TESTING DECISION TREES AS TOOLS TO HELP AGRICULTURAL EXTENSION STAFF ADVISE GHANAIAN FARMERS ON EFFECTIVE MAIZE STORAGE OPTIONS

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Abstract

Choice, together with the process of making that choice, is a critical issue in agricultural extension education. This calls for an understanding of farmers’ decision-making processes by agricultural extension staff which can help them to work more effectively with their clientele, as individuals and in groups. The purpose of this study was to determine the decisions on maize storage options made by farmers in the Volta Region of Ghana using a decision tree approach. The results indicated that the use of the decision tree is situation-specific, and is more effective with individual farmers than with groups. However, it is useful in group situations for creating problem awareness, and generating discussions among group members to bring out diverse views on recommended practices and options.

Introduction

Maize is the most important grain crop in Ghana. However, most farmers experience very high storage losses, with estimates reported at between 30-40% (Ghana Statistical Service, 1995). One of the recent factors contributing to high storage losses being experienced by Ghanaian farmers is a new and destructive pest of stored maize, the Larger Grain Borer (LGB) – Prostephanus truncatus (Horn). The LGB can turn the maize grains into powder, causing high losses to farmers and threatening their food supply and income. Preliminary results of a draft model to predict the possible impact of LGB in Ghana indicate that, if no action is taken to curb the outbreak of the pest, it could cause losses in maize of up to 30 billion cedis (about US$17 million) per annum (Boxall, 1995).

The LGB is most severe in the Volta Region of Ghana. A bilateral United Kingdom-Ghana Project, under the auspices of the Overseas Development Administration was launched in 1992 to work with farmers on the development, selection, and use of a series of maize storage options for controlling the LGB. The LGB Project is investigating, in close collaboration with farmers and extension staff, possible ways of controlling the new destructive pest, including improved storage methods. The focus of the LGB Project is to help farmers to select the most viable options from multiple recommendations, keeping in view their financial, technical, and socio-cultural situations.
The Agricultural Extension Service in Ghana

The agricultural extension service in Ghana is largely publicly funded and managed. One of the critical problems of the extension service is poor training of extension staff at all levels. The majority (85%) of the current extension staff of the Ministry of Food and Agriculture possess a 2-year post-secondary school certificate. The dominant communication approach used by extension staff is a linear model. Researchers act as the main source of “good” technologies while extension staff act as a conduit for the transfer of technologies from researchers to farmers, who in turn are expected to use the recommended technologies. Only a small number of extension staff in Ghana have received training in participatory extension approaches, such as the decision tree approach, which the staff could use to give farmers several choice options to deal with the high risks and uncertainties of farming.

Agricultural extension staff in Ghana have been trained to be the deliverers of technology, not facilitators of a process to involve farmers. Thus, most of the staff do not make provision for eliciting farmers’ ideas about the development and adaptation of new agricultural technologies. Where researchers and extension staff involve farmers at all, the farmers are only expected to follow staff directives. Thus, farmers play a passive role. As a result, recommendations from researchers and extension staff are often not appropriate to most farmers’ situations.

The Use of Decision Trees as Tools in Eliciting Information for Extension Education

Farmers’ decision-making process is the key to the adoption of agricultural innovations. Agricultural extension staff must have a thorough understanding of the decision-making process to enable them to help farmers to better achieve their goals. However, as van den Ban and Hawkins (1988) note, making a choice is difficult because we are usually uncertain about what the outcome will be. In the decision-making process we use information (knowledge) to reduce this uncertainty. Therefore, choice and knowledge must be examined simultaneously.

A decision tree is a graphic representation of how individuals make decisions. The decision tree modeling method has been used during the past two decades by ethnographers in many cultures to elicit and predict the actual choices of individuals in a group (Gladwin, 1976; Gladwin, 1979; Gladwin, Zabawa & Zimet, 1989; Pierre-Yves, 1995). Decision tree can be a useful agricultural extension tool in eliciting and tailoring messages and research recommendations to farmers’ situations.

