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PERSONAL AND SOCIO-ECOMOMICAL VARIABLES AFFECTING THE ADOPTION OF MAIZE PRODUCTION INTERVENTION PROGRAM BY DRYLAND FARMERS IN THE VUWANI DISTRICT, LIMPOPO PROVINCE

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ABSTRACT

The study is aimed to find out whether development in the Vuwani district still consists of farmers, communities being told what to do; often by institutions which had not taken time to understand their rural needs. The results tend to be poor, as they did not feel the ownership of the ideas imposed to them. The role of independent, dependent and the intervening variables were not taken into consideration when the extension program was delivered to the farmers. Questionnaires, interviews supplemented by systematic field observation and recordings were the only feasible way of obtaining reasonably accurate data. Questions were kept short to the point to ensure the farmers being interviewed understood their meaning. The methods used for sampling procedure are randomness in such a way that each samples of a given size has the same chance of being selected. The number of clients were 405(four hundred and five) throughout the Vuwani district and only 58 (fifty–eight) respondents (farmers) qualified to represent the community. Data analysis was done manually using tables, figures and Statistical Packages for Social Science Programmes (SPSS) for statistical analysis listing chi-square tests and non-parametric correlation using

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Spearmans rho. The findings show that 57% of the respondents were females, the majority of respondent have access to only between one and two hectares of available land and 55% having less than ten years of farming experience. With regard to the adoption and implementation of the maize production practices, (intervention program presented by extension workers) 75% of the female respondents plant their maize at the correct time against only 25% of the males. Purchasing of seed, fertilizer were early adopted by experience farmers. Only two of the practices show no differences with all other independent variables namely weed control and crop rotation. An encouraging finding was the fact that farmers (respondents) with a small piece of land available adopted more of the critical production practices than farmers with larger areas of a land available to them.

1. INTRODUCTION

In order to achieve development in the Vuwani district "modern" research results had to be transferred to the "traditional" farmers (respondents), and the extension (intervention) program seemed to be the appropriate means to do so. In practice, extension organizations everywhere pursue the overall goals of technology transfer or transmitting through human resource development though the emphasis will differ depending to the focused ideas to be improved. All decisions to adopt or reject a conservation practice and the subsequent behaviour change, rest with the individual or in this case the land users or farmers (respondents). Needs are the cause of all adoption behaviour, and most behaviour can consequently, except for reflexive or frustrated behaviour be deferred as goal–oriented, Düvel (1990). Innovations to be adopted may be ideas, practices or material artefact, perceived to be new by the relevant unit of adoption. The innovation is the change object. All innovation implies change, but not all change involves innovations as not all change involves innovations. Many changes are occurred at the individual levels, that is he/she can adopt or reject the innovations, but it can occur on the groups or organizations.

The Agricultural Extension Service Centre of the Vuwani district has been the van-guard or responsible for transferring the agricultural innovation. To do it effectively Vuwani Agricultural Service Centre has fourteen sub-services that assist the community with agricultural extension services and the provision of agricultural inputs through Levubu co-operatives.

The agricultural extension services provided to the farmers however communicated an extension program for the past three years to improve the maize production in the area. This intervention program focused on the adoption of the following critical maize production practices namely:

- Planting time
- Use of hybrid certified seeds
- Fertilizer program
- Row planting
- Pest control program
- Weed control program
- Harvesting time
- Crop rotation

The aim of the extension activities of Vuwani, was to raise the adoption levels of the farmers whom have been targeted. The aims of this study was to find out from the respondents of Vuwani district the extent to which some of their personal socio-economical variables affect their adoption of innovations recommended by the Vuwani Agricultural Service Centre.

The following objectives were formulated:

(a) To what extent did Vuwani farmers adopt the agricultural practices communicated to them as part of an extension programme.

(b) To find out if the independent variables namely gender, age, education, farming experience, farm size and actual yield does have an effect on the adoption behaviour regarding the recommended practices (independent variables).

2. LITERATURE REVIEW

There is a wide gap in many fields or practices between what is known and what is actually put into practice. Many innovations require a lengthy period often of some years from the time when they become available to the time they are readily adopted. Therefore a common problem for many individuals, groups and organizations is how to

speed up the rate of diffusion of an innovation. (Rogers, 1983). This suggests that respondents may take time to adopt practices such as planting in rows differently i.e. not at the same time.

