DETERMINANTS OF MANURE USE BY SMALL-SCALE CROP FARMERS IN THE KWAZULU-NATAL PROVINCE: A LOGIT ANALYSIS

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This study employed the logit model to examine factors that influence the use of cattle and chicken manure for managing soil fertility by surveying a random sample of 224 farm households in the Midlands of KwaZulu-Natal province, South Africa. The majority (87%) of the respondents were farming on communal land with an average farm size of 2.9 hectares. Sixty-three % of the farmers in the sample used manure to manage soil fertility in their fields. Cattle manure was used by 54% while chicken manure was used by 39% of the sample. Manure was readily available to 73% of the respondent farmers. The common method of applying manure was by a spreader. Some suggestions are made on strategies that could improve the efficiency of utilization of manure for soil fertility management in this agro ecosystem.

1. INTRODUCTION

In South Africa, decades of policy discrimination against the small-scale farming sector during the apartheid regime resulted in the small-scale sector being extremely neglected. Until recently, national agricultural programmes and policies were oriented largely to the large commercial sector. Recently however, agricultural policies have been reoriented to accommodate small farmers in the rural and peri-urban areas of South Africa. The Reconstruction and Development Programme (RDP) of the post apartheid Government, for example, considers the economic development of small-scale agriculture as the vehicle for raising the level of incomes and reducing the vulnerability of rural households to food insecurity (ANC, 1994). Under this programme, land will be redistributed to provide the disadvantaged with access to land in order to expand the small-scale farming sector. The emphasis by the government on small-scale agriculture has resulted in a marked surge in the numbers of small-scale crop farmers. This increase can also be a reflection of rising unemployment in the country. In South Africa the small-scale farming sector represents a large proportion of the

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country's population and has the potential to become an important contributor to household food security (FSSA, 1997).

Small-scale production systems in South Africa and other countries in sub-Saharan Africa involve a mixture of both crops and livestock (McIntyre et al., 1992; Powell & Williams, 1995). The crops and livestock contribute significantly to the livelihoods of the people. One of the most important threats to the sustainability of small-scale crop production systems is the decline in soil fertility associated with falling levels of organic matter and soil nutrients (Snapp, 1998; Smaling & Braun, 1996; Steiner, 1991). Although mineral fertilizers have played a major role in maintaining and increasing soil fertility in most areas of the world (FAO, 1992; Smaling, 1993), a range of factors mitigate against the widespread use of mineral fertilizers by small-scale farmers (Gerner & Harris, 1993; Smaling & Braun, 1996).

The high cost of these inorganic fertilizers is a major factor against their use by small-scale farmers given their limited financial resources. Fertilizer has also been shown to produce variable crop yield responses under small-scale conditions, which makes the technology risky and difficult to use by farmers in this sector (Smaling, 1993;Van Noordwijk et al., 1994). Consequently, the amount of inorganic fertilizer used by the small-scale farming sector in South Africa, for example, is generally small and significantly below the levels recommended for the agro-ecological regions of the country (FSSA, 1997). As a result, manure will continue to play a vital role in the maintenance of soil fertility in South Africa and elsewhere in the tropics (Bationo & Mokwunye, 1991; Yoganathan & van Averbeke, 1996; Materechera et al., 1998).

The Fertilizer Society of South Africa estimated that in 1989, there were approximately 3 million tons of manure available in South Africa from various feedlots (FSSA, 1989). The value of this manure calculated in terms of nitrogen, phosphorus and potassium was R29.7 million. It was also estimated that the manure was sufficient to meet 13.3%, 9.9% and 27.6% of the country's requirements of N, P and K respectively. However, it was estimated that only 25% of the 3 million tons of available manure were being used for soil fertility management. The bulk of the remaining 75% of the available manure was mostly wasted with a small portion used as energy for heating. These numbers are not expected to have changed much since then.

Maize is the most important crop grown in the Midlands region of KwaZulu-Natal province (KZN), especially among small-scale producers, since it provides food for the family. Intensive farming by mostly large commercial farmers produces beef and dairy, chicken, sheep and maize. Many intensive and semi-

commercial poultry and beef fattening units have recently mushroomed in the area. Consequently, the availability of manure has increased. Experience has shown, however, that although there is a general perception among the people in the area that manure is beneficial for soil fertility management, the use of manure by farmers is relatively low (Letty et al., 1999; de Villiers et al., 1999).

