percentage	49.36	50.82	49.13	49.70
	Association	**$r_s = 0.114, p = 0.100$**			
Administration	Weighted average score	2.43	2.39	2.12	2.28
	Weighted percentage	48.51	47.87	42.39	45.50
	Association	**$r_s = 0.024, p = 0.732$**			
Belief	Weighted average score	-	-	-	0.8
	Weighted percentage	-	-	-	17.00
	Association	**$r_s = 0.056, p = 0.431$**			
Fraud	Weighted average score	-	0.18	0.42	0.19
	Weighted percentage	-5.11	3.61	8.48	3.80
	Association	**$r_s = 0.212, p = 0.003$**			

A commonly mentioned or very important perceived relative disadvantage of fertilizer use is the high cost, accessibility (at the right time, quality and space) bureaucratic credit and input administration and fraud (adulteration, scale). Another two perceived disadvantages, namely belief held by participants that fertilizer kills soil productivity and compatibility, are also mentioned by some farmers as disadvantages though their number

* Weighted average score is the sum of the rank order frequencies multiplied respectively by 5 for 1st position, 4 for 2nd position, 3 for 3rd position, 2 for 4th position, 1 for 5th position and divided by the number of farmers in that category

is in insignificant. High fertilizer cost is a pressing and primary problem followed by accessibility, input administration (bureaucracy) and fraud (Table 6.13 and Appendix 6.3b) to all maize farmers irrespective of their level of adoption. As a result the correlation between relative disadvantages of fertilizer and fertilizer adoption is not found to be significant in most cases except fraud.

The fact that farmers keep on using fertilizer irrespective of the prevalence of all of these perceived problems indicates that fertilizer is well integrated into the farming system and farmers cannot afford to ignore this important technology. It also entail that minor interventions aimed at removing these obstacles can make tremendous difference in fertilizer consumption.

The assessment also shows that there is a strong relationship between fertilizer adoption and the associated intervening variables in most cases (Table 6.14). Need related factors are identified to closely influence fertilizer adoption, but the direction of relationship regarding need tension is negative as commonly experienced in this study.

Table 6.14 Relationships between intervening variables and fertilizer adoption

Variable	r_s	p
Perceived current efficiency regarding production efficiency	.008	.215
Need tension regarding production efficiency	-.377	.000
Perceived current efficiency regarding fertilizer	-.371	.000
Need tension regarding fertilizer	-.840	.000
Need compatibility regarding fertilizer	.507	.000
Perceived total attribute regarding fertilizer	-.103	.148

6.8.4 Influence of intervening variables on spot application

Respondents identify only two advantages in relation to spot application of fertilizer i.e. it economizes fertilizer use and improves fertilizer use efficiency by the plant. They were also requested to rate these advantages on a 5 point scale where 5 = very high and 1 =

very low with the purpose of identifying the more important between the two. Economic use of fertilizer is turned out to be the more important of the two, but unlike the use efficiency (r = 0.175, p = 0.013), does not correlate positively with adoption (r = 0.008, p = 0.908).

Table 6.15 Relationship between perceived technology attributes of spot application and adoption behavior as expressed by weighted mean and percentage scores*

Attribute	Parameters	Distributions of scores according to spot application categories None (N=57)	Low (N=78)	High (N=65)	Total (N=200)
Relative Advantages					
Economy	Weighted average score	3.61	3.28	3.77	3.54
	Weighted percentage	72.28	65.64	75.38	70.70
	Association	**$r_s = 0.008, p = 0.908$**			
Efficiency	Weighted average score	3.25	2.92	3.74	3.28
	Weighted percentage	64.91	58.46	74.77	65.60
	Association	**$r_s = 0.175, p = 0.013$**			
Relative disadvantages					
Laboriousness	Weighted average score	2.51	3.08	1.34	2.35
	Weighted percentage	50.18	61.54	26.77	47.00
	Association	**$r_s = -0.269, p = 0.000$**			
Toxicity	Weighted average score	0.00	0.04	0.02	0.02
	Weighted percentage	0.00	0.77	0.31	0.40
	Association	**$r_s = 0.070, p = 0.325$**			

As it is elaborated in Table 6.15, some farmers believe that toxicity of seed is associated with spot application unlike broadcasting. Some were conscious and believe that this happens only when it is not carefully applied at the right spacing but both the distribution and correlation tests do not indicate any kind of association between adoption and the perception of this attribute. About 2 percent to 20 percent of sample farmers perceive laboriousness of fertilizer application to be an acceptable problem while about 25 percent to 30 percent of them claim it to be a very important problem (Appendix 6.4b). Non-adopters are more concerned about this constraint than adopters as reflected in the negative relationship between the two factors (r_s = -0.269, p = 0.000). The negative

* Weighted average score is the sum of the rank order frequencies multiplied respectively by 2 for 1st position, 1 for 2nd position and divided by the number of farmers in that category

relationship concerning laboriousness suggest that though adopters are more aware of the disadvantage of the practice they are still using it probably because they found it to be more acceptable than other methods of fertilizer application. In general, laboriousness is found to be the most important problem followed by toxicity.

