Effectiveness Of Pesticide Labels As A Communication Tool For Smallholder Farmers On Pesticides Handling

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Abstract: This study was conducted in northern Tanzania to assess the effectiveness of pesticide labels in communicating useful information to horticultural farmers. A total of 200 respondents were obtained through simple random selection. Data were collected through personal and face-to-face interview using structured interview schedule, observation and focus group discussion. Simple descriptive statistics and cross tabulation were used in the analysis. The study revealed that 79.6% of farmers interviewed had not learned anything from the labels. With regard to the main source of information on pesticides use, 66.7% of the farmers get information from pesticides retailers. Misinterpretation of symbols and pictograms was realized among the farmers. It was revealed that 60% of the farmers cannot interpret correctly the warning symbols and pictograms. The study also revealed that 76.3% of the farmers are aware that pesticide labels contain useful information on safe use of pesticides, and 76.1% of all farmers interviewed read pesticides labels before using pesticides. Even when farmers read instructions, most do not understand the instructions provided on pesticide labels, the main reasons reported include the use of foreign language (53.3%), too technical language (51.7%) unclear information (40%), use of uncommon Swahili words (26.7%), while 35.5% said following information on the label do not give good results. Other factors influencing the use of information on pesticide labels were found to be farmer's perception on pesticide labels, lacking sensitization on label use and reading habit. The study concluded that pesticide labels do not communicate fully the intended information on pesticide use. Pesticide labels need to be simplified and capacity building on symbols, colour codes, pictograms safety precautions, health and environmental impacts of pesticides use is highly required to pesticide users.

KEY WORDS: Effectiveness; Pesticide label; Communication; Pesticides handling

1.1INTRODUCTION

Various extension tools are employed in communicating vital information to farmers. These tools including labels are used as extension materials to deliver specific information regarding a certain product to the end users. According to Luis (1988), agrochemicals, among other products, require labelling to ensure that the user get the necessary information, not only regarding the contents of the package, but also regarding the precaution to be taken when applying or handling it as well as measures to be adopted for avoiding risks to the health of humans, animals, plants, and the environment. Ideally, the label explains what the pesticide product is to be used for, how it should be used, how toxic it is, how to mix it and the respective application rate, precautions, re-entry times after application, pre-harvest intervals, type of clothing and personal protective equipment required. It also indicates the nature of the antidote (if it exists) in the case of poisoning and the symptoms of poisoning if humans are exposed to the pesticide (FAO 2002). Damalas et al. (2006) points out that if the labels are properly read, understood and followed, any pesticide product should be used safely and efficaciously. However, farmers, who are the major pesticide users, are not fully aware of the potential risks related to pesticide use (Stewart 1996; Clarke et al., 1997; Hwang et al., 2000; Mekonnen and Agonafir 2002; Yassin et al., 2002; Hurtig et al., 2003; Martinez et al., 2004; Salameh et al., 2004 cited by Damalas et al., 2006). A survey done by Boston (2007) on the use of user guided in electronic appliances shows that the often-overlooked user manual is fast becoming the primary source of product education and the most important part of the consumer brand experience outside of the product itself in electronic and kitchen devices. It revealed that, more than 86% of consumer respondents cited the user manual as the first place they turn to learn about the products they own. More than 77% noted that one of the most frequent reasons for consulting a user manual is to learn about using product features. Nevertheless, similar information on use of labels of pesticides among smallholder farmers to learn about pesticide products is scanty. Such knowledge is important considering that in the context where extension personnel in rural areas are inadequate, pesticide labels will continue to be a vital source of information on pesticides application and handling among smallholder producers. As such, this study aimed at assessing the effectiveness of pesticide labels as a tool of communication and factors that hinder their effectiveness in the use and handling of pesticide products among smallholder farmers.

