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FACTORS AFFECTING SMALLHOLDER FARMERS' RESPONSIVENESS TO CLIMATE VARIABILITY INDUCED HAZARDS IN ZIMBABWE

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ABSTRACT

Increasingly, unpredictable weather poses challenges to livelihoods as it requires greater investment of time, energy, and resources in order to maintain crops and animals through dry spells. Vulnerability to climate variability induced hazards can be reduced successfully with an understanding of the most vulnerable to the impacts and how the interactions between nature and society shape the underlying factors that contribute to vulnerability. This study analysed the factors affecting responsiveness of smallholder farmers to climate variability induced hazards. Cross-sectional data were collected using a household administered questionnaire from 300 randomly selected households from Seke and Murewa districts in Zimbabwe. Principal Component Analysis was used to identify and narrow the list into core uncorrelated factors. The Logistic regression model was then used to ascertain the influence of the identified socioeconomic factors and perceptions on responsiveness. The results reveal that productive assets had influence on responsiveness, but perceptions did not influence responsiveness. In conclusion, access to resources affects farmers' adjustments to reduce impacts of hazards.

Key Words: Dry spells, Principal Component Analysis, vulnerability

RÉSUMÉ

Des conditions atmosphériques posent de plus en plus des défis, étant donné d'énormes investissements en termes de temps, énergie et ressources nécessaires pour maintenir les cultures et bétail en condition de sécheresse. Le risque induit par la vulnérabilité liée à la variabilité climatique peut être réduit avec succès par la compréhension des impacts et la manière dont les interactions entre nature et la société façonnent les facteurs fondamentaux qui contribuent à la vulnérabilité. Cette étude a analysé les facteurs qui affectent la réaction des fermiers aux risques liés à la variabilité climatique. Des données transversales étaient collectées utilisant un questionnaire sur 300 ménages sélectionnés aléatoirement dans les districts de Seke et Murewa au Zimbabwe. L'analyse de la composante principale était utilisée pour identifier et transformer la liste en facteurs principaux non corrélées. Le modèle de régression logistique était utilisé pour déterminer l'influence des facteurs socioéconomiques identifiés et les perceptions sur la réaction des paysans. Les résultats révèlent que des biens productifs avaient une influence sur la réponse des fermiers, mais les perceptions n'ont pas influencé la réponse leurs réponses. En conclusion, l'accès aux ressources affecte l'ajustement des fermiers face à la réduction d'impacts de risques.

Mots Clés: Sécheresse, Analyse de la composante principale, vulnérabilité

INTRODUCTION

Vulnerability to climate variability and droughts in the smallholder farming sector in sub-Saharan Africa, is particularly exacerbated by overdependence of existing farming systems on rain-fed agriculture, compounded by factors such as widespread poverty and weak financial and structural capacity (Jennings and Magrath, 2009). Recent evidence has shown that there is an

increase in drought frequency particularly in the semi-arid regions (Unganai, 1996). In some years, the same locations that experience droughts experience floods. This has affected smallholder farm production. Also, the rainfall seasons start late and farmers are increasingly challenged by the uncertainty of the effective planting period (Jennings and Magrath, 2009).

In many cases, coping and adaptation choices are limited by inadequate financial resources and knowledge, thus, reducing vulnerability is a key aspect to improving smallholder farmers' resilience. In the process of reducing vulnerability; it is important to develop potentially effective; cost-beneficial strategies and information packages that are tailored to perceived and actual needs of smallholder farmers (O'Brien *et al.*, 2006). There is a need to shift from response and recovery to awareness and preparedness. A better understanding of farmers' current adaptation measures and their determinants will be important to inform policy for future successful adaptation of the agricultural sector (Thomalla *et al.*, 2006). Without the appropriate policies or adaptive strategies in place, the smallholder farmers will find it extremely difficult to practice sustainable agriculture in an environment with unpredictable climatic conditions. Thus, the objective of this study was to provide insights in the factors affecting farmers' responsiveness to climate variability in Zimbabwe.

METHODOLOGY

A field study was conducted in two districts of Zimbabwe, Seke and Murewa in Mashonaland East Province. Both districts are in Natural Region (NR) II. Seke is located 23 Km south of Harare; while Murewa district is located 81.5 Km northeast of Harare. Natural Region II covers 15% of total land area in Zimbabwe. Despite receiving rainfall levels of 800-1000 mm per year, which are lower than that of NR I, NR II is suitable for intensive farming based on crops or livestock production (USDA, 2004). In each district, three Wards were selected, and from each Ward five villages were selected. A Ward is an administrative unit made up of six to seven villages (Madzudzo, 1997). From each district, a sample size of 150 respondents were interviewed. Selection of households was done randomly targeting ten households in each village.