The relationship between intervening variables and adoption of spot application (Table 6.16) is strongly significant in many cases except perceived current efficiency regarding overall production. The relationship regarding need tension is significant but turns out be negative against expectations. Perceived need compatibility regarding the practice is the top among the behavior determining factors. In other words farmers who think that the use of spot application method would increase yield are more motivated to adopt spot application.

Table 6.16 Relationship between intervening variables and adoption of spot application

Variable	r_s	p
Perceived current efficiency regarding production efficiency	.053	.458
Need tension regarding production efficiency	-.204	.004
Perceived current efficiency regarding spot application	-.246	.000
Need tension regarding spot application	-.745	.000
Need compatibility regarding spot application	.539	.000
Perceived total attribute regarding spot application	.235	.001

6.9 THE INFLUENCE OF INTERVENING VARIABLES ON DAIRY PRACTICE ADOPTION

As in the case of maize, the intervening factors assumed to influence the adoption behavior of dairy farmers include perceived current efficiency and need tension regarding overall production efficiency, perceived current efficiency, need tension, need compatibility, and perceptions of technology attributes regarding each practice included in the dairy package. Adoption of recommended feed practice, for example, is assumed to be influenced by the perceived current efficiency and need tension regarding the overall production efficiency and perceived current efficiency, need tension, need compatibility and perceived attributes regarding improved feed.

6.9.1 Influence of intervening variables on breed adoption

Based on the above preamble, intervening factors that affect the improved breed adoption behavior of farmers in the study area are assumed to include perceived current efficiency and need tension regarding overall production (efficiency), and perceived current efficiency, need tension, need compatibility, and perceptions of attributes regarding the practice under consideration, improved breed.

As far as the perceptions of attributes are concerned, improved breed adoption is influenced by both positive (perceived relative advantages) and negative (perceived relative disadvantages) attributes of improved breed. The influence of each of the perceived positive and negative improved breed attributes will be first assessed followed by an assessment of the influence of all of the intervening variables including the total perception of attributes (sum total of relative advantages lees the disadvantages) on improved breed adoption.

Both economical and technical aspects are recognized as rewards of using an improved breed. High yield, fast growth rate, employment creation, additional income generation (compost, fuel wood), fast cost recovery rate, high price of culled animals, status associated with a head and internal satisfaction (hobby) are perceived to be some of the economic returns. The technical advantages on the other hand are, short calving interval, short open days, limited number of services, early first calving age and long lactation period. Technical advantages do, however, not feature among the five most important relative advantages mentioned. There is, however, little significant association between most of these factors and breed adoption (Table 6.17). An exception is employment creation, which is other than expected negatively related. High productivity, for example, does not have a significant relationship with breed adoption behavior of dairy farmers (r

= -0.012, p = 0.810), though the weighted average score of higher adopters (2.37) is a bit higher than that of the medium adopters (1.68), which is an indication of some sort of positive relationship.

Table 6.17 Relationship between perceived technology attributes of improved breeds and adoption behavior as expressed by weighted mean and percentage scores*

Attributes	Parameters	Distributions of scores according to improved breed adoption categories		
		Medium (N=47)	High (N=153)	Total (N=200)
Relative advantages				
Productivity	Weighted average score	1.68	2.37	2.21
	Weighted percentage	33.62	47.5	44.2
	Association	**r_s = -0.012, p = 0.810**		
Fast growth	Weighted average score	1.04	1.55	1.43
	Weighted percentage	20.85	31	28.6
	Association	**r_s = -0.024, p = 0.733**		
Employment	Weighted average score	1.32	0.9	0.100
	Weighted percentage	26.38	17.9	19.9
	Association	**r_s = -0.194, p = 0.006**		
Income	Weighted average score	0.17	0.75	0.615
	Weighted percentage	3.404	15	12.3
	Association	**r_s = 0.083, p = 0.240**		
Hobby	Weighted average score	0.57	1.56	1.33
	Weighted percentage	11.49	31.2	26.6
	Association	**r_s = 0.003, p = 0.646**		
Relative disadvantages				
Initial cost	Weighted average score	0.83	1.86	1.62
	Weighted percentage	16.6	37.3	32.4
	Association	**r_s = -0.008, p = 0.804**		
Skill	Weighted average score	0.83	1.67	1.47
	Weighted percentage	16.6	33.3	29.4
	Association	**r_s = -0.119, p = 0.094**		
Shortage	Weighted average score	1.11	1.92	1.73
	Weighted percentage	22.13	38.3	34.5
	Association	**r_s = -0.050, p = 0.481**		
Incompatibility	Weighted average score	0.83	1.16	1.08
	Weighted percentage	16.6	23.1	21.6
	Association	**r_s =- 0.115, p = 0.106**		
Credit	Weighted average score	0.32	0.37	0.36
	Weighted percentage	6.38	7.32	7.1
	Association	**r_s = -0.211, p = 0.003**		

* Weighted average score is the sum of the rank order frequencies multiplied respectively by 5 for 1st position, 4 for the 2nd position, 3 for the 3rd position, 2 for the 4th position, 1 for the 5th position and divided by the number of farmers in that category

Even though dairy farmers name quite a number of advantages, some disadvantages, mostly associated with compatibility aspects are also mentioned such as high initial cost, requirement for higher management skill, inability to maintain the required blood level of F2 generation, lack of breeding stock (crossbreed heifer or AI service), incompatibility with environment (susceptibility to disease, parasite and climatic strain), lack of access to production credit, lack of favorable market infrastructure, incompatibility of product with taste of consumers and requirement of high quality feed.

