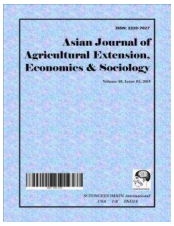

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Factors Affecting Uptake of Organic Soil Amendment Techniques to Sustainable Land Management: Case of Integrated Land Use Design Techniques in Schools and Communal Farming Communities

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Authors' contributions

This work was carried out in collaboration between all authors. Author CTG designed and supervised the study, managed the literature searches, wrote the protocol and wrote the first draft of the manuscript. Authors JC and NM managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

The study was carried out in schools teaching organic farming technologies in Zimbabwe. The research sought to find out effective implementation strategies of farming innovations through schools community integration. The selected schools consisted of 5 primary schools and 3 secondary schools. Structured questionnaires were administered to 55 primary school pupils and teachers, 34 secondary school pupils and teachers and 40 small holder farmers within the school environs. People who participated in the study had been trained in organic soil amendment

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techniques. It was found out that schools and surrounding farmers were trying out new organic soil amendment techniques, with the primary school sector practicing more of the new technologies than the secondary schools and the communal farming sector. It was also found out that schools had similar constraints that inhibited the uptake of organic farming technologies. The study recommended that introduction of innovations into the farming communities should be done through young people of primary school going age.

Keywords: Organic; soil amendment; sustainable; innovation; farmer; schools.

1. INTRODUCTION

Practitioners and policy makers concerned with high rates of rural poverty and food insecurity and declining per capita agricultural productivity in sub-saharan Africa have begun to attend to the natural resource management problems that are both cause and consequence of soil deterioration. Over the past decade, resources have been dedicated to developing, often in collaboration with farmers, farming technologies and natural resource management practices that break the vicious circle of poverty. Thus helping to facilitate the intensification of production, thereby increase agricultural productivity, food security and rural incomes across the continent [1]. Unfortunately, the rates of adoption and diffusion of improved natural resource management practices have generally fallen short of expectations due to low uptake rate. Adoption of technologies could be affected by education, training, type of advice and information which form the basis of farmers' knowledge. New technologies coming from outside the local environment may also be resisted by the primary beneficiaries. [2] The small holder farming sector have introduced environmentally-sound farming technologies, through research, extension, cross-compliance measures, education and awareness, information dissemination and engaging the farmers through interactive mechanisms.

The low uptake of farming innovations have been linked to the introduction of technologies that exhibits diseconomies of scale, risk and uncertain outcomes, low farmer education and expertise and lack of sustainability among other factors [3]. On the other hand a biographical characteristic such as the age of the farmer is considered as one of the most important determinant of farmer's decision in technology adoption [4]. It is opined that the age of a person can have intricate effects on adoption of sustainable agricultural technologies. It was also established that age have a direct effect on the probability of adoption of improved forage technologies in North East Highlands of Ethiopia [5]. Thus the age of farmer positively affected the probability of adoption. The reason was that older farmers possibly might have acquired more knowledge relative to younger farmers and would therefore resist taking up new technologies. It is therefore important to identify the ideal entry point when introducing innovative agricultural technologies and context specific factors affecting the adoption of sustainable farming technologies.

Some studies have shown that young farmers have a tendency to be more innovative due to their longer horizons and are risk lovers [6]This may imply that young pupils in schools may be the right entry points with new technologies. The inherent characteristics considered in the literature include complexity of the technology, compatibility with farmer environment and transferability. Below is a model of variables that determine the rate of adoption.

1.1 Variables Determining Rate of Adoption

Scherr [7,2] found that institutional factors that affect adoption include research, access to credit, extension, tenure, agricultural policy, markets, social factors and religion. In most African countries the factors that affect adoption of technologies seem to be similar as stated by [8]. Most technologies that researchers have developed have had low adoption and diffusion rates among most rural African societies [1]. Despite the high potential of some soil amendment practices to improve the sustainability of African agriculture, their transfer to the poorest farmers has, to date, been limited [9].

