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Environmental self-efficacy, attitude and behavior among small scale farmers in Zambia

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Abstract The rural livelihood system in Zambia is essentially agriculture, and agriculture is the main link between people and their environment. Through agricultural activities, people seek to husband the available soil, water and biological resources so as to 'harvest' a livelihood for themselves. The aim of this study is to examine Zambian farmers' awareness and attitude toward the degradation of the environment and their relationships with a set of beliefs to evaluate their perceived capacity to take actions to improve the environment. Results of the study revealed that perception of the severity of environmental degradation had a positive influence on both awareness of and attitude toward land degradation ($\beta = 0.47$; $p < .001$). Perception of susceptibility and benefits significantly influence farmers' attitude toward environmental degradation ($\beta = 0.51$; $p < .001$). Awareness of environmental degradation is a significant precursor of environmental self-efficacy and behavior ($\beta = 0.38$; $p < .001$). Increasing severity of environmental degradation tends to promote a positive attitude of Zambian farmers toward the environment ($\beta = 0.27$; $p < .001$). Greater awareness of environmental degradation enhances farmers' capacity in making decisions to improve the situation. Greater environmental awareness leads to greater involvement in land management programs. Greater awareness of the degradation of the environment leads to a more positive environmental behavior. The more individuals are aware of the existence of the degradation of the environment and of its consequences, the more likely they are to do something about it in order to ameliorate the situation ($\beta = 0.36$; $p < .001$). Farmers' environmental self-efficacy also plays a significant role in their decision to change their behavior. Greater perception of one's capability

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to improve the environment is significantly associated with a more positive environmental behavior ($\beta = .39$; $p < .001$).

Keywords Environment · Degradation · Awareness · Susceptible · Severity · Self-efficacy

1 Introduction

It is critical that society be made aware of environmental risks and about the importance of responding to reduce or eliminate those risks. The objective is to attain environmental literacy throughout all economic sections across all regions in the world. Without this awareness in place, society will not understand the need for change; it will tend not to support it and may be unwilling to participate in the process. Thus, for many years, most people had neither the idea of the extent of environmental degradation nor did they have an accurate sense of how rapidly the problems were becoming worse. As a result, society unwittingly continued to contribute to the problem (Reid and Nikel 2008). Learning from our mistakes, we now understand that environmental literacy, achieved through environmental education, is part of an effective strategy to protect the earth's resources (Callan and Thomas 2007; Royal Society 2005; Hare 2005; Turner 2003).

Today, in the beginning of the twenty-first century, issues on environmental education, conservation and management have emerged on the world's policy stage (Palmer 2003; Balmford 2002). Many ecosystems are dominated directly by humanity, and no ecosystem on earth's surface is free of pervasive human influence. Most aspects of the structure and functioning of Earth's ecosystems cannot be understood without accounting for the strong, often dominant influence of humanity (Vollebergh and Kemfert 2005; Hare 2005; Banzhaf 2003). Likewise, Redman (1999) and Nath (2007), noted, although most ecologists acknowledge that there are fundamental 'drivers' behind biological processes, they have little familiarity with the 'drivers' behind human action. Without taking into account these drivers and the interactions they engender, our understanding of ecosystem dynamics at both local and global levels will be limited, as will be our ability to apply these insights to public policy and environmental management decisions.

The main aim of any technological diffusion process is to bring about change in individual behavior with respect to the adoption of new practices. Two broad categories of change, technological change and social change are often presented in the literature (Binswanger 2001; Bressers 2004; Dietz 2003). The importance of the land in the economy makes its improvement desirable. Adoption of soil conservation techniques, for instance, can help reduce the adverse effects of land degradation. Conservation practices can limit runoff and improve agricultural productivity. Increased agricultural production can enhance a household socioeconomic situation and standards of living. It should also be noted that with increasing population, it is increasingly becoming difficult for everyone to have sufficient land. Improved land productivity, therefore, will tend to reduce the capital land need, thereby making it possible for more people to acquire this diminishing resource. Hence, a change in behavior in areas affected by environmental degradation may produce a positive outcome to the farmers in particular and the community as a whole (Gowdy 2005; O'Brien 2002; Redman 1999).

The benefits associated with adoption of sound agricultural practices make change desirable. To attain a certain level of improvement in the environment, not only are technological change important, but also changes in attitude and behavior of those

involved in agriculture are necessary. Attitude change implies that individuals are ready to take action. An economic approach to behavior change suggests that there exist barriers precluding individuals from changing behaviors. Important barriers included intrinsic characteristics of a particular technology, costs associated with the techniques in relation with farmers' economic conditions, credit availability and risk factors (Rodgers 1995; Mweemba 2004, 2008; Turner 2003). However, as suggested by social psychologists, regardless of strategies deployed, the deciding factor of behavioral change is what is going on in individuals' minds. For a particular policy to be successful, land users need to feel the strength and capacity to take actions to improve the environment. Nevertheless, there exist beliefs that can enhance or inhibit farmers' confidence in their ability to perform a particular task. Tracing back to three decades ago, Maloney and Ward (1973), in an article of *American Psychologist*, pointed out that our beliefs regarding the root of environmental crisis must be defined. The solution to environmental problems does not lie on traditional technological approaches but rather in the alteration of human behavior. We must go to the people in an attempt to understand these behaviors. We must determine what the population knows regarding ecology, the environment and pollution; how they feel about it; what commitments they are willing to make and what commitments they do make. These are the necessary antecedent steps that must be made before an attempt can be made to modify critically relevant behaviors.