No significant relationships are found between most of the perceived relative advantages and adoption of improved breeds (Table 6.17). The fact that most of the disadvantages, such as shortage of breeding stock, high initial cost and requirement of high management skill are equally perceived to be critical by both the medium and high breed adoption categories, as indicated in the slight variation between their weighted average score provides supportive evidence for the lack of significant association between these attributes and the dependent variable. On the other hand, in ability to maintain blood level of F2 generation and incompatibility of dairy and dairy products with taste of consumers are the least of all the problems mentioned only by a very few number of farmers (see Appendix 6.5b).

As far as the relationship between intervening variables and the adoption behavior of dairy farmers regarding improved breed is concerned, all of the intervening variables are found to be significantly associated with breed adoption (Table 6.18). The result is in agreement to the hypothesized association (Hypothesis 3.2) except the unexpected but commonly occurring negative relationship of need tension regarding production efficiency and the practice itself, which is probably caused due to behavior change attained as a result of the extension program.

Table 6.18 Relationship between intervening variables and adoption of improved dairy breed

Variable	r_s	p
Perceived current efficiency regarding production efficiency	-.196	.005
Need tension regarding production efficiency	-.242	.001
Perceived current efficiency regarding improved breed	-.261	.000
Need tension regarding improved breed	-.183	.010
Need compatibility regarding improved breed	.182	.010
Perceived total attribute regarding improved breed	.219	.002

6.9.2 Influence of intervening factors on adoption of housing practices

Some of the notable behavior positive psychological field forces with regard to the use of improved housing include prevention of feed wastage, provision of comfort and protection for animals, convenience for management, saving of time and keeping animals tidy and healthy.

No significant associations are found between most of the perceived relative advantages and the adoption behavior of dairy farmers regarding this practice (Table 6.19). This is reflected in the very similar rank order distributions and the non-significant correlations. Of all the advantages, prevention of feed wastage and keeping animals tidy and healthy are the most prominent, but only management convenience appears to have had limited influence on adoption behavior ($r = 0.165$, $p = 0.02$).

Table 6.19 Relationships between perceived technology attributes of improved housing and adoption behavior as expressed by weighted mean and percentage scores*

Attributes	Parameters	Distributions of scores according to housing practices adoption categories: None (N=58)	Low (N=72)	Medium (N=70)	Total (N=200)
Relative advantages					
Avoid feed wastage	Weighted average score	2.97	2.72	2.90	2.86
	Weighted percentage	59.31	54.44	58.00	57.10
	Association	**$r_s = -0.002, p = 0.762$**			
Comfort & protection	Weighted average score	1.60	1.97	1.56	1.72
	Weighted percentage	32.07	39.44	31.14	34.40
	Association	**$r_s = 0.005, p = 0.943$**			
Convenience	Weighted average score	1.02	1.18	1.19	1.14
	Weighted percentage	20.34	23.61	23.71	22.70
	Association	**$r_s = 0.165, p = 0.020$**			
Labor/time saving	Weighted average score	1.69	1.38	1.56	1.53
	Weighted percentage	33.79	27.50	31.14	30.60
	Association	**$r_s = 0.045, p = 0.530$**			
Keep animals healthy	Weighted average score	2.72	2.75	2.80	2.76
	Weighted percentage	54.48	55.00	56.00	55.20
	Association	**$r_s = 0.034, p = 0.630$**			
Relative disadvantages					
Installation cost	Weighted average score	2.98	3.28	3.14	3.15
	Weighted percentage	59.66	65.56	62.86	62.90
	Association	**$r_s = 0.017, p = 0.813$**			
Labor	Weighted average score	2.40	2.81	2.87	2.71
	Weighted percentage	47.93	56.11	57.43	54.20
	Association	**$r_s = 0.207, p = 0.003$**			

Only two factors are identified as disadvantages, namely, high installation cost and labor requirement. Participants were solicited to rate the disadvantages on a five-point scale, 5 being the highest disadvantage. According to this assessment high installation costs are found to be the most vital problem for about 40 percent of the sample farmers who assessed it 5 on the rating scale (Table 6.19 and Appendix 6.6b). Very few farmers reported these disadvantages as unimportant. However, only the labor requirements show a significant relationship with adoption ($r = 0.207$, $p = 0.000$) implies that the better

* Weighted average score is the sum of the rank order frequencies multiplied respectively by 5 for the 1st position, 4 for the 2nd position, 3 for the 3rd position, 2 for the 4th position, 1 for the 5th position and divided by the number of farmers in that category

adopters tend to be more aware or knowledgeable about the disadvantage of higher installation costs.

Regarding the relationship between intervening variables and adoption of housing practices, significant relationships are only found in the case of problem perception discrepancy and need tension with regard to the practice. In both cases the relationships are significantly negative, and in accordance with the same trend already observed previously.