The aim of this study was to investigate the determinants of manure utilization for soil fertility management by small-scale crop farmers in the region. A secondary objective was to identify possible solutions that could lead to the improved use of manure in the area.

2. METHODOLOGY

2.1 Sampling Procedure

A list of farmers involved in crop production in the Midlands area of KwaZulu Natal was obtained from the Provincial Department of Agriculture. A sample of 244 farmers was randomly selected from the list. A visit was made to each farmer and a questionnaire was administered in a participatory rapid appraisal approach. The interview consisted of a combination of structured and open-ended questions. The data were collected between October and December 1999.

2.2 Data Analysis

Descriptive statistics for the socio-economic variables obtained in the survey were used. The data collected from the respondents were analyzed using frequency counts, percentages and standard deviations. In order to determine the factors that influenced farmers' decision to use manure for soil fertility management, a logit model similar to Williams (1999) and Sureshwaran et al., (1996) was specified and its parameters estimated. The model was chosen over other similar models because it was not possible to quantify the amount of manure applied by all the farmers in the study. To overcome this problem and to ensure that manure acquired from all sources was considered, manure application was recorded as a dichotomous variable. In this study, the concern was not the amount of manure used by the farmer, but the probability of a positive event (the utilization of manure) occurring. A causal model was hypothesized and because of the way in which farmers were asked to respond to the survey instrument, the observations on the dependent variable of the model were dichotomous, i.e. they had values of one or zero (Anim and Van Schalkwyk, 1996; Garrod and Willis, 1995). Ordinary least squares (OLS) were inappropriate because of the implied heteroscedasticity of the error term (Gordon *et al*, 1994).

The empirical model used to analyze farmers' decision regarding manure utilization was specified as:

$$MANURE = \beta_0 + \beta_1 HERD + \beta_2 FS + \beta_3 FE + \beta_4 LANDTEN + \beta_5 TRAIN + \beta_6 EXSERVE + \beta_7 AVMAN + \beta_8 LANDLAB + \beta_9 ORGANISER + 0 \quad (1)$$

Where the dependent variable MANURE, is a dummy variable that takes on the value of 1 if a farmer had applied manure to his fields anytime prior to the study and 0 if he did not apply manure. HERD, the size of livestock herd, is an aggregate measure of the total number of animals owned by the farmer. One herd was taken as being equal to a fully-grown bull. Generally, it is expected that ownership of a large herd may have a positive effect on manure utilization, but farmers with few animals may be less willing to apply manure, especially if their cultivated farm size is large and/or if labour availability for collection and hand spreading of manure is limited, as is the case with most farmers in the study area. It was hypothesized that ownership of less than 1 HERD, is negatively correlated to manure utilization. The variable takes a value of 1 if a herd owed by the farmer is less than one and 0 otherwise.

FS is the total cultivated farm size in hectares as measured by the interviewer. Unless a farmer has a large herd size or was able to obtain manure from commercial livestock producers, the higher the total cultivated farm size, the less likely a farmer will be inclined to apply manure. A value of 1 was given to this variable if the farm size was above the mean sample average of 2.9 hectares and 0 otherwise.

FE is the number of years of farming experience that the farmer had at the time the survey was conducted. The variable was given a value of 1 if the farmer had farming experience above the sample mean of 10 years,and 0 otherwise.

LANDTEN is the land ownership status (land tenure) the farmer had over the cultivated land. Due to discriminatory apartheid laws, which existed in South Africa before 1994, many black smallholder farmers did not have access to land for farming. Most of the emerging small-scale farmers cultivate on communal land, without a title deed. Land under communal ownership is held in trust by traditional leaders (chiefs) for the community and allocated to the community members by the chief (van Rooyen & Nene, 1996a; 1996b). Research from elsewhere has shown that farmers who cultivate both borrowed (leased) and owned fields consistently divert manure toward the latter (Gavian & Fafcamps, 1996). This implies that the land tenure status (ownership of land) of a farmer and the nature of her access to the land may influence investment in soil fertility improvement or maintenance. It was hypothesized that LANDTEN was

positively related to manure application. The variable was given a value of 1 if a farmer had a title deed to the land and 0 otherwise.