In essence, for approaching environmental sustainability in society, attitudes toward the state of the environment, and views of progress and economic growth should be reformed (Royal Society 2005; Vezzoli and Manzini 2008). And these 'answers' are dependent upon people's decisions and behavior. Prior research on environmental degradation in Zambia examined the impact of small scale farming on agricultural land resources (Mweemba 2004). No research has been conducted to elucidate farmers' perceptions of environmental degradation and its influence on their farming behavior in Zambia. This study attempted to examine patterns of and relationships between human behavior(s) toward the environment in Zambia. By means of measuring individuals' social and psychological influences relating to their environmental behavior, it is hoped that a culturally adaptive structure for better understanding individuals' appropriate environmental behavior could be developed. Results of this study would serve to provide decision-makers a knowledge foundation upon which environmental policies, educational programs and communication strategies can be adequately established.

The study first evaluates farmers' awareness and attitude toward environmental degradation and their self-efficacy beliefs and behavior. Then, the beliefs that may influence their concerns and consciousness of the problem are evaluated. Finally, causal relationships among those constructs are statistically analyzed. The set of beliefs the study is dealing with includes perception of susceptibility, severity, barrier and benefits with respect to environmental issues. *Susceptibility* refers to ones' perception of being affected by environmental degradation. *Severity* is the consciousness of the seriousness of the problem. *Benefits* refer to the perceived economic and social benefits of environmental improvement, and *barriers* are the potential negative consequences or factors that may hinder positive action.

2 Aim

The aim of this study is to examine Zambian farmers' awareness and attitude toward the degradation of the environment and their relationships with a set of beliefs to evaluate their perceived capacity to take actions to improve the environment.

The following are the questions addressed in this study:

1. Do farmers' perceptions of susceptibility, severity, barriers and benefit significantly influence their awareness of the degradation of the environment?
2. Do farmers' perceptions of susceptibility, severity, barriers and benefit significantly influence their attitude toward the degradation of the environment?
3. Do awareness of and attitude toward the degradation of the environment significantly impact farmers' environmental self-efficacy? i.e. do awareness and attitude mediate between beliefs about the environment (susceptibility, severity, barrier and benefit) and self-efficacy?
4. Do awareness of and attitude toward the degradation of the environment significantly influence farmers' environmental behavior?
5. Does environmental self-efficacy significantly impact farmers' environmental behavior? i.e. does self-efficacy mediate the effect of awareness and attitude on behavior?

3 Hypotheses

The following are the hypotheses for the study:

1. Perceived severity of environmental degradation, susceptibility and benefit factors are positively related to environmental awareness and attitude.
2. Attitude toward and awareness of the degradation of the environment will significantly influence farmers' environmental behavior.
3. Attitude toward and awareness of the degradation of the environment will significantly influence farmers' environmental self-efficacy.
4. Environmental self-efficacy will be positively related to farmers' behavior.

4 Materials and methods

Although a classic type of study using written questionnaires was planned to be administered to the respondents in Magoye Settlement (July–September 2008) within the setting of formal interviews, the questionnaire that was prepared could not be used by individual respondents because most of them were illiterate. Interviews were, therefore, conducted with each individual and responses written down. All the interviews were translated into a local language. Some questions were carefully explained and re-explained on request. The structured interview was conducted in a way that it could seek to elicit information about small scale farmers' demographic characteristics. Other sections of the survey instrument dealt with farmers' awareness of soil erosion and land degradation, their perception of susceptibility, their appraised severity of environmental degradation, the benefits of conservation and their perceived barriers to change. Questions related to these issues were measured on a 5-point in terms of how strongly the respondents felt about a set of statements. The responses were weighted 1–5 with lower values indicating greater agreement. Magoye West has 450 households. To carry out this study, a sample of 102 respondents was used. This was found to be adequate and manageable due to time and resource limitation. A systematic random sampling was used. This is based on the selection of elements at equal intervals, starting with a randomly selected element on the population

list. So the members of the population have to be numbered first. For example, to select ten elements from a population of 100, the length of intervals '*K*' is determined as:

$$K = \underline{100} = 10 \text{ i.e. } \frac{\text{sizeofpopulation}}{\text{size of sample}}.$$

So the 10th from the sample would be numbers 10, 20, 30, 40, 50, 60, 70, 80, 90, 100.

Magoye West is located in the southern province of Zambia. Zambia is found in southern central Africa. It lies between longitudes 22°E and 34°E of the prime meridian and latitudes 08°S and 18°S of the equator (see Fig. 1).