Particular farming innovations are taken up quickly by some and only taken up later by others, while others never try out new technologies [10]. The factors affecting taking up of sustainable farming innovations have traditionally focused on farmer characteristics,

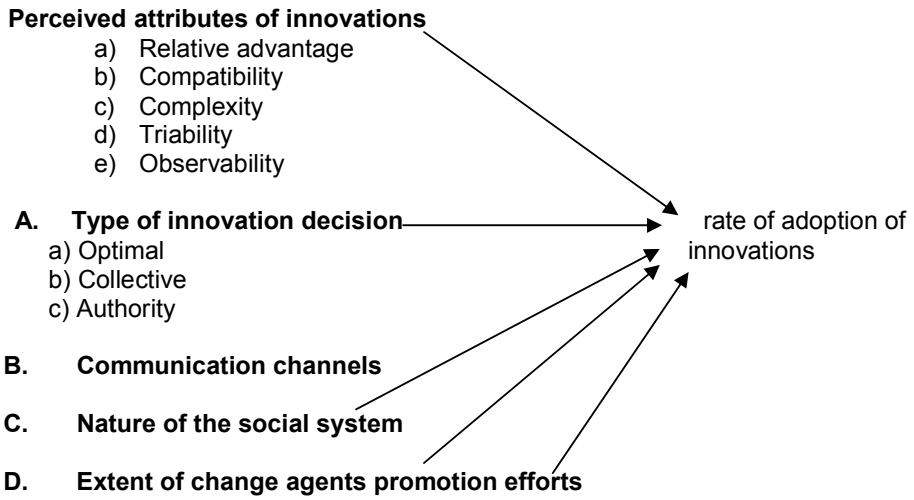

Fig. 1. Determinants of adoption rate
Source: [1].

inherent features of the technology and environment or institutional factors. Empirical household level studies of the determinants of adoption usually find that variables such as level of education, age, farm size, income and land tenure have a significant influence on uptake of farming innovations [1].

This study focused on people of heterogeneous age and educational experiences in schools and surrounding farming communities. Schools were targeted since they made good linkages with the communities and are generally composed of the young age group. Sustainability cannot just be looked at in biological or ecological terms because the state of hard system depends crucially on interactions between multiple human beings (i.e. on soft system) [11]. Therefore schools community integration is essential in the dissemination of any innovations or technologies [10].

The organic farming programme explored by this study was implemented through a model called Integrated Land-use Design (ILUD) in schools and communal farming areas of Zimbabwe. The programme aimed at promoting sustainable land use of school grounds and homesteads in the surrounding farming communities and promoting the integration of ecological principles into soil improvement techniques. The first level of school is more physically the part of the local community and at the same time less tightly enmeshed with the modern –sector occupational structure than secondary school, hence the combined study of communities and schools. One of the most important considerations for sustainable agricultural production is increasing the levels of soil fertility through introducing of organic soil amendment techniques [12]. The study, therefore, tried to find out the ideal entry point when introducing new farming innovation between primary and secondary schools, and or communal farmers.

2. METHODOLOGY

2.1 Description of Study Area

The study was carried out in a communal area of Zimbabwe characterized by farmers of common agricultural production whose focus is partially commercialized production systems with less than 50% of the produce marketed. The schools and surrounding farming communities are involved in integrated land-use design (ILUD) using organic soil amendment techniques.

The physical characteristics of the study site were as follows:

The site is a communal farm area, with an average annual rainfall 800-1000mm and temperature between 18-27°C. The soil type is sandy loam and loam clay and finally, the major agricultural activities are maize, soybeans, tobacco and groundnuts".

2.2 Sampling Process

The sampling frame consisted of pupils, teachers, school development committee,

parents or guardians of interviewed pupils and local communal farmers. The number of pupils interviewed was 74 with 46 of them being from primary schools and the remaining 28 pupils were from the secondary schools. All the pupils interviewed had been taught about organic soil amendment techniques. The pupils interviewed were therefore purposively selected to ensure they met the knowledge requirements. The number of teachers interviewed was 15 from a possible number of 16. All the teachers interviewed had attended a training workshop on organic soil amendment techniques and ILUD. Only 50% of 74 parents and communal farmers were interviewed.

A sample of 74 pupils, 15 teachers and 40 communal farmers/parents was interviewed out of a sampling frame of 176.

2.3 Data Collection

The data were collected under a descriptive survey using structured questionnaires. The pupils, teachers and communal farmers were interviewed using the same questionnaire. Primary data were also collected from school documents on the implementation process and uptake rate of farming innovations.

2.4 Data Analysis

Descriptive statistics, bar graphs and cluster analysis, was used to analyze the data collected. The categorical data collected was analyzed through cluster analysis. There are two clusters; where cluster one depicts factors associated with non adopters of organic farming technologies and the converse is cluster two.

3. RESULTS AND DISCUSSION

3.1 Number of Soil Amendment Techniques Adopted by Schools

Schools gave a description of the innovative techniques they used before the training in ILUD organic farming and those used after the training programme as shown below.