TRAIN indicates whether or not the farmer had attended some training on manure utilization within the last two years prior to this survey. Due to the low nutrient content of manures compared to inorganic fertilizers, farmers may be less inclined to apply manure to their fields without sufficient information and know-how on manure utilization and management. It was hypothesized that manure application was positively related to TRAIN. The variable train was considered to be 1 if the farmer had attended training within two years before the survey and 0 otherwise.

EXSERVE is the availability of extension services to farmers for the provision of information and advice on manure utilization. Due to the factors discussed under TRAIN, farmers require a readily available extension service system in order to support and guide them in the management of manure.

AVMAN is a dummy variable that takes on the value of 1 if the farmer had access to manure through commercial poultry or feedlot units and 0 if he did not. Due to the large amount of manure required to adequately supply plant nutrients, farmers can supplement manure from their own, usually small herd, by buying or otherwise acquiring manure from adjacent poultry production units, neighbours with bigger herds and commercial feedlots.

LANDLAB is the ratio of cultivated farm size to available household labour. Manuring, especially when it involves hauling and hand-spreading, is labour intensive. Despite its high labour intensity, farmers are obliged to collect manure from their neighbours around the village and transport it to their fields due to inadequate household herd size and/or lack of their own herd. Speirs and Olsen (1992) found that 82% of the households surveyed in Senegal, 70% in Mali and 85% in Niger transported manure to their fields using animal-drawn carts or head transport. Due to the labour-intensive nature of existing methods of manure application in the KZN midlands, it was hypothesized that the higher the land area in relation to available household labour, the lower the probability that a farmer will apply manure.

ORGANISER is the availability of organic fertilisers to the farmers as a substitute for manure. Organic fertiliser is here defined as any organic-based material that has been produced for soil fertility improvement and/or its maintenance. It was hypothesized that the availability of organic fertilizers would be negatively related to the utilization of manure since these two commodities are known to be substitutes.

The error term, 0, which represents unobservable socioeconomic factors and characteristics of the surveyed farmers, was assumed to be independently distributed over the survey period.

The parameters of the model specified in Equation (1) were estimated through an iterative maximum procedure (SAS, 1996). Parameter estimates for the model were evaluated at the 5% level of significance.

3. RESULTS AND DISCUSSION

3.1 Cropping systems

The majority (98%) of the farmers practiced dryland farming. Maize was the most common crop grown by 86% of the respondent farmers followed by potatoes (76%), vegetables (71%) and dry beans (48%). Maize was mainly grown for home consumption and the surplus sold for cash. The estimated average grain yields for maize under small-scale agriculture in the midlands was 3.8 t ha^{-1} while that for the large-scale commercial farmers was 7.5 t ha^{-1} (Manson, 1996). Soil acidity and poor fertility were considered to be the major causes of the low yields under the small-scale situation (Lettey et al., 1999).

3.1 Socio-economic factors

Some characteristics of the respondent farmers, which might have influenced manure utilization, are presented in Table 1. About 57% of the respondent farmers had been engaged in farming for over 10 years. The considerably low percentage of people engaged in farming for a long time is likely to be due to the political past of South Africa. Many black people did not, during the apartheid government, have access to land for agriculture (Mini, 1999).

The average farm size for the majority (87%) respondent farmers was 2.9 hectares. The small farm size for emerging farmers in the Midlands is consistent with that of similar farmers elsewhere in the country (van Rooyen & Nene, 1996a&b; FSSA, 1997). Only 9% of the respondent farmers had title deeds to their farmland while the majority (87%) were living on communal land. A small percentage (3%) of the respondent farmers held land under a leasehold agreement with either the owner or tribal authority.

3.2 Labour

It was found, in general, that the head of the household and/or the spouse took charge of household agricultural activities. This finding is similar to findings by Kirsten et al (1996) who found that the head of the household and the spouse spent around 25 hours per week during summer and 14 hours per week in the winter on agricultural activities. In this study, most respondents (67%) employed no labour from outside the household. Those households that employed labour from outside employed no more than 5 labourers. Generally, these labourers were paid in-kind, e.g. potatoes, clothes, maize, fertilizers, or meals.