4.1 Variable measurement

The variables representing awareness, attitude, susceptibility, perceived severity, benefits and barriers were recorded by asking farmers to scale a set of questions that express their beliefs about each issue. These questions evaluate farmers' attitudes toward ecological and

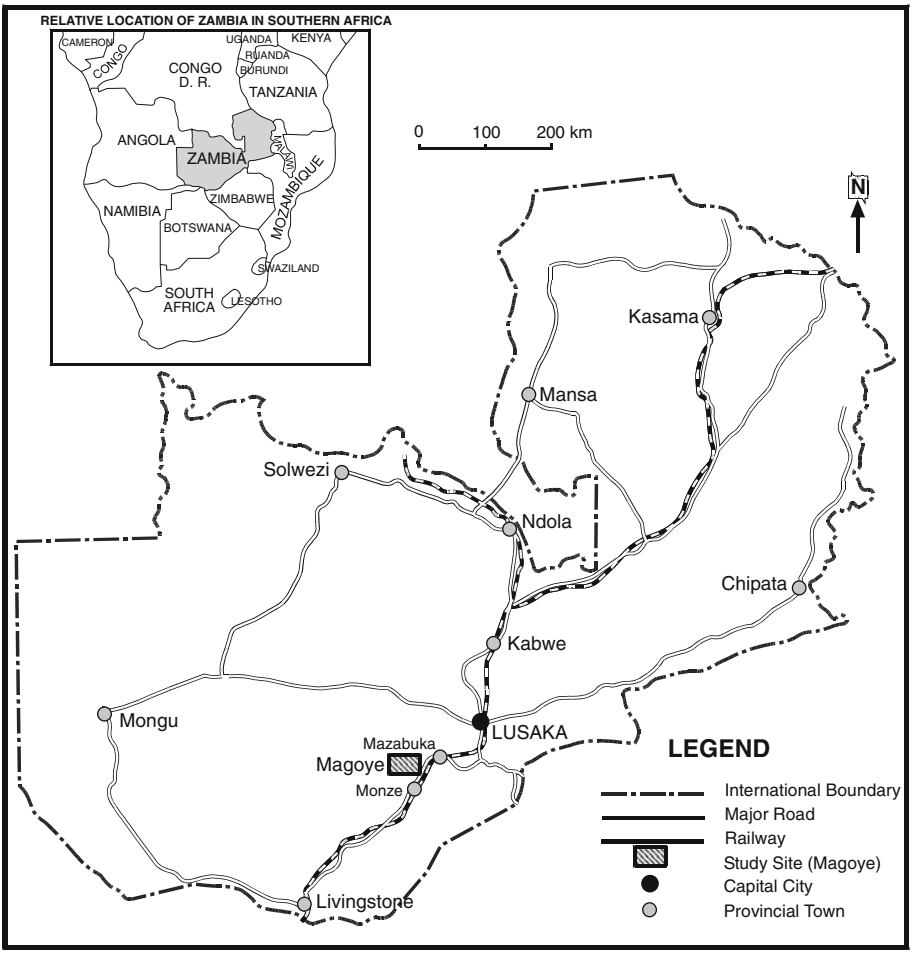

Fig. 1 Location of the study area

social problems related to the degradation of the environment. Behavior is recorded by asking farmers a set of questions that indicate actions they have taken or intend to take to mitigate environmental degradation. A series of other questions were included in the survey to elicit farmers' opinions regarding their self-efficacy in the regeneration of the environment in Zambia.

4.2 Exploratory factor analysis

Exploratory factor analysis was conducted on the data to extract the items that are loaded on each construct previously indicated. Exploratory factor analysis was conducted on the occurrence responses of each latent construct using the SAS software system (Hatcher 1994). Each set of items defining a particular construct was submitted separately to the exploratory factor analysis. The SCREE was used to determine the number of meaningful factors retained for interpretation, and an orthogonal varimax rotation, which attempts to minimize the number of variables that have high loadings on each factor, was used. A reliability assessment (Cronbach's alpha) was used to check for internal consistency of each factor.

Factor analysis allowed condensing a large set of variables or scale items down to a smaller, more manageable number of dimensions or factors. It does this by summarizing the underlying patterns of correlation and looking for 'clumps' or groups of closely related items. It takes a large set of variables and looks for a way that the data may be reduced using a smaller set of factors or components. The term 'factor analysis' encompasses a variety of different, although related techniques. One of the main distinctions is between what is termed principal components analysis (PCA) and factor analysis (FA). Both attempt to reduce a smaller number of linear combinations of the original variables in a way that captures or accounts for most of the variability in the pattern of correlations. All of the analyses described in this paper involve exploration of the relationship between continuous variables.

5 Results and discussion

This section considers the demographic characteristics of the farmers under study. Further, the study statistically examines the structure of environmental behavior and self-efficacy among farmers in Zambia. The psychological constructs used in this study include environmental awareness, attitude, self-efficacy, behavior and other belief factors.

5.1 Demographic characteristics of the people under study

The demographic characteristics of any area under study are important in understanding the living conditions of people through the impact they may have on the socioeconomic situation. Furthermore, data on the demographic characteristics of a population provides background information necessary for the understanding of other aspects of population, including economic activities.

5.2 Age structure

The average age of the farmers interviewed was 32.7 years. Only few farmers under the age of 20 were interviewed and a disproportionately high percentage of 35.1 and 30.8 of the male and female farmers, respectively, were over 50.