Hybrid seed had been developed by agricultural scientists years back. The adoption of hybrid seed was heavily promoted by the extension services and salesman from seed companies. Hardly 57% (33) of respondents use hybrid seed in the Vuwani district.

For the future as Chamber (1998) outlines, farmers first roles where outsiders as consultants, support farmers analysis, experiments search for and supply what farmers want and need. Those who improve and spread farmers first approaches stand to gain the reward of seeing that the poor families are truly served and indeed the farmers of Vuwani district were poorly served as their needs were not assessed by the researchers and outsiders consultants i.e. they were told what to do.

One of the constraints to adopt the practices is that many farmers face isolation and feeling that there is little they can do to change their lives. Some farmers will have to spent their entire lives struggling in difficult circumstances to provide for their families with little support or encouragement (Kalanzi, 1999).

The practice of producing maize in the low rainfall areas of arid and semi- arid regions of the world, without the use of irrigation water, is according to Kalanzi (1999) termed dryland farming.

Deciding which innovations (practices) are appropriate requires careful analysis and genuine analogue between development specialists (extensionists), policy makers and farmers (respondents) themselves. Many needs assessment techniques used in a developed region or province may be of little use in the developing areas where educational levels are low and resources scarce (Chamber, 1992) and educational level (knowledge) and farming experience in maize production played an important role in the Vuwani district.

According to Ekoja (2004:91-107) the rate of adoption is positively related to the level of education. Farm size also has a significant relationship to adoption of agricultural innovation by farmers. The

large and medium–scale farmers wanted to maximize agricultural productivity to a greater extent than the small scale farmers.

According to Habtemariam and Düvel (2004:56) indepent variables such as farm size and educational level were significantly related to both the adoption of practices and the production efficiency. Gender, farming experience and age however did not have a significant relationship.

Female farmers display a lower effectiveness and efficiency (maize yield = 1629kg/ha) which is evident in significantly lower maize yields than those of male farmers (yield = 2059kg/ha). According to Chiche, Düvel & Steyn (2003:63) female farmers (25%) are less inclined to use the recommended seed varieties than male farmers (81%).

3. METHODOLOGY

The study was conducted in 2003/4. The information for the study was obtained through intensive literature study on the needs of small-scale farmers and the dryland farmers in particular. Other information was obtained from interviewing community members (respondents); extension officers and personal observation.

A structured interview schedule formed the foundation of the study. The survey is a more standardized form of data collections that includes a prepared questionnaire. According to Düvel (1999) interview and questionnaire methods of data collection are one of the few techniques available for the study of attitudes, values, belief and motives. The methods can be applied to human population except for those with severe physical or mental deficiencies.

Questionnaires find out from the respondents (farmers) their formal education/qualifications; size of the maize fields, planting time, the use of hybrid certified seeds and fertilizer program; weed and pest control, harvesting time and crop rotation.

Questionnaire copies were administered to respondents in each extension office, who on interviewing the respondents ticked in the appropriate blocks to confirm their responses.

The data collected for the study were analysed by hand using tables and figures as well as the Statistical Package for Social Science Programmes (SPSS). Listing chi-square tests and non-parametric correlation using Spearmans rho was applied.

Randomness sampling procedures were used to select the 58 respondents to represent the community.

4. FINDINGS

The findings are presented figuratively, statistically and tablistically.

4.1 Some personal and socio-economic factors of the respondents

4.1.1 Gender

Dryland farming is practiced by both male and female farmers and the distribution of respondents in the Vuwani district according to gender are presented in Table 1.

A total of 58 respondents participated in the research and 33 respondents were females representing the community of Vuwani district. It is well accepted today that women make a sustainable contribution to food production as farmers. This also confirms that African women are responsible for feeding their families either by growing the food or earning money necessary to buy.

Table 1: The distribution of respondents in the Vuwani district according to gender (N = 58)

Gender	Number	%
Male	25	43
Female	33	57
Total	**58**	**100**

4.1.2 Age

The distribution of respondents according to age categories are indicated in Table 2.

Table 2: The distribution of respondents in the Vuwani district according to age categories (N = 58)

Age(categories)	No of Respondents	% (Percentage)
<30	4	6
30-40	5	9
41-50	18	31
51-60	18	31
61-70	12	21
>70	1	2
Total	**58**	**100**

According to the above table only 15% of respondent (in the age category of 40 years or younger) can be classified as relatively young. The majority of respondent 62% fall into middle-age categories while 23% respondents fall within the elderly age group of 61 years and older.