Table 1: Some characteristics of the respondent farmers in the study

	Characteristic	Frequency	Percentage
A	**Farming experience (Years)**		
	<10	140	57
	>10	104	43
B	**Farm size (ha)**		
	<3.0	212	87
	>3.0	32	13
C	**Land tenure**		
	Communal	210	85
	Leaseholder	11	4
	Owner (holds title deed)	23	9
D	**Family labour availability(AE)**		
	<3	171	70
	>3	73	30

AE = Adult Equivalent

3.3 Manure availability, sources and utilization

The availability, type, sources and method of application of manure are presented in Table 2. The majority (73%) of the respondent farmers claimed that manure was always available for use in the field. The farmers indicated that it was easy to establish agreements with the owners of nearby cattle and poultry feeding units to collect manure. Some farmers collected manure from their own pens (kraals). Cattle owners grazed their livestock in communal grazing areas. The animals were confined overnight in a kraal close to the household. The manure, which accumulated throughout the year in the kraal, was collected and applied to the field. Another way in which cattle manure was utilized was when cattle were driven into crop fields to feed on the remains of harvested crops. The 25% which indicated that manure was seldom available attributed this to lack of transport and/or equipment for haulage.

Cattle manure was used by 54% of the respondent farmers, followed by chicken manure (39%) and other manure (7%). It was quite interesting to note that despite the obvious advantages of chicken manure and its wide availability in the study area, its use as source of plant nutrients was relatively limited. It was established that many farmers were not accustomed to using chicken manure as fertilizer. One reason given was that most of the farmers do not keep chickens and so the manure had to be collected from commercial poultry units. This was in contrast with cattle manure which was available from their own, or neighbours kraals. Another reason was that most farmers had no experience with chicken manure and so lacked knowledge on the usefulness of this manure and its management. Some farmers believed that too much chicken manure would "burn" their crops. Cattle manure was also available in large quantities from beef and dairy units scattered around the region. The exact quantities of available manure in the region have however not yet been established. In most cases, the manure was broadcasted and ploughed under before planting.

Table 2: Availability, sources and utilization of manure by respondent farmers

	Variable	Frequency	Percentage
A	**Manure availability**		
	Always	178	73
	Seldom	61	25
	Not	5	2
B	**Type of manure used**		
	Cattle	132	54
	Chicken	95	39
	Others[1]	17	7
C	**Sources of manure[2]**		
	Poultry units		73
	Beef feedlots		45
	Dairy farms		22
	Own herd		13
D	**Method of manure application**		
	Use planter, mixed with fertilizer	137	56
	Placed in ridge furrow by hand	61	25
	Broadcast by hand	20	8
	Broadcast & with planter	15	6
	Cattle corralled on fields	11	5
E	**Organic fertilizer availability**		
	Available	0	0
	Not available	244	100

[1]Includes: goats, sheep, crop residues, and green manure
[2]Total exceeds 100% because farmers indicated multiple sources

3.4 Farmers' experiences and perceptions of manure

The proportion of sampled farmers who were still using manure and the different observations which the farmers had made after using manure, are presented in Table 3. Although 58% of the respondent farmers were still using manure for soil fertility management, 23% indicated that they had used manure before but had stopped. The reasons given for abandoning the use of manure included: they did not have transport and labour to haul and apply manure in the field (45%); low crop yields (20.5%); manure has low nutrient content (10.5%); encourages weed growth and has bad smell (7%); lack of appropriate technical information on the management of manure in the field (17%).

This finding is consistent with that of Enyong et al., (1999) who reported that farmers are in general risk averse when confronted with a technology that involves substantial tradeoffs. They suggested that farmers would adopt a technology only when they are convinced that it will bring about higher levels of achievement (yield in this case). The farmers in this study, who had stopped using or had never tried using manure, might have perceived manure as an added production cost without the assurance of a better yield.