5.3 Marital status

The proportion of married persons, especially women, is an important proximate determinant of fertility because most births occur within marital unions. It also entails how demographic factors may directly or indirectly contribute to increasing pressure on the natural resources. Out of the 102 farmers interviewed, 70% were married, 8% were single, 14% were widowed and 8% were divorced. In this study, 26% of the households were female headed when compared to 74% that were male headed. Male-headed households had a higher average household size of 5.2 when compared to 3.9 for female-headed households. The average household size for both female and male-headed households was 5.1.

5.4 Level of education

Thirty-eight percent of the farmers interviewed had no education at all. Thirty-six percent had attained primary school education, though none had completed their schooling even at this level. Of the 26 who had secondary education, only eight managed to complete secondary school.

The average number of years of school attendance among the respondents was 2.9. The level of education of farmers is very low; and of the farmers who had attended primary school, very few would be literate. According to United Nations Development Program (UNDP) (1997), there is a close relationship between education and extension training as well as obtaining loans. Basic education can enhance agricultural productivity. The effect of education on crop yields is likely to be attributed to the impact of rural people being familiar and comfortable with formal learning as such and being receptive to new farming techniques and opportunities. Since the sample comprised of people who were largely illiterate, agricultural training and credit offering to these farmers is very limited. Education, according to United Nations Development Program (UNDP) (1997), is a significant variable since more literate and knowledgeable people make better farmers because they are able to invest on the land by conserving the soils and forests. With such low education levels, natural resources conservation in this area was limited.

5.5 Farmers' awareness of the degradation of the environment

To assess farmers' awareness of environmental degradation in Zambia, farmers were asked to indicate their agreement with the knowledge of various environmental issues. The results show that, in general, farmers agree that they are aware of the degradation of the land in Zambia. Most farmers (79.8%) agree or strongly agree that they are aware of erosion problems in Zambia; that they are aware of erosion in the region (87.5%) and that they are aware of erosion in their plots (91%). Farmers who indicate little or no awareness of environmental degradation at national level and local levels represent 9% of the surveyed farmers. Although a majority of farmers perceived erosion problems at the various scales of influence, about 4% of the respondents seem to disagree that they experience soil erosion on their farms. Farmers, in general agreed that they were aware that erosion reduces soil nutrients (84.5%), that erosion reduces plot yields (88.7%) and that the crops they grow depend on the level of erosion (79.5%). Farmers had the view that tree cutting is responsible for erosion (98.1%) and that the farming practices in Zambia increased land degradation (85.4%). These findings suggest that farmers in the study area had a sound understanding of environmental degradation.

Awareness of land degradation is an important step toward undertaking remedial measures. Farmers have to be aware of erosion problems, of its consequences and eventual mitigating measures before they can engage in any conservation behavior. Awareness of the problem should generate greater willingness to change agricultural practices that will engender environmental improvement.

Nine (9) items were used to measure respondents' knowledge of environmental deterioration. An exploratory factor analysis was conducted on these 9 items to extract the awareness factor. This helped to examine the structure of awareness and assess its impact on farmers' environmental behavior and self-efficacy. A matrix rotation was used to obtain more interpretable factors. Out of the 9 items, 7 have loadings greater than 0.40 and were retained for further analysis (see Table 1).

The scales of these variables demonstrate a high level of reliability with an estimate of $\alpha = 0.74$. Questions that heavily load on the awareness factor covered a large range of issues. The items of the awareness factor are related to knowledge of the existence of erosion problems at the national, local and farm levels. Two of the variables capture the impact of erosion on soil nutrients and crop yields. The two final items capture the effect of farming practice and tree cutting on the process of erosion. The contents of items with the highest loadings relate to the aspects of awareness that erosion reduces soil nutrients and plot yields; that farming practices increase erosion and that tree cutting is responsible for this phenomenon. It is evident that from this exploratory factor analysis that items directly related to activities on the farm have the highest loadings on the awareness factor.

5.6 Farmers' attitude toward the environment

Questions included in this study were to elicit farmers' opinions regarding the linkages between erosion and food, water and health problems; the responsibility of various actors for the erosion process and their willingness to participate in environmental improvement. The results show that 89.6% of the farmers believed that the environment in Zambia is in danger of soil erosion. Forty-four percent of the respondents strongly agree that the environment was in danger and 20.2% simply agree with the statement. About 10% of the

Table 1 Factor loadings on awareness factor

Indicator	Factor loading	Cronbach's alpha
Awareness		0.74
I am aware of soil erosion problem in Zambia	0.45	
I am aware of soil erosion in the region	0.52	
I am aware of soil erosion in my plots	0.51	
I am aware that farming practices increase soil erosion	0.66	
I am aware that soil erosion reduces soil nutrients	0.73	
I am aware that soil erosion reduces plot yields	0.74	
Cutting trees is responsible for soil erosion	0.65	

respondents did not think that erosion puts the environment in great danger. Most farmers (90%) believed that deforestation causes erosion problems. They recognized that uphill agriculture activities cause considerable externalities. More than 91% acknowledged that farming practices on the hillsides seriously affect downstream areas.