4.1.3 Size of maize field (ha)

The size of land available for production is being indicated in Table 3.

The majority, 83% of the respondents (48) have between zero to five hectares of land available for maize production purposes.

Table 3: Distribution of the respondents according to the size of maize field in the Vuwani district (N = 58)

The size of maize field(ha)	No of respondents	%(Percentage)
0-5	48	83
6-10	6	10
11-15	1	2
16-20	3	5
Total	**58**	**100**

4.1.4 Farming experience

The farming experience of the respondents is being indicated in Table 4 below.

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Table 4: Distribution of respondents in the Vuwani district according to years of farming experience (N = 58)

Farming experience (years)	No of respondent	Percentage (%)
<5	18	31
5-10	14	24
11-15	9	15
16-20	8	14
21-25	8	14
>25	1	2
Total	**58**	**100**

The findings from the table above indicate that 31% of respondents (18) have less than five years farming experience while 69% of the respondents (40) have five years and more farming experience.

4.1.5 Yield in bags per hectare according to farming experience

The distribution of the respondents according to farming experience and the yield per hectare in the Vuwani district are presented in Table 5 below.

Table 5: Distribution of the respondents in different farming experience categories and the yield in bags per hectare (N = 56)

Yield in bags/ha	<10 bags/ha		10–20 bags/ha		21–30 bags/ha		31–40 bags/ha		41–50 bags/ha		Total
Farming experience	1		2		3		4		5		
<5	6	33%	7	35%	3	27%	0	0	1	50	17
5 – 10	4	24%	4	20%	4	36%	1	20%	1	50	14
11 – 15	3	18%	4	20%	2	18%	1	20%	0	0	10
16 –20	2	12%	3	15%	1	9%	2	40%	0	0	8
21 – 25	3	18%	1	5%	1	9%	1	20%	0	0	6
>25	0	0	1	5	0		0		0	0	1
Total	**18**	**100%**	**20**	**100%**	**11**	**100%**	**5**	**100%**	**2**	**100%**	**56**

According to the above table 32% (18) of all the respondents in all the categories of farming experience harvested less than ten bags per hectare while 76% of the respondents (13) with less than five years farming experience yielded only 20 bags or less per hectare. It is only in the yield category 31-40 bags/ha, where all the respondents (5) indicated that they have more than five years of experience

4.2 Correlation between the different independent variables (personal and socio-economic factors)

It has previously been believed that the adoption behaviour of farmers are largely determined or influenced by the socio-economic and personal factors. Although Düvel (1990), indicated that the more direct intervening variables (need, perception and knowledge) has not been taken into account and these variables are actually the predecessors of behaviour, it is still important to determine if there is any correlations between the following independent variables namely; gender, age, farming experience, educational level, farm size and the yield as indicated in Table 6 below.

According to Table 6 the following:

i) There is no correlation between gender and any one of the other independent variables. Although an indication of a negative correlation (-0.238; $p = 0.069$) exist between gender and farm size, indicating that the higher the number of female farmers the smaller the average size of the farm.

ii) A negative correlation (Pearson $r = -0.272$; $p = 0.037$) was found between age and the level of education and it was confirmed by Spearman's rho correlation ($r = 0.250$; $p = 0.05$), indicating that the older the respondents (farmers), the lower their level of education.

iii) A highly significant correlation (Pearson) exist between different age categories and farming experience ($r = 0.450$; $p = 0.00$). This means that the older the farmers (respondents), the more experience they have. This finding was confirmed by Spearman's rho correlation ($r = 0.433$; $p = 0.001$).

Table 6: The correlation between the different independent variables, as reflected by respondents data, in the Vuwani district

Independent variables	Farm size		Yield categories		Farming experience		Educational level		Age categories		Age		Gender	
	1	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Gender	-.278 .069	-.126 .342	.003 .981	.011 .936	-.041 .758	-.047 .726	-.175 .185	-.181 .171	-.012 .928	.018 .894	.048 .718	-.012 .927		
Farmer age	.011	.126 .342	.013 .924	.062 .645	.436** .001	.418** .001	-.272* .037	-.250 .057						
Age categories	.011 .932	.072 .586	.045 .735	.047 .727	.450** .000	-435** .001	-.230 0.079	-.258* .048						
Educational level	.195 .139	.106 .426	-.017 .897	-.012 .929	-.137 .302	-.160 .226								
Farming Experience	.220 .094	.381 .003	.402 .002	.422* .001										
Yield categories	.358** .006	.583** .000												
Farming size														