Descriptive statistics were used to examine general characteristics of households. Principal Component Analysis (PCA) was used to identify sets of inter-related variables. The purpose of PCA is to reduce a number of observed variables into a relatively smaller number of components (Maddala, 1992).The principal components were then used in a Logistic regression model.

The logistic model had two categories of dependent variable namely, 1 = adaptation and 0 = no-adaptation. The two categories represented the level of responsiveness, where the adaptation strategies that farmers had adopted were used to show how responsive farmers could be, given their socioeconomic characteristics, available resources, perceptions and geographical location. The binary logistic model is represented as shown below:

$$\Pr(y=1|x') = \frac{\exp(x'\beta)}{1+\exp(x'\beta)} = \mathrm{A}(x'\beta)$$

..... Equation 1

Where $\Pr(y=1|x')$ represents the conditional probability of an event happening, that is the dependent variable taking a value of 1, given an independent variable χ. The dependent variable χ represents a vector of all the explanatory factors. The explanatory power of the independent variable is explained by the coefficient β (Greene, 2003). Socioeconomic factors such as household characteristics, livestock endowment, draft ownership, land size, access to credit were incorporated into this analysis to explain the relationships that exist between these socioeconomic factors and perceptions to responsiveness.

RESULTS AND DISCUSSION

Table1 presents a general description of the sample used in the study. A total of 300 households were interviewed but 1 questionnaire was discarded due to inconsistencies in the way questions were answered. Of the 299 households, 149 households were from Seke district and the other 150 households from Murewa district. From the 299 households, there are more male-headed

TABLE 1. General characteristics of the sample used in the study in Seke and Murewa districts in Zimbabwe

Variable	N	Proportion within sample (%)
Households interviewed	299	100
Female headed households	96	32.1
Male headed households	203	67.9
Communal farmers	252	84.3
Small-scale commercial farmers	47	15.7
Proportion with primary education (yes/no)	272	91.0

n=299

(67.9%) households than female-headed (32.1%) households. A total of 91% of the respondents had up to at least primary school education.

The outputs for the PCA are presented in Table 2. The outputs showed that only three principal components were extracted. These are:

Component 1: This component is related to "characteristics of household head". It includes age of household head; education level of household head; and farming experience;

Component 2: This component is related to "productive assets". It includes total land owned by a household and draft power (number of cattle owned); and

Component 3: This component is related to "human capital". It includes highest education level in the family and household size.

A standardised regression factor score was created for each of the three components using linear combination of the variables that loaded on each factor. These regression factors were then used in logistic analysis.

Factors influencing responsiveness. Data for regression analysis are presented in Table 3. It is clear that only "productive assets" significantly influences responsiveness at 5% significant level. Farmers with more productive assets were 1.19e+07 times more responsive than farmers who had productive assets who were nonresponsive.

The data shows that for every unit household with "productive assets" that was unresponsive; 1.19e+07 units of households with "productive assets" were responsive. These results showed how access to "productive assets" could greatly improve responsiveness. These findings are supported by a research done in Ethiopia by Legesse and Drake (2005) whose research findings showed that asset endowment had a positive influence on all risk variables related to

TABLE 2. Factor loadings of variables on the components

	Component		
	1	2	3
Age of household head	.853*	.249	.115
Education level Household head	-.818*	.181	.198
Highest education level in family	-.374	.314	.687*
Household size	.317	-.098	.826*
Farming experience	.786*	.247	.186
Total land area	.007	.865*	.068
Draft power	.192	.817*	.032

TABLE 3. Regression outputs for factors influencing responsiveness to droughts in Seke and Murewa districts of Zimbabwe

Adaptation	Odds Ratio	Std. Err.	Z	P>z
Perception	.519	.272	-1.25	0.210
Characteristics of household head	189.982	520.393	1.92	0.055*
Productive assets	1.19e+07	8.59e+07	2.25	0.024**
Human capital	4.898	5.312	1.46	0.143
Gender	.532	1.085	-0.31	0.757
Religion	1.061	.035	1.80	0.073*
Marital status	.0182	.038	-1.90	0.057*
Own television	18.076	38.998	1.34	0.180
Extension	.065	.188	-0.95	0.344
Distance to livestock water source	.999	.0186	-0.04	0.969
Credit access	3.796	7.285	0.70	0.487
LR $chi^2(11)$	31.95			
Prob > chi^2	0.0008			
Log likelihood	-9.230			
Pseudo R^2	0.634			
Hosmer-Lemeshow chi^2 (8)	0.005			

*; ** Significant at 10 and 5%, respectively

institutions. This shows that an increase in "productive assets" will directly increase the responsiveness of smallholder farmers.