Further, with respect to the linkages between erosion and other issues, all respondents agree that soil erosion causes food shortages in Zambia; that it causes water shortages (89.4%) and plays a significant role in disease infection in the communities (79.5%). Farmers also expressed their opinions on institutional responsibility of erosion in Zambia. Most farmers (77.5%) believed that local inhabitants, especially farmers, were responsible for erosion problems. Majority (81%) also agreed that every citizen is responsible for erosion and that the government had a role in the problem (82%). However, 76% of the farmers disagreed that international institutions involved in development operations are responsible for erosion. A substantial number of farmers (21%) agreed that such institutions play a role in the degradation of the environment.

Improvement of the environment requires investments from different actors including the government and the farmers themselves. For the farmers to invest in the amelioration of the environment, not only do they need to have the economic means, but they also must be willing to do so. Farmers were asked a set of questions in order to assess their willingness to participate in the improvement of the environment. About 91% of the respondents agreed they were willing to participate in the improvement of the environment. However, majority (62%) of them did not think that Zambia had the means to improve the environment and that they were not willing to contribute financially toward this activity (71%). The items dealing with environmental attitudes in the questionnaire were subjected to a varimax rotation factor analysis. Two factors were obtained from the analysis (Table 2). Factor 1 consists of seven items with loadings greater than 0.40.

The items mainly reflected the global effects of soil erosion and the individuals' responsibility in the process. The second attitudinal factor consists of two items that capture farmers' perception of the involvement of international elements in environmental

Table 2 Attitude factor with varimax rotated factor loadings

Item	Factor loading	Cronbach's alpha
Attitude 1		0.79
Environment is in danger due to soil erosion	0.62	
Deforestation causes soil erosion	0.61	
Uphill farming practices affect downhill areas	0.63	
Soil erosion can cause diseases	0.66	
Soil erosion causes water shortages	0.54	
Zambians are responsible for soil erosion	0.61	
Local inhabitants are responsible for soil erosion	0.72	
Attitude 2		0.81
International institutions are responsible for soil erosion	0.79	
Growing export crops is related to soil erosion	0.80	

degradation in Zambia. For instance, the role of exports and the responsibility of international organizations are explored. The two factors seem to have a relatively good reliability. The coefficient alphas were $\alpha = 0.79$ for the first attitude factor and 0.81 for the second one.

5.7 Farmers' self-efficacy

The farmers' beliefs concerning their capability to act in order to limit environmental degradation were evaluated using four different questions. From the results, it can be deduced that farmers have a strong belief about their capacity to take action within their respective community. The results show that 86% of the surveyed farmers declared that they are capable of reducing the degradation of the land on their farms. A smaller percentage (61.7%) of the respondents believed they can limit erosion problems at the village level. Seventy-six percent of the respondents agreed they were capable of reducing land degradation within their community of residence. The findings show the importance of proximity in land users' thinking. The closer the target, the more likely they feel capable of taking action to mitigate the effects of erosion.

Farmers also expressed their opinions regarding their capacity to influence the decision-makers and their ability to intervene at the national level to improve the environment in Zambia. The results show a sense of respondents' incapacity to act beyond their community. Only 41% of the respondents believed they are capable of reducing environmental degradation at national level. Farmers, however, did not understand how their involvement in conservation practices may reduce land degradation in the country. Nevertheless, 63% of the farmers thought they could influence decision-makers to take actions to improve the environment.

The four items measuring farmers' environmental self-efficacy are related to their ability to intervene at different levels to improve the environment. A varimax rotation factor analysis suggests two different factors composing of two items each (Table 3). The first self-efficacy factor deals with respondents' ability to reduce environmental degradation at the farm and village levels. This factor has a reliability coefficient of $\alpha = 0.67$. The second deals with respondents' capacity to reduce environmental degradation at the national level and their ability to influence policy makers in order to improve the environment. The factor has a poor internal consistency with a reliability coefficient of 0.43.

Table 3 Self-efficacy factor loadings

Item	Factor loading	Cronbach's alpha
Efficacy 1		0.67
My ability to reduce environmental degradation on my farm	0.81	
My ability to reduce environmental degradation at village level	0.79	
Efficacy 2		0.43
My ability to reduce Zambia's environmental degradation	0.63	
My ability to influence policy makers to protect the environment	0.75	

This suggests that Zambian farmers feel greater capability to act locally rather than at national level.

5.8 Farmers' environmental behavior

To assess individuals' environmental behavior, a number of items were included in the questionnaire that inquired about the extent to which respondents engaged in certain behaviors. Of the farmers interviewed, 86% agreed that conservation of the soil is the best way to guarantee their survival. Among those who agreed with this statement, 81% strongly agreed. Further, 87% felt that it is their responsibility to encourage their peers to adopt soil conservation techniques. The results suggest that farmers understand the need for the necessary collective action on the part of all individuals to improve the environment. The farmers' opinions on their financial effort to protect the environment were weaker than other cases. Of the respondents interviewed, 65% agreed that they have made financial decisions to protect their lands. The results also show that 30% of the farmers declared they did not make financial investments to improve the environment.

Table 4 reports the items that have loadings greater than 0.40 on the behavioral construct. The items highly load on the behavior factor. All the items, but two, had loadings greater than 0.70. The five items together had a coefficient of reliability of $\alpha = 0.70$, indicating a reasonable internal consistency.