1.2 STATEMENT OF THE PROBLEM

Labels on pesticides are increasingly being used as a means of communicating the necessary information including how to use and handle pesticides by the end users. Experience shows that information contained on pesticides labels in most cases do not meet Farmers informational needs to enable them make informed decision on choosing the appropriate pesticide for a specific crop pest. Moreover, experience shows that most pesticides users rarely make use of information on the label before using pesticides. Reasons for not using this information are not clearly documented (Wilkinson et al., 1997). So far issues such as pesticides use and handling, pesticides health and environmental impacts, pesticides residues, packaging and transportation are well documented (FAO, 2002). However the effectiveness of the pesticides labels as a tool for communicating information on agrochemicals to the end users is not clearly understood. The study on pesticides use by smallholder farmers by Ngowi et al. (2007) in vegetable production in Northern Tanzania showed that 68% of farmers reported having felt sick after routine application of pesticides. Pesticide-related health symptoms were associated with lacking adherence to information provided on pesticide labels and 39% of farmers reported spending money on health due to pesticides. Wilson (2000) has estimated the private cost of Farmers exposure to pesticides in Sri Lanka. Using the cost of illness approach, he estimated that a farmer on average incurs a cost of USD 546 a year. Farmers exposed to pesticides incur costs due to

hospitalization, physician consultation and self-treatments. Some of the costs incurred are costs of transport and costs involved with special diets and hired labour due to inability to work on sick days. The indirect private costs incurred are loss of working hours and days, loss of efficiency, time a patient spend visiting hospitals or a physician and loss of leisure hours (Wilson, 2000). All these costs are associated with injudicious use of pesticides resulting from lacking information on pesticides safe use, hence the need to assess the effectiveness of pesticide labels as communication and identify the factors limiting their effectiveness in communication vital information to pesticide end users.

1.3 OBJECTIVES OF THE STUDY

1.3.1 General Objective

The general objective of the study was to assess the effectiveness of pesticides labels as information communication tool on safe use of pesticides among small holder farmers.

1.3.2 Specific Objectives

(i) To determine the extent to which farmers understand symbols and pictograms on pesticides labels
(ii) To determine the extent to which farmers use pesticides based on instruction on labels
(iii) To identify factors limiting the use of information on pesticide labels

1.4 RESEARCH QUESTIONS

(i) To what extent do farmers read and understand pesticides labels before buying, mixing, application, storage and/or disposal of unwanted remains or empty containers?
(ii) Do the farmers follow the pesticides application instructions and practice as indicated in the labels and how does understanding of labels influence Farmers spraying technology?
(iii) Are the pesticides labels designed in accordance to national and international standards such that the signs, symbols, and pictograms on pesticide label commonly understood to convey the same message to all users?

1.5 JUSTIFICATION OF THE STUDY

Studies done in Ngarenanyuki and Mang'ola wards (WAHSA, 2008, unpublished) in Northern Tanzania where pesticides are extensively used in onion and tomato production indicated high pesticides exposure among farmers, poor pesticides handling and disposal of pesticides containers. Likewise, a survey by Dalamas et al. (2006) among farmers to investigate Farmers attitudes towards information given on container labels in respect to pesticide use and safety issues revealed that information on pesticide labels is hard to read and understand. This shows that farmers do not make of all information and/or inability of the pesticides labels to attract farmers attention to read and understand important pesticides use information communicated through the labels to end users. On the other hand, a survey done by Boston (2007) on the use of user guided in electronic appliances shows that the often-overlooked user manual is fast becoming the primary source of product education and the most important part of the consumer brand experience outside of the product itself in electronic and kitchen devices. It revealed that, more than 86% of consumer respondents cited the user manual as the first place they turn to learn about the products they own. More than 77% noted that one of the most frequent reasons for consulting a user manual is to learn about using product features. Such information to ascertain the proportion of smallholder farmers using pesticides to learn about the pesticide products they use in agricultural production is hardly available. There is limited evidence on previous studies on awareness of smallholder farmers in Tanzania on pesticides labels, the extent to which they are used and their effectiveness in communicating vital information are reported in the literature. This shows that much is unknown on the extent to which labels and instruction manual are used in agriculture, hence the need to ascertain the extent of the use of pesticides labels and instructions manuals among smallholder farmers in horticultural production. The rationale for undertaking this study is to enhance strong farmer knowledge on pesticides label and its relation to safe use of pesticides. The study was therefore set to unveil the extent to which smallholder farmers understand and put in practice information provided on pesticides labels during handling of the pesticides and to identify the limiting factors of effective use of the labels. This study will present facts as to why the guidelines on the labels are not effectively used. Understanding the extent to which smallholder farmers understand and put into practice the information provided on the pesticides labels will be of paramount importance for Ministry of Agriculture, Food Security and Cooperatives (MAFC) and its Pesticide Certifying and Research Center, Tropical Pesticides Research Institute (TPRI) and policy makers when approving pesticides and pesticides labels that are responsible for communicating safe use and proper pesticides handling. It will provide important input to improve the labels for a wider use by smallholder farmers and other pesticides users so as to enable the users get full benefits of the information provided there in. This is to ensure that suitable understandable information and warnings are included in the product label by careful use of labeling as a vital source of information to pesticides users.