Table 6.20 Relationship between intervening variables and adoption of improved housing practice

Variable	r_s	p
Perceived current efficiency regarding production efficiency	.082	.251
Need tension regarding production efficiency	.111	.117
Perceived current efficiency regarding improved housing practice	-.509	.000
Need tension regarding improved housing practice	-.381	.000
Need compatibility regarding improved housing practice	.010	.888
Perceived total attribute regarding improved housing practice	.003	.966

6.9.3 Influence of intervening variables on adoption of medical practice

Perceived relative advantages or behavior positive psychological field factors of dairy farmers regarding medical practices include prevention (specifically related with vaccination), disease curing and contribution to milk production increase. The mean weighted values indicate that disease curing and prevention are the first and second most important advantages (Table 6.21 and Appendix 6.7a) for dairy farmers of ALWDADPMA. Only in the case of prevention is there a linear relationship with adoption behavior ($r = 0.133$) but only at 5 percent level of probability implying that adopters tend to be more aware of these advantages than the non- or poor adopters.

Table 6.21 Relationships between perceived technology attributes of recommended medical practices and adoption behavior as expressed by weighted mean and percentage scores*

Attributes	Parameters	Distributions of scores according to medical practice adoption categories			
		Low (N=62)	Medium (N=52)	High (N=86)	Total (N=200)
Relative advantages					
Prevention (advantage in reference to vaccination)	Weighted average score	0.806	1.12	1.5	1.185
	Weighted percentage	16.13	22.3	30	23.7
	Association	**r_s = 0.133, p = 0.061**			
Disease curing	Weighted average score	1.387	1.31	0.965	1.185
	Weighted percentage	27.74	26.2	19.3	23.7
	Association	**r_s = -0.093, p = 0.189**			
Productivity (refers to increase in milk yield)	Weighted average score	0.806	0.58	0.535	0.63
	Weighted percentage	16.13	11.5	10.7	12.6
	Association	**r_s = 0.053, p = 0.622**			
Relative disadvantages					
Cost	Weighted average score	1.226	1.87	1.36	1.45
	Weighted percentage	24.52	37.3	27.21	29
	Association	**r_s = 0.098, p = 0.169**			
Effectiveness (refers to disease curing ability of available medicine)	Weighted average score	1.145	0.65	-0.17	0.45
	Weighted percentage	22.9	13.1	-3.49	9
	Association	**r_s = -0.183, p = 0.010**			
Specialist (unlike others, medical practices are operated by technicians)	Weighted average score	1.742	1.46	2.07	1.81
	Weighted percentage	34.84	29.2	41.4	36.2
	Association	**r_s =-0.215, p = 0.002**			
Vaccine (there is shortage of vaccine)	Weighted average score	0.048	-0.19	-0.05	-0.055
	Weighted percentage	0.968	-3.85	-0.93	-1.1
	Association	**r_s = 0.048, p = 0.499**			
Medicine (there is shortage also)	Weighted average score	-0.02	0.29	0.721	0.38
	Weighted Percentage	-0.32	5.77	14.42	7.6
	Association	**r_s = -0.072, p = 0.276**			

Incurring additional cost, lack of efficiency, skill or specialist requirement, shortage of vaccines, shortage of medicine and inconvenience of sprayer handling are some of the disadvantages mentioned by dairy farmers of ALWDADPMA. Requirement of specialist is the most important problem for about 40 percent of sample farmers followed by additional costs and lack of effectiveness, which are rated the 2nd and 3rd most important problems for a substantial (10 to 30 percent) number of respondents (Table 6.22 and Appendix 6.7b). Shortages of medicine and vaccines are not perceived to be a serious

* Weighted score is the sum of the rank order frequencies multiplied respectively by 4 for the 1st position, 3 for the 2nd position, 2 for the 3rd position, 1 for the 4th position and divided by the number of farmers in that category

problem. There is, however, no significant relationship between most of the perceived attributes of medical practice and adoption except lack of effectiveness (r = -0.0183, p = 0.010) and requirement of specialists (r = -0.215, p = 0.002). In both cases the relationship is highly significant and negative implying that the non- or poor adopters tend to be more aware of these constraints.

As far as the relationship between intervening variables and the adoption behavior of recommended medical practices is concerned, significant and expected relationships are found only regarding two factors. The relationship between need compatibility and perceived current efficiency with adoption of medical practices is significant and is in agreement with the expected. The rest of the intervening variables are beyond expectations either due to lack of significant relationship or direction of association (Table 6.22).

Table 6.22 Relationship between intervening variables and adoption of recommended medical practice

Variable	r_s	p
Perceived current efficiency regarding production efficiency	.088	.217
Need tension regarding production efficiency	.010	.892
Perceived current efficiency regarding medical practice	-.412	.000
Need tension regarding medical practice	-.570	.000
Need compatibility regarding medical practice	.272	.000
Perceived total attribute regarding medical practice	-.078	.271

6.9.4 Influence of intervening variables on adoption of feed practices

High nutritive value, palatability and high dry matter content are some of the perceived relative advantages of recommended feed practices mentioned by respondents. High nutritive value is rated the most important advantage by more than 75 percent of respondents followed by palatability and dry matter content rated as the 2nd and 3rd most important advantages respectively by between 10 to 75 percent of the respondents (Table 6.23 and Appendix 6.8a). The similarity between the various adopter categories in terms of the weighted average rank order position and the correlation analyses indicate at some form of association between attributes of feed and adoption behavior, but with the exception of the advantage of high dry matter (r = 0.144, p = 0.041) the findings do not provide evidence in support of the hypothesis that the perception of practice attributes contribute toward their adoption.