Table 3: Farmers' experiences with manure and its effects on soil and crops

	Variable	Frequency	Percentage
A	**Experience with manure utilization**		
	Never used	47	19
	Used but discontinued	56	23
	Still using	141	58
B	**Positive attributes**		
	Better crop growth (healthier and greener)	161	69
	Kept soil moisture longer	10	4
	Cheap and always available	51	21
	Reduced soil sourness (acidity)	15	6
C	**Negative attributes**		
	Demands labour and transport	110	45.1
	Low nutrient content	50	20.5
	Utilization requires technical information	42	17.4
	Its performance is slow	26	10.5
	Encourages weed growth	12	4.8
	Bad odour	4	1.7

The majority (69%) of farmers who used manure to manage soil fertility indicated that they had observed improved soil conditions and crop growth and yield after applying manure. Most farmers explained that they had observed an increase in the water retention, reduced stickiness on clayey soils, and increased soil pH after applying manure. It was claimed that the plants where manure was applied

looked healthier/greener, and produced higher yields than those without manure. A high proportion (63%) of the respondent farmers indicated that although the yields obtained in crops where fertilizer was used were higher than those of manure alone, the combined effect of manure and fertilizer produced equally higher yields.

On clayey soils that became compact easily, manure, it was claimed, improved the physical properties of the soils. This was reflected in that the soils became granular, absorbed rainwater more readily and drained away free water easily during continuous heavy rain. Consequently, the soils were claimed to be better aerated with the result that seeds germinated more quickly and plant roots penetrated deeper into the soil.

3.5 Communication-related factors

Table 4 shows that 67% of the respondent farmers had not attended any formal training related to the use and management of manure while 32% have had the opportunity to participate in such learning experiences. This finding confirms that many farmers in the study area were using manure but without the necessary technical information necessary for its efficient use and management. Most of the farmers cited lack of knowledge and information about the optimum use and management of manure as an important factor that was deterring the efficiency of manure utilization. For example, 77% of the farmers who used manure claimed that they did not have any knowledge regarding the optimum rate, time and method of application. On the contrary, the majority (81%) of the respondent farmers reported that they had ready access to extension services and personnel. It was apparent that there is a need to include and/or increase technical information on manure use and management in the extension programmes in this agroecosystem. In light of the apparent limited experimental data available, it is recommended that research should also focus on the development of optimum strategies for maximizing the efficient use of the available manure resources under the existing farmers' situation.

3.6 Problems associated with manure utilization

Difficulty in application and offensive smell were some of the reasons given for not using manure. The bulkiness of manure, implying increased transportation costs, and growth of many weeds after application of manure deterred some farmers from using manure. Chicken manure was considered to have reduced the incidence of stalk borer and maize grey leaf spot disease.

Table 4: Attendance of training and availability of extension services on manure utilization

	Variable	Frequency	Percentage
A	**Training**		
	Never attended	163	67
	Attended	78	32
	Not applicable	3	1
B	**Extension services**		
	Available	198	81
	Not available	46	19

Most of the respondent farmers (81%) shared the opinion that it was necessary to improve the quality of available manure in order to increase their fertilizer value. This would involve introducing technologies that remove or reduce the number of weed seeds and smell from the manure; granulating or pelleting the manure; proper storage and composting of manure; and improved supply of technical information on use and management of manure.

Another problem that was noted in the study was that involving the handling of manure. Manure was in most cases carted from the stables or kraals to the fields a few weeks before it was ploughed into the soil. During the waiting period, the manure was left in little heaps and was exposed to wind, sun and even rain. Consequently, the ammonia nitrogen may volatilize and in some cases, the manure would go mouldy, meaning that the available nitrogen had been converted into fungoid. This would reduce the available nitrogen and other nutrients in the manure.

3.7 Quality of manure resources

The effectiveness of animal manure depends on their chemical composition. Table 5 gives the average composition of the cattle and chicken manure. The composition of manure varied widely across the study area. In comparison to cattle manure, chicken manure contained a higher nutrient content (especially N and P). Assuming that roughly 1000 hens in a chicken house produce about 20 tons of fresh manure, or 5 tons of air-dry manure per annum (Sims & Wolf, 1994), the approximately 7.5 million hens in the Midlands would produce about 150,000 tons of fresh manure or 40,000 tons of air-dry manure with 10% moisture. This implies that chicken manure should be considered as an important source of plant nutrients in the region. The value of chicken manure is already highly recognized elsewhere (Shepherd & Withers, 1999).