1 = Pearson Correlation *2 = Spearman rho*
** *= correlation significant at 0.01* *** = correlation is significant at 0.01*
** = correlation significant at 0.05* ** = correlation is significant at 0.05*

iv) The analysis of the data also indicated a highly significant correlation (Pearson) between farming experience and yield categories (r = 0.402; p = 0.002) and it as confirmed by spearman's rho (r = 0.422; p = 0.001). The more experienced the respondents, the higher the maize yield that they have obtained.

v) According to Pearson, there is a highly significant correlation (r = 0.358; p = 0.006) and confirmed by Spearman's rho (r = 0.583; p = 0.000) between yield categories and farm size. This means that the higher the yield the larger the size of land available for maize production. The above-mentioned results need to be taken into consideration by the extension officer while planning and executing the extension program.

4.3 The influence of the independent variables on the recommended practices

In Table 7 the respondents knowledge about some of the recommended practices presented to farmers by extension workers over a period of three yeas, are being indicated.

Table 7: Respondents knowledge with regard to some maize production practices, Vuwani district

Critical maize production practices	Percentage respondents		
	Have knowledge	Some idea	No knowledge
1. Time of planting	29	32	39
2. Fertilizer program	41	11	48
3. Row planting	38	5	57
4. Pest control	24	7	69
5. Harvesting time	21	16	63
6. Weed control	38	5	57
7. Crop rotation	5	9	86

According to the Table 7 above, respondents still do not have enough knowledge to successfully produce maize. It is therefore important to determine the possible role that the independent variables might have played in farmers poor reaction or performance.

4.3.1 The influence of the independent variables on the planting time of maize

According to research (Sensako, 1996) October/November is the optimum planting time for maize in Vuwani district. The planting time of maize as being implemented by male and female farmers are being indicated in Table 8.

The study reveals the following with regard to planting time:

- More female farmers (75%) plant during the recommended planting time than male farmers (25%) and although not very strong the difference is significant ($\chi^2 = 7.499$; $p = 0.058$).

- A total of 48% respondents, who are slightly younger ($\bar{x} = 51.25$) than the mean average age (52.55) of all respondents, do plant maize during the recommended time.

Table 8: Planting time for maize as being implemented according to gender in the Vuwani district

Respondents	June/July		Aug/Sept		Oct/Nov		Dec >		Total	
	n	%	n	%	n	%	n	%	N	%
Male	1	33	10	67	7	25	6	50	24	41
Female	2	67	5	33	21	75	6	50	34	59
Total N	**3**	**100**	**15**	**100**	**28**	**100**	**12**	**100**	**58**	**100**

- A total of 78% respondents with more than 10 years of experience do know when the correct planting time is against 44% of respondents with less than 10 years of experience – the more experience the better the knowledge with regard to planting time.

- The smaller the size of land available for maize production the better the respondents knowledge with regard to planting time.

- Respondents with a higher yield per hectare display a better knowledge with regard to planting time.

4.3.2 The use of hybrid certified seed for optimum production

The maize hybrid seed package used as trials did perform well and above the average yield of the region (Farmer's Weekly, 2003 and Panar, 1985) and local extension workers recommended the cultivar SNK2147 who performs well under stress and is more suited to early planting.

With regard to respondents use of hybrid certified seed the study reveals the following:

- A total of 57% of respondents in all the age categories do make use of hybrid certified seed, while 31% do not make use of hybrid certified seed.

- No significant differences occur between the different age categories with regard to the use of hybrid certified seed, although more respondents (67%) in the age category 50 – 60 make use of hybrid certified seed, than in any of the other age categories.

- Respondents in all the age categories predicted an increase in production if hybrid certified seed will be used.

- Although not significantly, more female farmers (61%) make use of hybrid certified seed than male farmers (52%) and more female farmers (21%) were not satisfied with the seed they used than male farmers (16%).

- With regard to farming experience, it is only in the category of less than five (5) years of experience that more respondents do not make use of hybrid certified seed. In the same category of farming experience the majority of respondents also rated their choice of seed to be poor.

- With regard to size of land available, the larger (3 – 20 ha) the land available the more respondents (72%) make use of hybrid certified seed. The smaller the size of land (1-2 ha) the less the respondents (50%) make use of hybrid certified seed.