3.2 Users of Organic Farming Techniques in Primary and Secondary Schools

Before the training in ILUD the primary school sector was already practicing some of the organic soil amendment techniques both in the garden and in the field. The techniques that were in use in the garden included manuring, mulching, crop rotation, intercropping and composting. After the training in ILUD, four new techniques were taken up and used in the garden. The new techniques were liquid manure, trench beds, double digging Kenyan way and double digging (DD) Zimbabwean way (Fig. 2).

Before the training in ILUD the techniques that were in use in the garden were manuring, mulching, crop rotation and composting while in the field the techniques that were

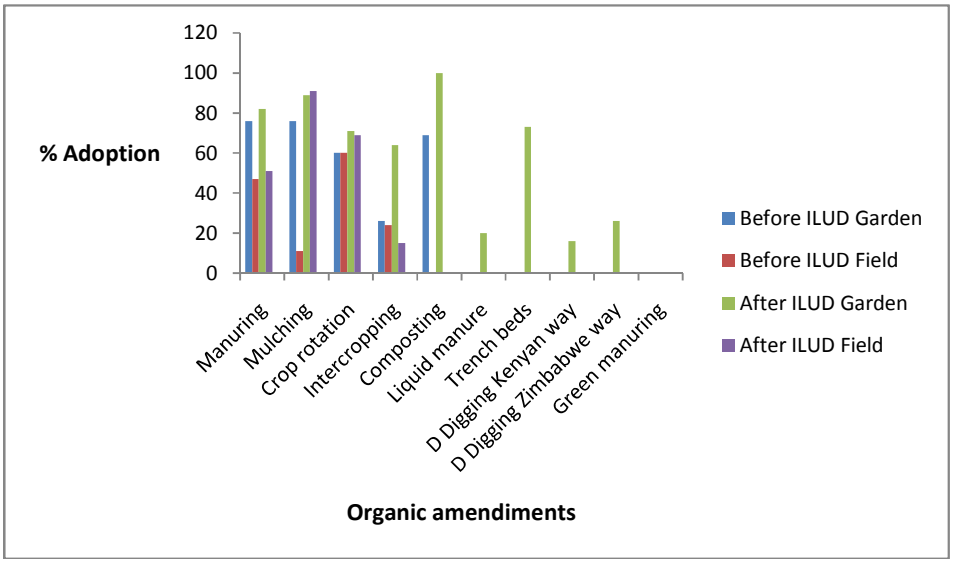

Fig. 2. Percentage adoption of organic techniques in Primary Schools before and after training in ILUD

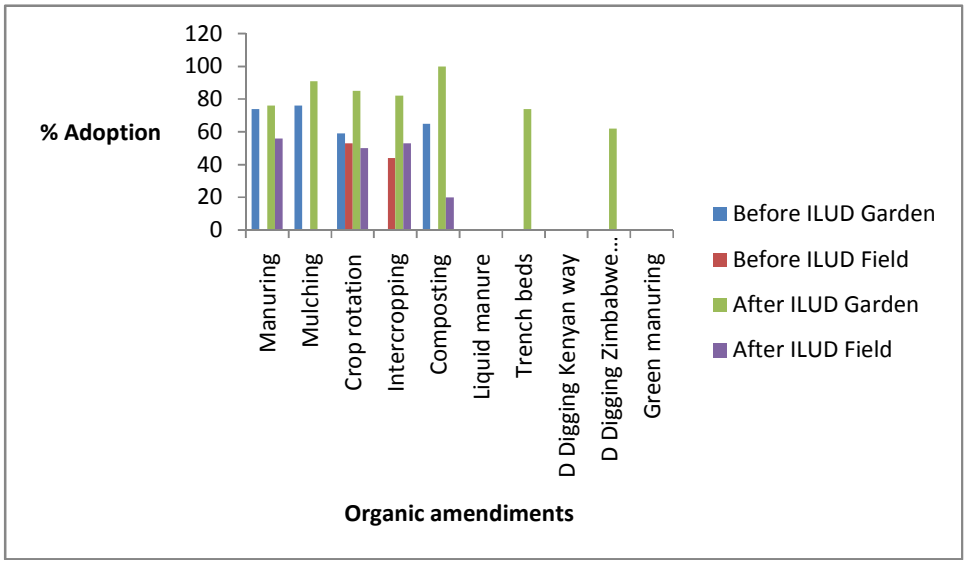

Fig. 3. Percentage adoption of organic techniques in Secondary Schools before and after training in ILUD

in use were crop rotation and intercropping. After the training in ILUD three new technologies were taken up in the garden namely intercropping, trench beds and DD the Zimbabwean way. In the field two new technologies, namely manuring and composting were also applied. The techniques that were already in use increased in the intensity of use. This is similar to the findings by [13].