Table 6.23 Relationships between perceived technology attributes of feed practices and adoption behavior as expressed by weighted mean and percentage score*

Attributes	Parameters	Distributions of scores according to feed practice adoption category			
		Low (N=85)	Medium (N=44)	High (N=71)	Total (N=200)
Relative advantages					
Nutritive value	Weighted average score	1.80	1.57	1.62	1.69
	Weighted percentage	36.00	31.36	32.39	33.70
	Association	**r_s = -0.263, p = 0.000**			
Palatability	Weighted average score	1.02	1.07	1.20	1.10
	Weighted percentage	20.47	21.36	23.94	21.90
	Association	**r_s =-0.027, p = 0.709**			
Dry-matter	Weighted average score	0.18	0.36	0.18	0.22
	Weighted percentage	3.53	7.27	3.66	4.40
	Association	**r_s = 0.144, p = 0.041**			
Relative disadvantages					
Cost	Weighted average score	2.82	3.27	3.01	2.99
	Weighted percentage	56.47	65.45	60.28	59.80
	Association	**r_s = 0.093, p = 0.191**			
Shortage	Weighted average score	2.46	2.59	2.18	2.39
	Weighted percentage	49.18	51.82	43.66	47.80
	Association	**r_s = -0.068, p = 0.340**			
Land (shortage for feed production)	Weighted average score	3.06	2.93	3.18	3.08
	Weighted percentage	61.18	58.64	63.66	61.50
	Association	**r_s = 0.053, p = 0.453**			
Labor	Weighted average score	1.96	2.02	1.99	1.99
	Weighted percentage	39.29	40.45	39.72	39.70
	Association	**r_s = 0.071, p = 0.317**			

The associated high cost, shortage in supply (especially forage seeds), lack of land (for hay making) and laboriousness are some of the shortcomings of improved feed perceived

* Weighted average score is the sum of the rank order frequencies multiplied respectively by 4 for the 1st position, 3 for the 2nd position, 2 for the 3rd position, 1 for the 4th position divided by the number of farmers in that category

by dairy farmers. When asked to rate the drawbacks on a five-point scale (5 = highest), lack of land for hay making is found to be the most important problem for almost 60 percent of the sample farmers, followed by high cost and shortage in supply which are also rated high by about 30 t and 20 percent of respondents, respectively (Appendix 6.8b).

With respect to the relationship between intervening variables and adoption, need compatibility and perceived current problem regarding the practice are found to be strongly related with the feed adoption behavior of dairy farmers (Table 6.24). Need tension and perceived total attribute regarding this practice are not significantly related. On the other hand, need tension and perceived current efficiency regarding the overall production efficiency are significantly related with behavior though the association is not as strong as that of the other intervening variables associated with this practice.

Table 6.24 Relationship between intervening variables and adoption of recommended feed practice

Variable	r_s	p
Perceived current efficiency regarding production efficiency	.135	.057
Need tension regarding production efficiency	.231	.001
Perceived current efficiency regarding improved feed practice	-.640	.000
Need tension regarding improved feed practice	-.061	.390
Need compatibility regarding improved feed practice	.285	.000
Perceived total attribute regarding improved feed practice	-.072	.309

In general, analysis of the relationships between the various intervening variables assumed to influence the adoption behavior of maize and dairy farmers regarding each of the practices included in the packages of the two enterprises showed that most of the need related factors (need compatibility and perceived current efficiency) regarding the practices are significantly related with adoption as expected. This very high and consistent relationship suggest that needs are reliable factors in predicting the adoption behavior of farmers

The relationship between need tension regarding the practices and adoption is usually significant but the direction is negative. This unexpected result can be associated to need satisfaction and/or the likelihood of overrating own efficiency by the least efficient category of farmers.

Perceptions of technology attributes are, in most cases, not found to be significantly related with the adoption behavior of farmers due to the possible reasons provided.

6.10 THE INFLUENCE OF INTERVENING FACTORS ON MAIZE AND DAIRY PACKAGE ADOPTION

In the earlier section, the influences of the intervening factors on the adoption behavior of farmers in relation to each practice (fertilizer, spot application of fertilizer, seed, line planting in maize) and (breed, housing, medical and feed practices in dairy) were assessed. This section is interested in evaluating the influence of these variables on the package as a whole. Factors affecting the adoption behavior of maize and dairy farmers, as pointed out previously are perceived current efficiency, need tension, need compatibility, and perceptions of technology attributes with respect to the above-mentioned practices and the overall production efficiency.

6.10.1 Maize

Unlike the independent variables, the influence of intervening variables on maize package adoption is significant in all of the 18 causal variables except in perceptions of technology attributes regarding seed (Table 6.25). With the exceptions of perceived current efficiency regarding spot application and line planting, which are significant at the 10 percent level of probability, the rest are significant at the 1percent (12 factors) and 5 percent (4 factors) level. All of the variables have the expected sign or the nature or direction of influence except those associated with need tension for reasons already explained in the preceding chapter. This represents strong evidence in support of Hypothesis 3.2. Need related factors (need tension and need compatibility) are the top among the list while factors associated with technology attributes are relatively less important as indicated in the comparatively lower correlations.