4.3.3 The use of fertilizer for optimum production

Today the importance of soil fertility and therefore the application of fertilizer to improve soil fertility is a known fact. Good nutrition is the cornerstone of quality yields. It involves the supply of essential nutrients in a balanced farm to create the right environment for updates (Bew & Smit, 2005). According to the study the respondents indicated the following:

- Only 32% of the respondents did apply fertilizer while 52% did not apply any fertilizer.
- Although the difference is not significant more female respondents (56%) applied fertilizers than males (44%).
- A total of 57% of respondents still rated their fertilizers application as very good while 43% rated it as very poor.
- A total of 67% of the respondents who did not apply fertilizer have less than 10 years of experience, however only 48% of the respondents with less than 10 years experience are satisfied with the use of fertilizer.
- The larger the size of land the more do respondents apply fertilizer.
- The higher the maize yield the higher the percentage of respondents who applied the recommended fertilizer (See Table 9).

Table 9: The effect of fertilizer used on the maize yield (in bags), according to respondents in the Vuwani district

Yield categories bags/ha	Fertilizer use (application)							
	Yes		Sometimes		No		Total	
	n	%	n	%	n	%	N	%
≤ 10	3	19	2	12	11	69	16	100
11-20	1	7	2	13	12	80	15	100
21-40	6	46	2	15	5	39	13	100
≥ 41	8	62	4	31	1	7	13	100
Total	**18**	**32**	**10**	**18**	**29**	**50**	**57**	**100**

4.3.4 Weed control practices and the influence of the independent variable

Weeds are in competition with the maize plant for nutrients and moisture in the soil and therefore a weed control program is an important tool to assist farming reducing risk and to increase maize production. The analysis of the data indicated that:

- A total of 97% of the respondents applied weed control methods, 83% applied the recommended methods while 14% applied a mixed combination of own and recommended methods.

- Only 7% of the respondents indicted that they are not satisfied with the methods applied.

- No differences occur between any of the personal and socio-economic variables and the practice of weed control methods.

4.3.5 The influence of the independent variable in planting of maize in rows

- Row planting enables the farmer to use less seed which is expensive, implement weed control practices and apply fertilizer more effectively. With regard to the practice of row planting the study reveals the following:

- The majority of female respondents 64 practised row planting while only 36% male respondents applied row planting.

- The disappointing factor is that 57% of all respondents are not aware or did not adopt row planting as a practice.

- The percentage of respondents that do plant their maize in rows increases from 14% in the age group > 30 percent to 54% in the age group >50 years of age. The older the farmers the more they plant maize in rows.

- The highest percentage (27,3%) of respondents that do plant in rows do have between 5 and 10 years of experience and the highest

percentage (36.4%) of respondents that do not plant in rows do have less than 5 years of experience.

- No significant correlation could be found between row planting and size of land although percentage wise there are more respondents (31%) with less than 5 ha that do plant in rows than respondents (7%) with more than 5 ha of land.

- There is an indication that more farmers (45%) who planted their maize in rows harvested a higher yield (> 40 bags 10 hectares) than farmers (13%) who broadcasted the seed.

4.3.6 Implementation of a pest control program in maize production

An important part of the maize production intervention program communicated to farmers in the Vuwani district is a pest control program. The extension staff however realizes that only a limited number of farmers can afford to purchase chemicals and therefore they have also recommended natural pest control methods to the farmers.

The influence of the personal and socio-economic factors on the adoption of the pest control program reveals the following:

- Only 13% of all the respondents do apply chemical pest control methods.

- 31% of the respondents applying pest control methods are males and 69% are female respondents.

- A disappointing factor is that 47% of female respondents and 53% of male respondents do not use pesticides at all.

- The majority of respondents (69%) who do apply pesticides are 51 years of age and older.

- Farmers (69%) with more than 10 years of experience tends more to apply pesticides than farmers (31%) with less experience.

- Size of land did not influence farmers to use pesticides.

4.3.7 The influence of the personal and socio-economic factors on the harvesting time of maize

Harvesting time of maize is not regarded as a very important aspect by farmers in the Vuwani district. It is however a known fact that harvesting too early or to late can have a serious negative effect on the yield per hectare. The month of June is according to research the most appropriate time. The results of the study discloses the following:

- A total of 54% of the respondents indicated April/May as the best time to harvest.

- Slightly more females (53%) than males (47%) indicated April/May as the best harvesting time for maize.