The results also showed that of the characteristics of household head, religion and marital status were the most significant P<10%). This means that as household head gets older, more educated and acquires more faming experience; responsiveness to climate variability induced hazards will increase. The odds ratio of household heads that were older, more educated and had more farming experience being more responsive, was 189.982 times more than household heads with the same characteristics being unresponsive. In his research in 11 African countries, Maddison (2006) found similar results that educated farmers were more likely to respond by making at least one adaptation. Although farmers who are older, more experienced and more educated are likely to be more responsive, it is better access to information that will assist them in taking effective and efficient measures (Nhemachena and Hassan, 2007).

Marital status was, however, negatively correlated with responsiveness (Table 3). This means that single, widowed or divorced household heads were more responsive than married household heads. The odds ratio of marital status was 0.0182, which showed that for every 0.0182 units of monogamously married households that were responsive; 1 unit was nonresponsive. This could have been because decision making can be made slow if extensive consultations are to be made, but for those who are single, widowed or divorced, decision making is much faster which significantly improves responsiveness.

"Human capital" was not significant implying that having highly educated household members and large household sizes did not translate into responsiveness. This could have been because the household head is the one with the final say for all issues concerning the household. Polson and Spencer (1991) also noted that family size above the mean rural family size was not significant in the adoption of new cassava varieties in south western Nigeria. They argued that because subsistence households are resource poor, larger family size may (in real terms) do not contribute significantly to increasing the resource pool of the farm family.

Perceptions were also not significant possibly because all the interviewees were aware of climate change and variability, despite the differences in household socioeconomic characteristics. Given such a scenario, then perceptions cease to be a

limiting factor in contributing to responsiveness or failure to respond.

From the results in Table 3, access to extension and gender were also not significant in influencing responsiveness. This could have been because in both districts, access to extension was high and both sexes had equal access to this service. Besides marital status, perceptions, gender of household head, access to extension and distance to water source were also negatively correlated to adaptation.

CONCLUSION

Increase in productive assets and an improvement in characteristics household head results in an increase in responsiveness among smallholder households in Seke and Murewa districts of Zimbabwe. Thus, improvement of farmers' access to total land owned, draft power and farmer education will increase responsiveness of smallholder farmers. In terms of policy implications, this means that improvement of adaptive capacity is very crucial to improve farmers' responsiveness to climate variability induced hazards.

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REFERENCES

Greene, W.H. 2003. Econometric analysis. Fifth Edition. Prentice Hall, New Jersey, USA.

Jennings, S. and Magrath, J. 2009. What happened to the seasons? Oxfam GB research report.

Legesse, B. and Drake, L. 2005. Determinants of smallholder farmers' perceptions of risk in the Eastern Highlands of Ethiopia. Routledge Informa Ltd. UK. *Journal of Risk Research*.

Maddala, G.S. 1992. Introduction to econometrics. Second Edition. Macmillan publishing company, New York, USA.

Maddison, D. 2006. The perception of and adaptation to climate change in Africa. CEEPA Discussion Paper No.10. Centre for Environmental Economics and Policy in Africa. University of Pretoria, South Africa.

Madzudzo, E. 1997. Communal tenure, motivational dynamics and sustainable wildlife management in Zimbabwe. *Zambezia* XXIV (ii).

Nhemachena, C. and Hassan, R. 2007. Micro-Level Analysis of Farmers' adaptation to Climate Change in Southern Africa. IFPRI Discussion Paper No. 714. Environment and production Technology division.

O'Brien, G., O'Keefe, P., Rose, J. and Wisner, B. 2006. Climate change and disaster management. Overseas Development institute. Blackwell Publishing Oxford, UK. *Disasters* 30:64-80.

Polson, R.A. and Spencer, D.S.C. 1991. The technology adoption process in subsistence agriculture: The case of Cassava in south western Nigeria. *Agricultural systems* 36:1.

Thomalla, F., Downing, T., Spanger-Siegfried, E., Han, G. and Rockstrom, J. 2006. Reducing hazard vulnerability: towards a common approach between disaster risk reduction and climate adaptation. Overseas Development institute. Blackwell Publishing Oxford, UK. *Disasters* 30:39-48.

Unganai, L. 1996. Historic and future climatic change in Zimbabwe. *Climate Research* 6:137-145.

USDA, 2004. Agro-climatic zones in Zimbabwe. Production estimates and crop assessment division. Foreign Agricultural Service, United States Department of Agriculture, Washington D.C. USA.