5.9 Farmers' susceptibility to environmental problems

The susceptibility of the farmers toward the degradation of the environment was assessed using 9 variables. The descriptive findings for this factor indicated that farmers believed that they were susceptible to the degradation of the environment. The results show that 71% of the farmers agreed that their farming practices do not cause soil erosion, but 30% disagreed to such a statement. Many farmers disagreed that they had too much experience in farming to be the cause of erosion (70%), that they cannot cause erosion because they farm correctly (61.3%) and that there is no erosion problem in their community (71%). However, the majority of the farmers (81%) believed that they have taken some conservation measures to prevent erosion.

The nine-item scale included in the survey instrument to assess respondents' perception of their susceptibility to environmental degradation was subjected to a varimax rotation

Table 4 Perceived behavior factor loadings

Indicator	Factor loading	Cronbach's alpha
Behavior		0.70
Soil conservation guarantees my family survival	0.47	
It is responsibility to encourage others to conserve nature	0.76	
Made financial efforts to protect the environment	0.71	
Made efforts to adopt conservation practices	0.72	
My responsibility to seek knowledge to solve environmental problems	0.44	

Table 5 Factor loading on susceptibility constructs

Item	Factor loading	Cronbach's alpha
Susceptibility		0.79
I am aware of erosion problems	0.56	
I use soil conservation techniques on my plot	0.82	
I maintain soil conservation structures to prevent soil erosion	0.83	
I plant trees to prevent erosion	0.71	

factor analysis. The analysis indicated a single factor with loadings greater than 0.40 (Table 5).

Four items were retained by the analysis. These indicators suggest that respondents do not perceive themselves as being affected by erosion problem because they have taken conservation measures to prevent them. Cronbach's alpha coefficient for susceptibility was $\alpha = 0.79$ indicating a relatively good internal consistency.

5.10 Farmer's perceived severity factor

The perceived severity of land degradation was measured using nine items. These items capture the extent to which farmers perceived the negative effects of erosion at different levels. The results show that farmers overwhelmingly agreed that soil erosion causes extensive damage to plots, soil fertility and crop yields. The rate of agreement with each statement was over 96% for each variable.

Exploratory factor analysis was used to extract the most important items defining the severity factor. The results indicated that there were two factors underlying responses to these items (Table 6). The five items with loadings greater than 0.40 define the first severity factor. This factor mainly reflects the perception of the damages caused by erosion at the farm level. The reliability of coefficient for this factor is $\alpha = 0.81$. The second factor

Table 6 Farmers' severity factor loadings

Item	Factor loading	Cronbach's alpha
Severity 1		0.81
Erosion can cause damage to my plots	0.80	
Erosion can reduce soil nutrients	0.85	
Erosion can reduce crop yields	0.77	
Erosion can cause famine	0.63	
Erosion can cause damage to all plots	0.56	
Severity 2		0.76
Erosion can damage the environment	0.77	
Erosion can cause damage to rivers and dams	0.81	
Erosion can cause damage to roads	0.64	

Table 7 Perceived barrier factor loadings

Item	Factor loading	Cronbach's alpha
Barrier		0.81
Don't protect my plots due to no erosion	0.61	
Don't seek technical assistance to protect my plots	0.43	
Don't look for aid, people would think am poor	0.85	
Don't look for aid, don't like extension officers	0.84	
Don't seek for aid from extension officers due to distance	0.80	
Don't seek aid, have no connections	0.70	
Don't protect my soil to avoid neighbor hatred	0.50	

has a reliability coefficient of 0.76. Items highly loaded on this factor assess farmers' perception of the effects of erosion on the environment, roads and rivers.

5.11 Farmers' perceived barrier factor

The results show that 80% of the farmers disagreed with the statements that they have not taken actions to ameliorate their environment. However, 18% of the respondents indicated that they were afraid of seeking technical assistance to protect their plots. Factor analysis suggests 7 items that measure perceived barriers to environmental improvement.

These items have high loadings on the perceived barrier factor. The coefficient alpha was $\alpha = 0.81$ for all seven items (Table 7). Based on the coefficients, the scale measuring the items is reliable.

Table 8 Farmers' benefit factor loadings

Item	Factor loading	Cronbach's alpha
Benefit 1		0.84
Monitor my plot to detect erosion problems	0.71	
Install erosion barriers in my plots	0.89	
Take conservation measures while planting	0.79	
Seek conservation assistance to prevent erosion	0.83	
Encourage other farmers to conserve soils	0.80	
Benefit 2		0.70
Avoid certain farming practices which cause erosion	0.81	
Avoid growing certain crops which cause erosion	0.78	
Avoid advise that encourage soil erosion	0.70	

5.12 Farmers' perceived benefits

Table 8 shows the factor loadings for the perceived benefit factor. Of the farmers interviewed, 79% agreed that they have done something to improve the land because it brings some positive outcomes. The items assessing perceive benefits of environmental improvement were reduced to 2 underlying factors by factor analysis with varimax rotation (Table 8).

Factor 1 has five items and factor 2 has three items with loadings greater than 0.40. Reliability coefficients for factor 1 and 2 are $\alpha = 0.84$ and $\alpha = 0.70$, respectively.

5.13 Statistical analysis to explain environmental belief–attitude–behavior relationships

The objective was to establish the relationships between the set of environmental beliefs (perceived susceptibility, severity, barriers and benefits) and awareness of, and attitude toward land degradation. Causal effects of awareness and attitude on environmental behavior were also investigated.