Table 6.25 Correlation between intervening variables and package adoption

Variable	r	p	Variable	r	p
Maize			Dairy		
PCE-efficiency	0.110	0.120	PCE-efficiency	0.011	0.872
PCE-fertilizer	-0.282	0.000	PCE-breed	0.088	0.215
PCE-spot	-0.125	0.078	PCE-housing	-0.442	0.000
PCE-seed	-0.338	0.000	PCE-medical	-0.178	0.012
PCE-line planting	-0.136	0.056	PCE-feed	-0.337	0.000
NT-efficiency	-0.348	0.000	NT-efficiency	0.074	0.295
NT-fertilizer	-0.785	0.000	NT-breed	-0.234	0.001
NT-spot	-0.738	0.000	NT-housing	-0.272	0.000
NT-seed	-0.747	0.000	NT-medical	-0.506	0.000
NT-line planting	-0.157	0.026	NT-feed	-0.106	0.136
NC-fertilizer	0.563	0.000	NC-breed	-0.144	0.043
NC-spot	0.677	0.000	NC-housing	0.075	0.291
NC-seed	0.590	0.000	NC-medical	0.181	0.010
NC-line planting	0.754	0.000	NC-feed	0.258	0.000
PTA-fertilizer	-0.155	0.029	PTA-breed	0.048	0.500
PTA-spot	0.144	0.043	PTA-housing	-0.010	0.893
PTA-seed	0.044	0.050	PTA-medical	0.113	0.111
PTA-line planting	0.180	0.011	PTA-feed	0.106	0.136

(PCE = Perceived current efficiency, NT = Need tension, NC = Need compatibility, PTA = Perceived total attribute)

6.10.2 Dairy

Strong associations are also found between intervening factors on the adoption behavior of dairy farmers though the number of causal factors significantly associated with the dependent variable is not as high as in the case of maize. While 7 factors, mainly those related to need tension are significant at the 1percent level, perceived current efficiency regarding medical practices and need compatibility regarding breed are significant at the 5 percent level (Table 6.25). The relationships between factors associated with the variables need compatibilisty and perceived current efficiency and the adoption behavior of dairy farmers are significant in most cases providing further evidence for the validity of Hypothesis 3.2. All factors associated with perceptions of technology attributes are not significantly related with package adoption and appear to contradict the hypothesis (Hypothesis 3.2). The variables associated with need tension have very significant relationships, but the nature (direction) is not as hypothesized but for reasons already discussed.

6.11 CONTRIBUTIONS OF INTERVENING VARIABLES TO PACKAGE ADOPTION VARIANCE

In order to assess more accurately and determine the contributions of intervening variables on maize and dairy package adoption behavior of respondents, multiple regression analysis were used (Table 6.26).

Only those factors, which were significantly associated with the dependent variable, adoption (section 6.7), are included in the multiple regression model.

Table 6.26 Standard multiple regression estimates of the contribution of intervening variables on package adoption

Maize				Dairy			
Variable	Beta	t	p	Variable	Beta	t	p
Constant	-	9.383	0.000	Constant	-	33.354	0.000
PCE-fertilizer	-0.101	-3.166	0.002	PCE-housing	-0.433	-10.121	0.000
PCE-seed	-0.118	-3.963	0.000	PCE-medical	-0.208	-4.686	0.000
NT-efficiency	0.052	1.534	0.127	PCE-feed	-0.209	-4.681	0.000
NT-fertilizer	-0.375	-9.261	0.000	NT-breed	-0.063	-1.491	0.138
NT-spot	-0.280	-7.977	0.000	NT-housing	-0.350	-8.087	0.000
NT-seed	-0.305	-8.386	0.000	NT-medical	-0.414	-9.205	0.000
NT-line planting	-0.062	-2.000	0.047	NC-breed	-0.052	-1.129	0.260
NC-fertilizer	0.126	3.959	0.000	NC-medical	0.039	0.848	0.390
PTA-fertilizer	-0.047	-1.626	0.127	NC-feed	0.197	4.173	0.000
PTA-spot	-0.009	0.242	0.809				
PTA-line planting	0.006	0.157	0.875				
R^2=0.872				R^2=0.683			

(PCE = Perceived current efficiency, NT = Need tension, NC = Need compatibility, PTA = Perceived total attribute)

Intervening variables explain 87.2 percent (R^2=0.872) and 68.3 percent (R^2=0.683) of the variation in the adoption behavior of maize and dairy farmers, respectively. The greatest contribution comes from need related factors (need tension and need compatibility) in both enterprises, once again indicating the fact that needs are indispensable factors in behavior determination. Perceptions of technology attributes, which were significantly correlated with adoption, namely, perceptions of the attributes of fertilizer use, spot application of fertilizer, and line planting are not found to be significant predictors of the adoption behavior of maize farmers as previously observed in this study.