1.6 SCOPE OF THE STUDY

This study interviewed farmers involved in horticultural production were the use of pesticides and other agrochemicals in combating pests and diseases in high. Respondents were farmers producing tomatoes, onions, carrots, cucumbers and, cabbage and other edible vegetables. To ensure equal representation of primary data collection, data collection were limited to edible horticultural crops.

1.6 LIMITATION OF THE STUDY

The study was done during pesticide application period; respondents were very mobile in search of pesticides as well as out in the fields for pesticides application. Some were not corporative in responding to questions.

2 LITERATURE REVIEW

2.1 INTRODUCTION

This part of the study provides the synopsis of literature review, which includes conceptual framework and review of variables also known as empirical review.

2.2 THEORETICAL FRAMEWORK

The effectiveness of pesticides label as a tool for communicating information to the end users is determined by the ability of information on the labels to create awareness and influence Farmers decision making on pesticides safe use. The key aspect in effectiveness is the extent to which farmers understand the information provided on the labels and make use of it practically in their use and handling of pesticides. In this context, effectiveness is measured by the level at which farmers read and understand the information on the label and the extent to which they use the pesticides label to acquire proper knowledge of pesticides use and apply it. Farmer's ability to understand information and transform it into action can be directly or indirectly affected by nature, size and types of pesticides labels, attitude toward pesticides label and complexity of different signs and symbols. The study assessed Farmers understanding of information on the labels and their ability to put into practice such information.

2.2.1 Farmers understanding of symbols and pictograms on pesticides labels

The pesticide product label is the main method of communication between a pesticide manufacturer and the pesticide users. It provides applicators with specific instruction on how to use the products safely and correctly (Prochaska, 2011). Wilkinson et al. (1997) reported that illiteracy, imperfect knowledge of the language, or imperfect vision can be major obstacles for farmers to read and comprehend the information found on pesticide labels. Farmer's ability to comprehend the information from labels can be influenced by different factors. In their study to investigate Farmers attitudes towards information given on container labels in respect to pesticide use and safety issues, Damalas et al. (2006) realized that pesticide labels are hard to understand (incomprehensible). The survey revealed that a large proportion of the farmers (72%) agreed that most information on pesticide labels is hard to read, whereas the vast majority (94%) agreed that most of the information on pesticide labels is hard to understand. The survey further revealed that more than half of the farmers (63%) reported that they often try to read the labels but do not understand everything featured on them, whereas only a tiny proportion of the farmers (6%) stated that they always read and understand the entire label. Among those farmers who stated that they never read the labels, just over half (53%) reported that it is because they do not understand the information the labels contain, whereas 35% claimed that it is because they already know the information. Inability of farmers to understand the information provided on the labels was attributed to inability of farmers to read (e.g. illiterates), low education levels and poor literacy skills, or inability of farmers to understand the language used in the wording of the label. The latter is particularly important for farmers because labels may include unfamiliar words that few people can readily understand. It is a common observation that understanding much of the information requires some technical knowledge on the part of the farmers. Properly interpreting the pesticide label is crucial to selecting the most appropriate pesticide products for use and therefore receiving maximum benefit from their use (PAN-UK, 2000). Kauzeni (1989) reported that problems in communicating agricultural information and advice stem from factors such as the language used. Damalas et al. (2006) pointed out such factors to include technical language, and use of other symbols to convey ideas that are uncommon resulting in misinterpretation and little or no response to the message or information disseminated because it cannot be comprehended. Studies done on food labels indicate that while consumers are checking labels, they do not necessarily understand what they are reading. Half of the world's consumers said they only "partly" understand the nutritional labels on food, with 60% of Asia Pacific's citizens leading the world in this lack of understanding, followed by Europeans (50%) and Latin Americans (45%). Most conversant with food labeling were the North Americans, with 64% claiming to "mostly" understand food labels. However, there is a difference between what consumers believe and how they behave. The study showed that only 37% of consumers select foods primarily on their nutritional content (Mahgoub et al., 2007).