- The majority of female respondents (72%) however do not know the best (correct) time for harvesting, while only 52% of males indicated the wrong time for harvesting of maize.

- A total of 65% of the respondents who harvested the crop in April/May have 10 years or less farming experience while only 35% in the same category have more than 10 years of experience. The opposite however occur for respondents harvesting in June where 56% have more than 10 years of experience and only 44% have 10 years or less experience. There is therefore a tendency that, the more farming experience, the more farmers tends to harvest in June, the most appropriate month.

- The larger the size of land available the more the number of respondents indicating April/May as their best harvesting time – the reason for this could be because they harvest by hand and a lack of labour.

4.3.8 Crop rotation as a farming practice and the influence of the independent variables

Research done by the Agricultural Research Council indicated that insects and diseases can decreases maize production by at least 30% (National Agricultural Directory, 2004:446) and the practice of crop rotation can help to protect the maize crop from pest and diseases.

According to the study:

- Crop rotation as a practice, is to a great extent not implemented by farmers in Vuwani district and only 7% indicated that they do practice rotational planting.

- The majority of respondents (90%) however indicated that they are not satisfied with their current practice of crop rotation.

- Disappointingly is the fact that the majority of farmers (83%) with more than 5 hectares of land available also do not have a crop rotation plan.

5. SUMMARY AND CONCLUSION

The findings with regard to the influence of the five independent variables on the implementation of the recommended variables are being indicated in Table 10.

- Only two recommended practices namely weed control and crop rotation show no differences with all five independent variables.

- Two practices namely the use of hybrid certified seed and the application of fertilizer show clear differences with all the independent variables.

- Respondents discloses a very low level of knowledge specifically with regard to the best planting time (29%), harvesting time (21%) and crop rotation (5%).

- Yield categories, as an independent variable, show clear differences with regard to six of the eight practices while no differences occur between yield and weed control and between yield and crop rotation.

It is finally hereby recommended that any agricultural intervention program needs to be planned with the recipients, the farmers and their needs, problems, knowledge and aspirations should be taken into consideration.

Table10: The influence (showing a difference) of the different individual independent variables on the maize production practices

Independent variables	Recommended maize production practices							
	Planting time	Use of certified hybrid seed	Fertilizer program	Row planting	Weed control	Pest control	Harvesting time	Crop rotation
Gender	√	√	√	√	X	X	X	X
Age	√	√	√	√	X	√	X	X
Farming experience	√	√	√	X	X	√	√	X
Size of land	X	√	√	√	X	?	X	X
Yield	√	√	√	√	X	√	X	X

√ = Clear differences between categories of the independent variables and the production practice
X = No differences
? = An indication of a difference

REFERENCES

BEW. M.A. & SMIT. N., 2005. *Omnia Nutriology,* 21 January.

CHAMBER, R., 1994. *Rural appraisal: Rapid relaxed and participatory.* Institute of Development Studies, Brighton, UK..

CHAMBER, R., 1989. *Farmers first: Farmer innovation and agricultural research*. London: Intermediate: Technology Publications.

CHICHE, Y., DÜVEL, G.H. & STEYN, G.J., 2003. Maize production efficiency in the Arsi Negele farming zone of Ethiopia: A gender perspective. *S. Afr. Jnl. Agric. Ext.,* 32:60-72.

DÜVEL, G.H., 1990. Needs and their role in conservation farming. *Journal of Extension System,* 6(2):21-41.

DÜVEL, G.H., 1999. *Evaluation of extension*. Course material not published.

EKOJA, I.I., 2004. Personal variables affecting adoption of agricultural innovations by Nigerian farmers. *S.Afr. Jnl. Agric. Ext.,* 33:94-107.
FARMERS WEEKLY, 2003. Serving agriculture. 3rd October.

HABTEMARIAM, A.G., & DÜVEL, G.H., 2004. Towards a more appropriate and responsive approach for Ethiopia. *S. Afr. Jnl. Agric. Ext.,* 33:52-63.

KALANZI, A.S., 1999. *Needs assessment and reconciliation among livestock farmers in Genyesa district*. M Inst Agrar, University of Pretoria.

NATIONAL AGRICULTURAL DIRECTORY, 2004. *Field crops and horticulture.* pp.446.

PANAR, 1985. *Truly South Africa*.

ROGERS, E.M., 1983. *Diffusion of innovations*. New York: The Free Press. pp 1-5.

SENSAKO, 1996. S*eed that performs on your farm,* Summer.