6.12 THE COMPARATIVE CONTRIBUTION OF INTERVENING VARIABLES TO THE VARIANCE IN PACKAGE ADOPTION BEHAVIOR

In order to obtain a better perspective of the relative importance of the various factors in explaining adoption behavior of respondents, a comparison was made between the contribution of independent and intervening factors. Table 6.27 illustrates the overall contributions of independent and intervening variables and the combined effect of the two sets of variables on adoption. It is apparent from the table that the input from independent variables is very small both in case of maize (32.4 percent) and dairy (17.8 percent) when compared to the much bigger contribution of the intervening variables where the value of the coefficient of determination is 0.872 (87.2 percent) in maize and 0.683 (68.3 percent) in dairy. This contribution is almost equal to the total effect of the two sets of variables, namely 0.891 (89.1 percent) in maize and 0.737 (73.7 percent) in dairy.

Table 6.27 Comparison of coefficient of determination based on standard multiple regression estimations

Category of variables	Maize			Dairy		
	R^2	F	Total P	R^2	F	Total P
1. Independent	0.324	13.17	0.000	0.178	10.56	0.000
2. Intervening	0.872	116.135	0.000	0.683	45.557	0.000
3. 1+2	0.891	81.79	0.000	0.737	40.088	0.000

Hierarchical multiple regression estimations were also made to compute the differential contribution of the intervening variables and determine the critical factors influencing adoption behavior as depicted in Table 6.28.

Table 6.28 Comparative influence of independent and intervening factors based on hierarchical multiple regression estimation in maize and dairy production

	Maize				Dairy			
Model-1	Variable	Beta	t	p	Variable	Bteta	t	p
	Constant	-	3.619	0.000	Constant	-	18.584	0.000
	Age	-0.039	-0.547	0.585	Farm size	0.229	3.467	0.001
	Education	0.167	2.090	0.036	Experience	0.001	0.015	0.988
	Farm size	0.085	1.145	0.255	Education	0.160	2.203	0.028
	Media: dummy	0.356	4.547	0.000	Media: dummy	0.251	3.546	0.000
	Ecology: dummy	0.341	4.530	0.000				
	Extension: dummy	-0.080	-1.169	0.244				
	Modernity: dummy	-0.070	-0.927	0.355				
	R^2=0.324, R^2 change=0.324, F=13.17, p=0.00				**R^2=0.178, R^2 change=0.178, F=10.56, p=0.000**			
Model-2	Constant		8.580	0.000	Constant	-	26.060	0.000
	Age	-0.043	-1.383	0.168	Farm size	0.091	2.168	0.031
	Education	0.005	0.130	0.897	Experience	0.010	0.244	0.807
	Farm size	0.052	1.594	0.113	Education	0.063	1.352	0.178
	Media: dummy	0.053	1.477	0.141	Media: dummy	0.107	2.325	0.021
	Ecology: dummy	0.199	4.576	0.000				
	Extension: dummy	-0.034	-0.965	0.336				
	Modernity	0.009	0.254	0.800				
	PCE-fertilizer	-0.121	-3.866	0.000	NT-breed	-0.018	-0.465	0.642
	PCE-seed	-0.093	-3.187	0.002	NT-housing	-0.347	-8.457	0.000
	NT-efficiency	0.003	0.099	0.921	NT-medical	-0.392	-8.987	0.000
	NT-fertilizer	-0.381	-9.488	0.000	NC-breed	-0.097	-2.218	0.028
	NT-spot	-0.199	-5.222	0.000	NC-medical	0.056	1.270	0.206
	NT-seed	-0.292	-8.257	0.000	NC-feed	0.152	3.330	0.001
	NT-line planting	-0.108	-3.402	0.001	PCE-housing	-0.421	-10.205	0.000
	NC-fertilizer	0.084	2.671	0.008	PCE-medical	-0.196	-4.669	0.000
	PTA-fertilizer	-0.014	-0.484	0.629	PCE-feed	-0.200	-4.849	0.000
	PTA-spot	0.030	0.733	0.464				
	PTA-line planting	-0.061	-1.563	0.120				
	R^2=0.89, R^2 change=0.566, F=81.79, p=0.000				**R^2=0.737, R^2 change=0.559, F=43.9, p=0.000**			

(PCE = Perceived current efficiency, NT = Need tension, NC = Need compatibility, PTA = Perceived total attribute)

According to Table 6.28, the differential contribution (R^2change) in maize, for example, is 0.566. This implies that 56.6 percent of the variation in the adoption behavior of maize farmers is explained by the intervening variables alone when the influence of the independent variables is controlled. This, in other words, means that the balance, (87.2 percent-56.6 percent), which is 30.6 percent is an indirect effect of independent variables, explained via the intervening ones (Fig. 6.2).