Chemical composition of cattle manure is influenced by among other things the quality of feed, age, storage and handling conditions (Somda et al., 1993; Tanner et al., 1993). It is suggested that the large variation in the quality of manure samples observed in this study could be a reflection of the differences in the management of cattle in the Midlands region. The method by which animal manure is stored and treated during storage may also greatly affect its composition and value. There exists a lot of literature on this aspect and much research has been conducted thereon (Murwira et al., 1993). The changes which plant nutrients undergo during the process of decomposition and the losses that can occur as a result of volatilization and leaching are well known (Murwira & Kirchman, 1993; Sims, 1986). Quality of manure did not, however, seem to have any influence on the farmer's choice to use manure in this study.

Table 5: Some characteristics of cattle and chicken manure from the Midlands of KZN Province, South Africa

Characteristic	Units *Range*	Cattle *SE*	*Mean*[1]	*Range*	Chicken *SE*	*Mean*
Ash content	(%) 45.7-56.3	4.8	49.1	27.8-32.6	1.42	31.7
Dry matter	(%) 50.2-74.8	8.1	68.2	75.3-79.4	0.96	77.8
Organic carbon	(%) 31.6-56.5	7.2	47.7	32.1-35.2	1.13	34.3
Total Nitrogen	(%) 0.12-2.11	1.13	1.67	2.6-4.3	0.77	3.8
C:N ratio	- 21:1-34:1	9.1	29:1	7:1-10:1	1.5	9:1
Available P	(mg kg^{-1}) 0.68-1.88	0.27	1.07	1.83-3.57	0.59	2.36

[1]Mean of twenty determinations based on dry weight of manure

3.8 Factors influencing farmers' decisions to use manure

A summary of the statistics for the logit model is presented in Table 6. The model required 6 iterations to generate the parameter estimates. The likelihood ratio test indicates that the specified model explained significant non-zero variations in the factors influencing farmers' decisions to adopt manure utilization. The model correctly classified 75 % of the farmers that utilized manure. The McFadden's R^2 was relatively high for the qualitative response models but is consistent with results obtained in other studies (Capps & Kramer, 1985).

Table 6: Summary statistics for the logit model

Statistic	Value
McFadden's R^2	0.326
Log of likelihood function	-37.488
Likelihood ratio test	36.196
% of farmers correctly classified	75
Total number of iterations	6.0

The estimates of likelihood of farmers to use manure for soil fertility management according to the logit model are shown in Table 7. Five out of the seven factors analyzed were statistically significant in explaining farmers' decision to utilize manure. These factors were farm size, manure availability, herd size, farmers' experience in farming, and the availability of extension services. The signs of all significant parameter estimates were consistent with *a priori* expectations.

Table 7: Parameter estimates of maximum likelihood for manure utilization according to the logit model

Variable	Parameter estimate (coefficient)	Asymptotic standard error	Change in probability
FS	-1.0863*	0.9007	-0.3425
HERD	1.6862*	0.7366	0.5316
FE	2.0314*	1.0737	0.6405
LANDTEN	1.7167 ns	0.7668	0.5241
TRAIN	0.0925 ns	0.1370	0.0292
EXSERVE	1.6979*	0.7976	0.4352
AVMAN	2.1699*	0.7265	0.6832
LANDLAB	-0.1608*	0.0942	-0.0170
INTERCEPT	-4.4233	2.0690	-

*, Significant at the 5% level; ns, not significant

In keeping with expectations, the probability of utilizing manure was negatively influenced by the amount of land cultivated (FS). Farmers producing crops on a farm size that was below the sample mean of 2.9 hectares used manure mainly from their own kraals for soil fertility management on their fields. Farmers producing on larger farm sizes (>2.9 hectares) were commercially oriented and produced small marketable surpluses, which are sold to augment household income. Farm size is an indication of the level of economic resources available to subsistence farmers. As a result of having more economic resources at their disposal, and the difficulties associated with applying manure over large areas, the probability of using manure decreased with increasing farm size while the use of inorganic fertilizers increased. For example, the probability of using manure dropped by 34% when the farm size increased beyond the mean size of 2.9 hectares. On the other hand, farmers with farming experience of more than 10 years average had greater probabilities (64%) of utilizing manure.