2.2.2 Farmers Use of Pesticides Based on Instruction on Labels

The information on the pesticide label defines the use pattern of the pesticide based upon the assessed risks to health, the environment and trade (Regulatory Support Unit, Public Health Division, 2010). By law, certain kinds of information must appear on a pesticide label. Pesticide users have the legal responsibility to read, understand and follow the label directions. Pesticides should be packed and labeled according to WHO specifications, that is, the label should be in English and in the local language, and should indicate the contents, safety instructions (warnings) and possible measures in the event of swallowing or contamination (PAN-UK, 2000). It is the responsibility of the pesticides user to read, understand and follow the label instructions to ensure that pesticides are applied according to the regulations. A survey by Boston (2007) on the use electronic and kitchen devices based on instruction manuals revealed that the product user manual is an increasingly critical tool for both consumers and brand managers. He further noted that the often-overlooked user manual is fast becoming the primary source of product education and the most important part of the consumer brand experience outside of the product itself. It is important that pesticides are used only for registered uses, that means, those uses that are on the label, as their use for unapproved purposes could increase the risk to human health and the environment, damage international trade, and result in poor pest control (Regulatory Support Unit, Public Health Division, 2010). Damalas et al. (2006) survey on tobacco farmers in the rural area of Pieria to investigate Farmers attitudes towards information given on container labels shows that most farmers when deciding to use a pesticide product primarily rely on pesticide salesmen's information, while others rely on their own experience and only a few farmers (6%) rely primarily on the information found on the product labels. They concluded that essential information about pesticide handling and safety issues found on pesticide labels has to be more effectively communicated to the farmers using appropriate label formats which facilitate noticeability, legibility, and comprehension. On the contrary, Boston (2007) reported that more than 86% of electronic consumer respondents cited the user manual as the first place they turn to learn about the products they own and more than 77% noted that one of the most frequent reasons for consulting a user manual is to learn about using product features. The use of instruction manuals is highly advanced in the electronic industry as Boston (2007) explains in his study that consumers expect on-demand access to user manuals and are even using them as a resource prior to purchase. He

revealed that more than 20% of the most sophisticated Internet users say that they review the user manual before purchasing a product and 26% of this same group indicated that they use the user manual to check compatibility with other products. In his publication, Prochaska (2011) stresses that reading and following the pesticide label directions is critical to using pesticide products correctly as the pesticide label is the information written on and often attached to the pesticide container that tells how to use the product effectively and safely. Adherence to pesticide label directions should minimize personal and environmental contamination risks. Further, it is a violation of state laws to use a pesticide in any way other than recommended by the label directions. The bottom line in using pesticides safely is to read and follow pesticide label directions.

2.2.3 Pesticides application in relation to the information provided on pesticides labels

Every pesticide user has the responsibility to read and follow the label information so no harm will result from misuse or mishandling of pesticides (O'Connor-Marer, 2000). Damalas et al. (2006) noted that most farmers (57%) when deciding to use a pesticide product they primarily rely on pesticide salesmen's information, while nearly a third (32%) reported that they rely on their own experience. Forty-six percent of the farmers declared that they normally exceed the recommended rates indicated on the label, whereas none reported using less than the label rates. Grieshop and Stiles (1989) study on pesticides label use found that pesticide labels did not influence users' practices because they were not so effective in their warnings and recommendations. This was also reflected in a study by Lockwood et al. (1994) who found that a significant proportion of the American public could not or did not read or understand pesticide labels and did not follow the label instructions. Similar findings were reported by Avory and Goggon (1994) who reported that only 38% of the farmers always read the manufacturer's entire label when using a pesticide product for the first time. Several studies investigating overuse and misuse of pesticides found that inadequate product labeling and Farmers lack of information often lead to widespread overuse or misuse of dangerous pesticides in developing countries (Dung and Dung, 1999; Dung et al., 1999; Huan and Le Van Thiet, 2000 cited by Damalas et al. 2006)