For all covariates with ordinal or ratio level data, linear regressions were run with the interpretive predictors of environmental awareness and attitude as independent variables. The standardized regression coefficients (β) and p values are reported in Tables 9, 10, 11 and 12. Beta (β) is a standardized score, which allows for direct comparisons of the relative strengths of relationships between variables. p is a standardized measure of statistical

Table 9 Predictors of environmental awareness

Variable	Coefficient
Perceived susceptibility	0.21
Perceived severity	0.47*
Perceived barriers	−0.09
Perceived benefits	0.12
R^2	0.12

* Significant at $\alpha = .001$

Table 10 Predictors of environmental attitude

Variable	Coefficient
Perceived susceptibility	0.51*
Perceived severity	0.22*
Perceived barriers	−0.13
Perceived benefits	0.31*
R^2	0.56

* Significant at $\alpha = .001$

Table 11 Influence of awareness and attitude on environmental behavior

Variable	Coefficient
Awareness	0.37*
Attitude	0.07
R^2	0.09

* Significant at $\alpha = .001$

Table 12 Influence of awareness and attitude on environmental self-efficacy

Variable	Coefficient
Awareness	0.39*
Attitude	−0.11
R^2	0.08

* Significant at $\alpha = .001$

significance and identifies the likelihood that a particular outcome may have occurred by chance. A p value less than 0.05 is generally considered statistically significant. A smaller p value increases the confidence that the findings are valid (George and Mallery 2001).

5.13.1 Statistical analysis of environmental awareness predictors

This section seeks an answer to the question as to what the belief factors that enhance Zambian farmers' awareness of environmental degradation problems are. The role of perception of the susceptibility toward the problem, its perceived severity, the social and technical barriers and the benefit of environmental improvement in raising farmers' awareness are examined. It was postulated that all the belief variables, but perceived barriers, would have a positive causal effect on the awareness factor.

It was hypothesized that farmers who perceived greater barriers to environmental improvement would less likely to be aware of the degradation of the environment. The results show that among the belief factors, only perception of severity of the degradation of the environment was found to cause farmers awareness of the problems. Results in Table 9 show a positive and significant relationship between perceived severity and awareness of environmental degradation ($\beta = 0.47$, $p < .001$).

These findings support the hypothesis that perception of severity of the degradation of the environment was positively and significantly related to awareness. The results indicate that greater perception of the severity of erosion problems cause farmers to be more aware of the degradation of the environment. Perceived susceptibility with coefficient of 0.21 and perceived benefit factor with coefficient of 0.12 were positively related to awareness, while perceived barrier factor had a negative relationship (−0.01). These coefficients were not significant at 99% level of significance.

It can be deduced that the perceived severity of the degradation of the environment had a stronger relationship with awareness ($\beta = 0.47$, $p < .001$) than did the other variables. The more severe they perceived soil erosion, the more they become aware of the extent of environmental degradation.

5.13.2 Statistical analysis of environmental attitude predictors

The results show that three of the four factors were significantly related to attitude toward the environment. The perception of susceptibility was positively related to attitude toward the environment ($\beta = 0.51$, $p < .001$). The results suggest that farmers who feel more susceptible to land degradation are more likely to develop a positive attitude toward the environment (Table 10).

The perceive severity factor was positively related to the attitude variable ($\beta = 0.22$, $p < .005$). Increasing severity of environmental degradation tends to promote a positive attitude of Zambian farmers toward the environment. Perceived benefits of environmental improvements had also a positive relationship with attitude ($\beta = 0.31$, $p < .001$).

Perception of the benefits of an improved environment seems to play a significant role in influencing farmers' attitude toward environmental degradation. Although attitude may not lead to actual behavior, the results indicate that farmers are more likely to develop a positive attitude toward the environment if they perceive a greater benefit from an improved environment. It should be noted that perceived barriers have a negative causal effect on attitude, but its influence was insignificant.

5.13.3 Statistical analysis of the influence of attitude and awareness on behavior

This section examines the role played by individuals' beliefs about the environment on their behavior. It was hypothesized that a set of farmers' beliefs about the degradation of the environment would be significantly related to their awareness of the situation and their attitude toward it. Attitude and awareness would in turn have a significant relationship with farmers' environmental behavior. Therefore, it is assumed that attitude and awareness would play a mediating role between farmers' environmental beliefs and their behavior.

Table 11 shows that awareness of the degradation of the environment has a positive influence on respondents' self-reported behavior ($\beta = 0.37$, $p < .001$). The results support the hypothesis that greater awareness of the degradation of the environment leads to a more positive environmental behavior. The more individuals are aware of the existence of the degradation of the environment and of its consequences, the more likely they are to do something about it in order to ameliorate the situation. These results support the idea that behavioral change is a process. This is especially true for environmental problems that generally have direct impacts and cause significant externalities. Before individual can take a given measure to limit the effects of soil erosion for instance, they have to be conscious of the problems. As indicated by the results, consciousness of the degradation of the environment may be influenced by the perception of the severity of the problem. Hence, greater perception of the erosion problem may significantly influence farmers' willingness to take action to limit the damage.