According to Compton (1994), the decision tree is a useful way of (a) capturing the current state of knowledge, (b) distinguishing pieces of information essential for making decisions from those which are merely interesting, and (c) pointing out gaps in knowledge. Gladwin (1979), and Gladwin, Zabawa and Zimet (1989) provide empirical results to show that the decision tree can be used as an advisory tool to elicit information from individuals about their decision-making criteria on choices of recommendations, and to find out why a particular individual or a group of people acts in a certain way. Making specific reference to pest management, Mumford and Norton (1984) opine that when research and extension programs in pest control are being developed, it is important that an early attempt is made to obtain information on farmer perceptions on the constraints affecting certain options and on farmers’ objectives.

Methodology

This study was a follow-up on the results of a Participatory Rural Appraisal (PRA) which was done in the LGB Project with maize farmers, maize traders, and extension staff in the major agro-ecological zones in the Volta Region regarding the best options for storing maize. The PRA results indicated use of several indigenous pest control materials, including the neem tree, wood ashes, smoke, and lime. Field
experiments had been conducted to assess the effectiveness of some indigenous pest control methods in controlling LGB (Addo, 1994). However, none of these methods was found to be effective in controlling LGB infestation, especially for long-term (more than one month) storage of maize. Based on the PRA results and three years of working experience with farmers, the LGB Project developed decision trees depicting various recommendations for the best storage options available to farmers.

Since decision making is very subjective and personal, involving a careful thought process, it is important to recognize the unique context and the larger system within which specific choices are being made when eliciting information about the decision-making process of an individual or a group of people. Therefore, this study was designed to test the decision trees in the LGB Project, especially with regard to two key questions: (a) “How do I store my maize?”, and (b) “My store is infested – What shall I do?”

The study was carried out from January to November 1995 in eight villages in the Volta Region. The villages were drawn from four of the five agro-ecological zones of the region. The fifth zone was not included because LGB was not a serious problem there at the time the study was conducted. The selection of the villages was purposive and was based on the following criteria: (a) the incidence of LGB in the area, (b) the importance of maize growing and storage in the area, and (c) representation of the major agro-ecological zones in the region. The study was carried out in consultation with key stakeholders of the farming systems in the study area, including the LGB project staff, extension staff of the Ministry of Agriculture, farmers, and maize traders.

Individual interviews and focus group discussions with farmers, maize traders, and extension staff were used to collect data. Decision trees were tested on 102 randomly selected maize farmers in the eight purposively-selected villages. Informal discussions were held with 20 extension staff in the study area to get their assessment of the approach of generating and constructing a decision tree to represent farmers’ decision-making processes.

Results

Out of the total of 102 farmers surveyed, 55% were men while 45% were women. The majority (71.5%) of them were between the ages of 31-50. With respect to how they usually handled and used harvested maize, 61% of the respondents indicated that they stored maize for both sale and food, 18.7% for sale only, and 20.3% for food only. Regarding experience with LGB infestation of stored maize, 28% of the respondents indicated that they had experienced LGB in previous years.

Decision Tree 1, “How do I store my maize?”, depicts farmers’ infestation history, threshold price expectation, time for keeping maize, expected maize use patterns, and whether the steps provided on the tree were popular or not. Farmers’ answers to the first question on the tree led to the development of the paths as well as the recommendations on the tree. The cost-benefit of choosing each option was analyzed with the farmers, and the implications of the choices were explained to them.

Decision Tree 1 was tested with 88 farmers to see how they would respond to the options in actual practice. Seventy-four farmers (84%) indicated that they stored maize in the husk for more than three months, while 14 farmers (16%) stored maize for less than three months in this manner. Farmers who stored maize for less than three months gave the following reasons: (a) good price for the early harvested maize, (b) defray debt, (c) need money for preparing new farm plot, and (d) fear of envy from other farmers who may not get good harvests.
Contact Editor for graphic.
[Figure: Decision Tree 2]
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The villages in which this study was conducted are ranked among the high LGB risk areas. Based on PRA results and the experience of the LGB Project, the most suitable option available to farmers for protecting their stored maize from LGB damage is to “shell and treat” the maize with a chemical called Actellic Super. The farmers’ decision-making process for the control of LGB was compared with the LGB Project’s recommendations (Decision Tree 2). Sixty-six farmers took part in this exercise. However, as Figure 1 indicates, only 26 farmers (39.4%) followed the ‘shell and treat’ recommendation when their maize is infested by LGB. Twenty-one farmers (31.8%) who did not follow the recommended practice either sold their maize or used it for other purposes giving the following reasons for their action: (a) needed money for clearing a new maize plot, (b) unexpectedly high selling price for maize, (c) no chemical in the village, (d) fear the effects of chemical on maize for family food, and (e) maize used for unexpected funeral and other emergencies. Nineteen farmers (28.8%) did not consider the “shell and treat” recommendation before taking an unrelated action. This means that the “shell and treat” recommendation alone is not suitable to all maize farmers and they should be given other options.