The coefficient of LANDTEN was not significant at the 5% level and this is similar to research finding by van Rooyen & Nene (1996a) who found that communal land ownership did not adversely affect farmers' decisions to invest in the land. It is quite likely that land tenure and farm size were positively correlated. If this was the case, then this co-linearity could have been one possible reason why tenure appeared to be non-significant. The other reason could be that the presence of a title deed may not reflect secure tenure. Recent literature has challenged the perception that customary land tenure is secure, and Thompson (1996:88-98) provided convincing evidence that private returns on investment and exchange are not predictable. Lyne (1996) stated that it was significant that Thomson's findings related to arable land which was characterised by relatively well-defined and exclusive individual property rights. However, these property rights were not well enforced and farmers risked severe crop losses due to theft and damage caused by livestock (Lyne, 1996). Manure procurement arrangements with neighbours and adjacent commercial livestock units increased the probability of manure utilization by 68%. Similarly the farmers' decision to use manure was not affected by whether or not they had previously attended any training. The probability of using manure increased only by 2% with training.

Generally, the majority of the farmers perceived manure as an important resource for soil fertility management in the area. Farmers were willing to adopt the technology as long as technical information becomes available. As Enyong et al. (1999) have observed, African smallholder farmers recognize the importance of soil fertility for crop production and have modified their practices to suite the available organic resources. Tiffen and Mortimore (1994) for example, have shown how farmers in Machakos, Kenya, improved the quality of their land through investments in new technologies, knowledge and improved management techniques. Similarly, Williams (1999) has shown that farmers in West Africa make decision to adopt manuring technology based on existing socio-economic, institutional, agronomic and ecological concerns.

4. CONCLUSION

This study has shown that manure is one of the principal resources available for soil fertility management in the Midlands of KZN. Indications are that, as the intensification of small-scale farming becomes higher due to the large numbers of emerging farmers in South Africa, manure will continue to play an important role as a source of plant nutrients. Evidence from this study suggests that the

available manure in the region is currently used injudiciously. Although both cattle and chicken manure were readily available to farmers in the area, a larger proportion of farmers used cattle manure, despite the obvious benefits of chicken manure such as its higher nutrient content and faster mineralization. The reasons are mostly technical and socioeconomic. Farmers were not accustomed to using chicken manure because it was not, until recently, available to them in large quantities. Consequently, most of the farmers did not have the experience and technical information regarding its use and management. The role of extension services among households was considered to be vital in the technology adoption process and needs to be strengthened in the area. Appropriate policies and institutional arrangements also needed to be strengthened in order to encourage the utilization of available manure for soil fertility management by the farmers in this agro ecosystem.

It was determined that farmers cultivating up to 2.9 hectares and producing mainly for subsistence had a higher probability of adopting manure compared with larger farmers producing some marketable surpluses. Land ownership, though significant in the technology adoption process, needs further investigation as far as its influence on the use of manure is concerned. Furthermore, strategies for improved use and management of the available manure resources need to be identified in order to establish a rational basis for their use. It is suggested that extensive research on the composition or quality, mineralization of plant nutrients and availability to plants, the proper time and method of manure application, etc. should be conducted and results properly disseminated to farmers and extension workers. Similarly, training and information campaigns on techniques that improve the efficiency of manure utilization are also needed.

Policies such as helping small-scale farmers to organise into co-operatives and/or associations would help reduce the high unit costs of negotiating deals, transportation, treating and storing of manure. It would be easier and more cost-effective to procure large quantities of manure, especially chicken manure, from commercial plants and spread the cost over a larger number of individual farmers than hiring transport for smaller quantities. Other possible policy measures that could help reduce costs and encourage the utilization of manure include negotiating with large poultry units for the disposal of chicken manure in areas within reasonable distance from small-scale farming communities, and the provision of manure storage facilities in this community as an environmentally sound alternative.

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