However, results also show that a positive attitude toward the environment does not cause farmers to take measures to reduce the problem. Attitude was found insignificant. It can be concluded that perceived severity of the degradation of the environment is one of the most important factors that may lead farmers to change their behavior with respect to the environment. Awareness plays a mediating role on the effect of perception of the severity of land degradation on behavior.

5.13.4 Statistical analysis of belief–attitude–self-efficacy relationships

Self-efficacy is the belief about one's ability to carry out the action required by a situation. Previous studies have focused on effects of self-efficacy on behavior, neglecting the factors that are likely to play a determinant role in shaping it. This study assumed that perceptions of environment degradation in Zambia would raise greater consciousness and concern for the environment that would enhance farmers' beliefs about their ability to take action to solve the problem.

Table 12 shows that farmers' environmental self-efficacy is primarily caused by their awareness of the degradation of the environment. The awareness factor is positively and

significantly related to environmental self-efficacy ($\beta = 0.39$, $p < .001$). The results indicate that farmers who are more aware of soil erosion problems are more likely to feel capable of reducing environmental degradation on their farms and at the village level.

6 Conclusion

The perception of the severity of environmental degradation appears to play a significant role in raising farmers' awareness and shaping of their attitude. The implication of these findings for land management policies are that farmers will feel capable of taking actions to improve the environment and will put greater efforts into it to the degree they perceive the seriousness of the problem to be. Immediate threats of soil erosion for instance, will cause greater awareness of farmers, and ultimately a greater inclination to embrace change.

Results of the study revealed that perception of the severity of environmental degradation had a positive influence on both awareness of and attitude toward land degradation. Perception of susceptibility and benefits significantly influence farmers' attitude toward environmental degradation. Awareness of environmental degradation is a significant precursor of environmental self-efficacy and behavior. Greater awareness of environmental degradation enhances farmers' capacity in making decisions to improve the situation. Greater environmental awareness leads to greater involvement in land management programs. Farmers' environmental self-efficacy also plays a significant role in their decision to change their behavior. Greater perception of one's capability to improve the environment is significantly associated with a more positive environmental behavior. Farmers must have a clear consciousness of the problems before they can take decisions to act.

References

Balmford, A. (2002). Economic reasons for conserving wild nature. *Science, 27*, 93–96.

Banzhaf, S. (2003). Accounting for the environment. *Resources, 151*, 6–10.

Binswanger, M. (2001). Technological progress and sustainable development: What about the re-bound effect? *Ecological Economics, 36*, 119–132.

Bressers, J. T. A. (2004). Implementing sustainable development: How to know what works, where, when and how. In W. M. Lafferty (Ed.), *Governance for sustainable development: The challenge of adapting form to function* (Vol. 76, pp. 284–318). Cheltenham: Edward Elgar

Callan, J. S., & Thomas, J. M. (2007). *Environmental economics and management: Theory, policy and applications*. Beijing: Tsinghua University Press.

Dietz, T. (2003). The struggle to govern the commons. *Science, 302*, 1907–1912.

George, D., & Mallery, P. (2001). *SPSS for windows* (3rd ed.). Boston: Allyn & Bacon.

Gowdy, J. (2005). Sustainability and collapse: What economics bring to the debate? *Global Environmental Change, 10*, 117–129.

Hare, B. (2005). Relationship between increases in global mean temperature and impacts on ecosystems, food production, water and socio-economic systems, In *Avoiding dangerous climate change*. Exeter, U.K.

Hatcher, L. (1994). *A step-by-step approach to using SAS system for factor analysis and structural equation modeling*. Cary N.C: SAS Institute.

Maloney, M. P., & Ward, P. (1973). Ecology: Lets hear from the people. *American Psychologists, 28*(7), 583–586.

Mweemba, L. (2004). *The impact of small-scale farming on agricultural land resources in Magoye West settlement*. Lusaka: Unza Press.

Mweemba, L. (2008). Environmental degradation and rural poverty in Zambia: A silent alliance. *Journal of Applied Science, 3*(5), 369–376.

Nath, B. (2007). A heuristic for setting effective standards to ensure global environmental sustainability. *Environment, Development and Sustainability 4*:1–15.
O'Brien, M. (2002). *Making better environmental decisions: An alternative to risk assessment*. Cambridge: MIT Press.
Palmer, J. A. (2003). *Environmental education in the 21st century, theory, practice, progress and promise*. New York: Routledge Ltd.
Redman, L. C. (1999). *Human impact on ancient environments*. Tucson: University of Arizona Press.
Reid, A., & Nikel, J. (2008). *Participating and learning perspectives on education and the environment, health and sustainability*. Italy: Zanichelli Ltd.
Rodgers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: Free Press.
Royal Society. (2005). *Ocean acidification due to increasing atmospheric carbon dioxide*. London: The Royal Society.
Turner, B. L. (2003). A framework for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Science, 100*(14), 8074–8079.
United Nations Development Program (UNDP). (1997). *African development indicators*. Washington D.C: New York.
Vezzoli, C., & Manzini, E. (2008). *Design for environmental sustainability*. Italy: Zanic Ltd.
Vollebergh, H. R. J., & Kemfert, C. (2005). The role of technological change for a sustainable development. *Ecological Economics, 53*, 133–147.