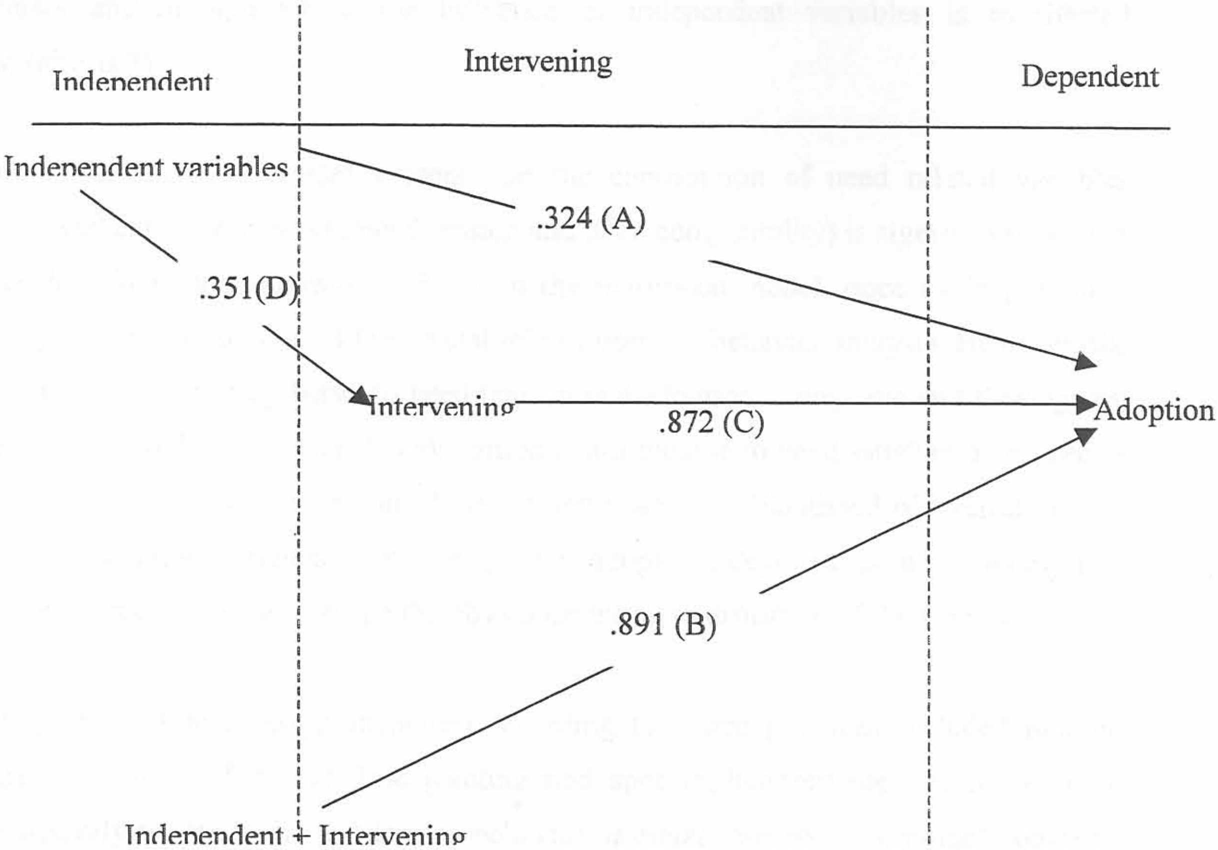

Fig. 6.2 Path diagram showing the relationship between independent, intervening variables and adoption behavior of maize farmers*

The total effect of independent variables will now increase to 63 percent when the indirect effect of independent variables is considered, since the total effect of independent variables is the sum of their direct effect (32.4 percent) and indirect effect (30.6 percent),

* Values 'A', 'B', and 'C' are obtained from the regression model (Table 6.27). 'D' is determined by calculation i.e. 0.306/0.872=0.351

which is 63 percent. In other words the fact that almost half of the cumulative effect of independent variables is manifested via the intervening variables indicates that the effect of independent variables is noticeable only when their impact is assessed along with the intervening variables. This together with the very high contribution of intervening variables to the variation in the adoption behavior of farmers in the study area once again provides strong evidence in support of the main hypothesis of intervening variables being the likely precursor of the adoption or decision-making behavior of maize and dairy farmers and through which the influence of independent variables is manifested (hypothesis 3).

From Table 6.28, it is also evident that the contribution of need related variables (perceived current efficiency, need tension and need compatibility) is significantly higher than the rest of the variables included in the regression model, once again providing strong evidence in support of the crucial role of needs in behavior analysis. However, the direction of relationship between need tension and adoption is negative and thus against the hypothesized expectation. The distortion is attributable to need satisfaction caused as a result of extension intervention of the last ten years. The likelihood of overrating own practice adoption efficiency by the poorer adopter categories is also believed to drastically reduce the need scope thereby contributing to distortion of the findings.

Perceptions (of technology attributes) regarding the three practices included into the regression model (fertilizer, line planting and spot application) are not found to be significantly related with the adoption behavior of maize farmers as commonly observed in this study. Possible reasons for this, as discussed in the previous sections, can be attributed to the undermining effect of vigorously developed negative psychological field factors, lack of a five-point measurement scale to adequately measure the strength or importance of the attributes (valence) and an overlap between the various concepts of intervening variables, especially perceptions and knowledge, which play a less important role in behavior analysis.

In conclusion, analysis of the behavior of farmers regarding maize and dairy farming in the study area shows that intervening variables are the most crucial factors. On top of the very high contributions of intervening variables to the variation in the adoption behavior of respondent farmers in the study area, the implication of the fact that 50 percent of the influence of independent variables is encompassed by intervening variables (as shown in example above) is that an assessment of the intervening variables alone can produce sufficient results in behavior analysis. This in turn makes provision for the drastic reduction of the very great number of variables to have been associated in behavior analysis. The focus of extension can now, therefore, shift to the more direct and immediate precursors of behavior, intervening variables, which pave the way for the emergence of a more flexible, sensitive, and participatory extension approaches, which above all emphasize the needs or problems and perceptions of the development actors, the people.