3.3 Number of Techniques Adopted by Surrounding Communal Farming Communities

Before the training in ILUD, three soil amendment techniques were in use in the garden namely manuring, mulching and composting while in the field manuring and mulching were in use. After the training in ILUD no new technique was adopted for use in the garden save for an increase in the use of the techniques that were already in use, but there was the adoption of crop rotation and intercropping in the field. Similar results were echoed by [14].

3.4 Level of Innovation Take up

Figs. 2 and 3 shows that there was increased use of the organic soil amendment techniques in secondary schools and in primary schools in the gardens compared with communal farmers illustrated in Fig. 4, however, the number of new technologies taken up by the primary school sector were more than those taken by the secondary school sector. Similar results were found by [15] Communal farmers applied the technologies to bigger fields while schools restricted the innovations to gardens.

3.5 Factors Affecting Innovation Take up

Table 1 shows variables that are highly associated with take up of innovations and these may (not) be factors affecting adoption. Cluster 1 indicates factors that are not associated with adoption while cluster 2 shows variables that are associated with adoption (1=adoption, 0=non-adoption). This therefore implies that focus is on cluster 2.

Most primary schools indicated that lack of manpower to carry out some of the techniques such as double digging techniques was the result of failure to take up the innovation on a bigger scale as young primary pupils found it more demanding in terms of energy requirements. There was no practice of green manuring at all by both primary and secondary schools. Communal farmers also pointed out that it was difficult to practice green manuring as it had no direct benefit in terms of cash or provision of food. That was also established by [16] that additionally green manuring crops occupy for one or more years, land that could be planted to food crops. Consequently they are less likely to be adopted by both schools and communal

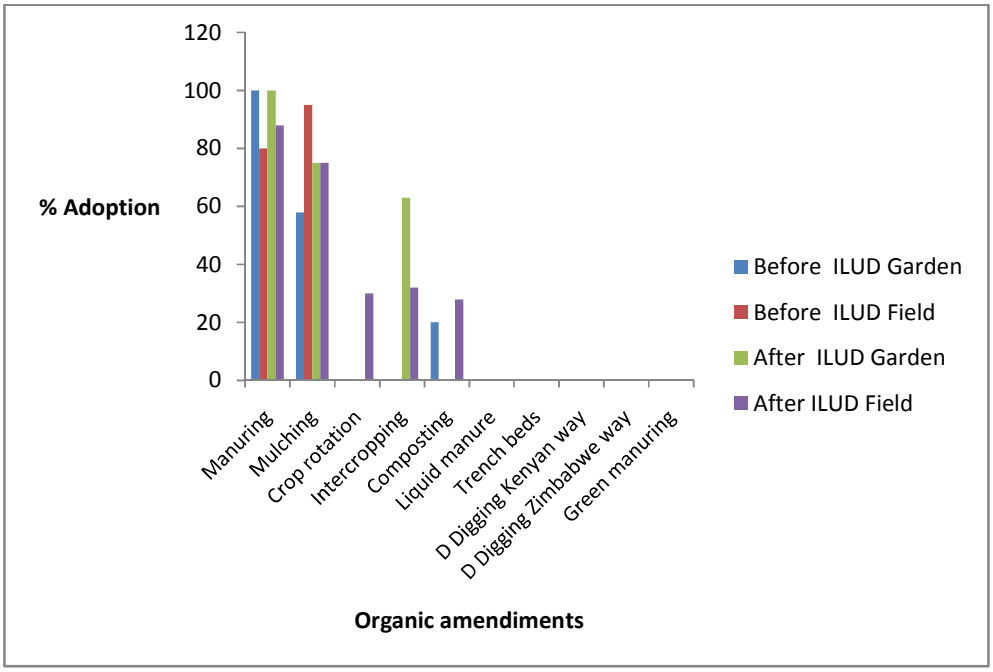

Fig. 4. Percentage adopters of organic farming techniques by surrounding communal farmers before and after training in ILUD