It is important to point out that the respondents who feared the effects of the use of chemicals in storing maize were all women. If women, who are estimated to account for about 90% of food processors, are not willing to use chemicals to store large quantities of food crops, then Ghana’s food security is at risk, especially in case of an unexpected severe outbreak of LGB. This means that more women farmers should be reached by the extension service to explain to them the need for appropriate and timely use of chemicals for maize storage, and to convince them about the safety of these recommended chemicals on food crops.

Farmers’ perceptions and the criteria they use for judging maize storage losses should be considered within their unique context and social system. For example, the LGB Project defines a maize damage threshold as the observed level of damage in the outer wall of the barn caused by LGB at which the farmer decides to take any control measure to prevent further losses. According to the LGB Project’s recommendation, three damaged cobs out of every hundred cobs seen outside the barn should serve as the threshold – a point when the barn should be brought down within one month. In this study, however, farmers perceived a maize damage threshold differently. In Penyi village, for instance, where maize is a staple food and is removed from the barn regularly, farmers examine the maize while dehusking and shelling, and determine their own damage threshold. In contrast, in Dzolokpuita and Dzogbekope villages, where maize is not removed regularly from the barn, the damage thresholds are determined by listening to the noise of insects in the stack, and looking for powder on the cobs.

An attempt was also made in the study to find out whether females differed from males on the number of LGB damaged cobs considered as the acceptable threshold, beyond which the farmer would no longer accept any insect damage and, therefore, would take action to control or eliminate the insect. Three cobs out of a hundred cobs (3%) was accepted as the threshold for the female group, while thirty cobs...
out of a hundred cobs (30%) was accepted by the male group. This seems to confirm the general opinion of the LGB Project staff that the LGB (and other pests) problem has been of more concern to women than to men, because women are generally responsible for food processing, preservation, storage, and preparation in Ghana.

Informal discussions were held with 20 extension staff in the study area. The aim was to get their assessment of the approach of generating and constructing a decision tree to represent farmers’ decision-making processes. Eighteen staff (90%) indicated that the approach was very useful in helping extension staff to understand how farmers make choices. They indicated that the process was participatory, helpful in facilitating dialogue between farmers and extension staff, helpful in bringing out issues from the farmer’s point of view which is essential for adoption of innovations, and helpful in identifying farmers’ situations and thus enabling them to choose the most appropriate options. Two staff (10%) indicated that the construction of a decision tree involves too many arrows (paths), thereby making the process rather complicated and difficult to use practically. This is an interesting finding, because it reinforces the fact that many extension staff tend to view farmers’ problems as simple, straightforward, and unidirectional. However, in real life, farmers normally encounter complex and multifaceted problems which do not lend themselves to simple, shortcut choices.

**Conclusion**

The decision tree is an excellent tool for informing extension staff of the specific choices farmers make and the rationale for those choices. The experience from this study indicated that the use of the decision tree is better suited to individual farmer’s choice making rather than group choice making, even though the group process of generating a decision tree is valuable for creating awareness about a problem and generating discussion among group members. However, it would appear that the decision tree is better adapted to specific individual situations rather than the diverse needs of group members because farmers, even those within the same village, do not usually have the same needs or goals. Each farmer makes his or her decision based on past experience and the unique context or environment within which he or she operates. As van den Ban and Hawkins (1988:91) pointed out, each farmer makes decisions based on probability estimates. Extension staff can, and should, play a useful role in helping farmers make their decisions on the basis of what they perceive as the most correct probability estimates.

**References**