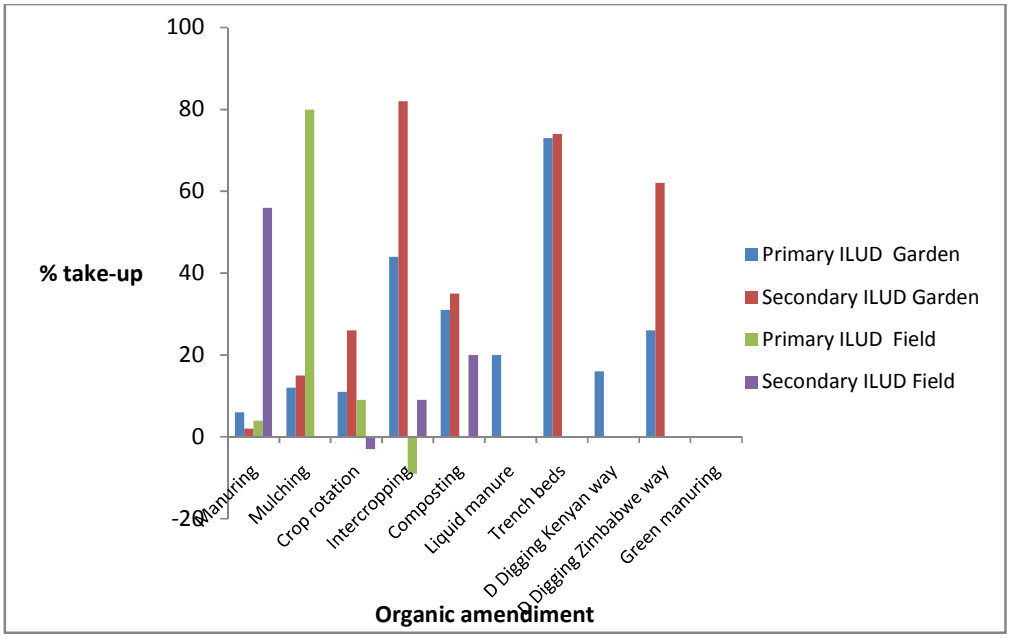

Fig. 5. Percentages take - up rate of innovation in schools

farmers unless given significant support on seed supply and extra land allocation.

Lack of in-depth knowledge on liquid manure was pointed out as one reason for lack of adoption of the technique. Some schools indicated that lack of containers for preparation of liquid manure was the reason for not adopting the technique.

Table 1. Factors affecting taking up of innovations

Factors (variables)	Cluster 1	Cluster 2	Codes
Soil type	0	1	1=yes, 0=no
Sex	1	2	1=male, 2=female
Age	4	3	3=7 to 13, 4=14 to 18
Sector of school	2	1	1=primary, 2=secondary
Adoption status	0	1	1=yes, 0=no

4. CONCLUSION

There was more adoption of sustainable soil amendment techniques in primary schools than in secondary schools. It is suggested that owing to the early adoption of techniques in primary schools any new technologies that are directed to community development should be introduced through primary schools as centers of dissemination of those technologies or innovations to the communities. The primary schools can act as effective and viable entry points of farming technologies to the communities.

Schools can be used as focal points for farmers of tomorrow [10]. Effective learning can be fostered through schools because many development and research organizations are using schools to enhance awareness. Schools are often seen as unifying ground especially where rivalry exists within a population [10]. It is much easier to change attitude and encourage progressive thinking, hence foster appreciation of new technologies. Schools are crucial and can be used to influence positive change. The natural interest of a child is unfettered, excited and curious and curiosity is nurtured at an early age, implying that any innovations that have to be directed to the community can be best done through the young people.

5. RECOMMENDATIONS

The study recommends the use of primary schools as entry points for introducing innovations to the communities as these are avenues through which young people can be reached with useful messages and knowledge that they can use when they become adults, thus they are pathways to accelerate the adoption of agricultural technologies. Schools also have the potential to instill positive attitudes amongst the youth [13].

Although the primary schools may be affective entry points it should be noted that not all primary schools may be viable entry points owing to factors such as lack of resources in some schools, so innovations must be targeted to those primary schools with resources for early adoption. According to [14], there are categories in the adoption process, innovators, early adopters, early majority, late majority and laggards. This implies that although the primary schools are early adopters of innovations there are some categories among them which should be taken into considerations. As with most innovations in agriculture the aim is to target innovators and early adopters who have the resources to take the risk of adopting new technologies.

While primary schools may be viable entry points of technologies to the communities secondary schools should continue with those technologies learned at primary schools. Above all, community linkages should be fostered to ensure that what pupils learn at school is passed on to the people in the community.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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