2.2.4 Factors Limiting the Use of Pesticides Labels

The effective use of information from pesticides labels depend on both the form in which the information is presented and on Farmers attitudes towards the sources presenting it (Slovic, 1986, Kasperson, 1992; Stern and Dietz, 1994 cited by Lichtenberg, 1999). Damalas et al. (2006) observed that the information on pesticide labels is hard to read. This results in farmers not being able to understand and hence limiting the scope of their use. They noted that 94% of the participants of the survey agreed that pesticide labels are hard to understand (incomprehensible). This was attributed to factors such as inability of farmers to read, low education levels and poor literacy skills, or inability of farmers to understand the language used in the wording of the label. The latter is particularly important for farmers because labels may include unfamiliar words that few people can readily understand. Lockwood et al. (1994) found that the average label required a cognitive reading ability (i.e. read, interpret, comprehend) which means that no more than 60% and perhaps less than 50% of American adults could understand a pesticide label. Wording used for pesticide warning labels affected perception of the appropriateness of hazard statements with the most effective variations being the use of the personal pronoun (Edworthy et al., 2004 cited by Damalas et al., 2006). Another reason why farmers do not read the pesticide labels is the view that they already know all the information the labels provide. Farmers who use a given brand product year after year often assume that the label information is always the same as the year before. This is not necessarily so. Active ingredients, formulation, and times of application may change as a result of research and field trials (Damalas et al., 2006) Studies on the use of labels in food packages among consumers revealed that barriers to the effective use of nutrition information on the food label include old age, low socio-economic status and lack of education (Mahgoub et al., 2007). They argue that if label information is more usable by consumers, society can greatly benefit from a public health perspective. They further indicated that effectively designed nutrition disclosures facilitate the utilization of nutrition information and that some consumer characteristics such as education affect the utilization. A recent study by Douaud (2006) shows a significant deficiency in the public understands of food labels. In the study, poor label comprehension was correlated with low-level literacy and numeracy skills, but even patients with higher literacy could have difficulties interpreting labels.

2.3 SUMMARY

For a variety of reasons, many farmers do not receive the full benefit of the information on the label. This is because some labels are difficult to read, or because farmers assume that they know well how to use the product, or because they are not aware of the types of information found on the label. Literature reveals the extent to which labels are used in electronic and food products is highly advanced than in agriculture and mostly by smallholder famers. No previous studies on awareness of smallholder farmers in Tanzania about pesticides labels and pesticides labeling are reported in the literature. The relationships between a number of factors including age, level of education, and family income of the participants and the level of knowledge and use of food labels and nutrition information have been studied. Such literature is hardly found regarding smallholder farmers and pesticide labels. Clear understanding of Farmers knowledge, attitudes, and practices regarding pesticide label is the first step toward understanding the effectiveness of communication process with regard to pesticides labels. Literature also shows that little is done in studying the extent to which pesticides labels are used with respect safe use of pesticides among smallholder farmers. Majority of farmers do not make efficient use of the information from the labels; hence the objective of this study was to investigate Farmers ability to comprehend and put into practice information about pesticide use and safety issues found on pesticide labels and factors limiting their use.

3 RESEARCH METHODOLOGIES

3.1 INTRODUCTION

This chapter is on the overall research design, sample size, data collection methods and procedures that were observed in finding answers to the research questions.

3.2 RESEARCH DESIGN
The study adopted the cross sectional research design in which data was collected at a single point within the study area, and which, according to Babbie (1986) is suitable for determining relationships between and among variables.

3.3 TARGET POPULATION
The study population included farmers involved in horticultural production. The list of names from which the sample was selected was obtained from respective village government offices. The units of analysis were household heads in respective villages.

3.4 SAMPLING PROCEDURES AND SAMPLE SIZE
Purposive sampling was used to select the districts under the study. Decision to select Karatu and Arusha district was based on their high production of tomatoes and onions and the extensive use of pesticides in horticultural production. Purposive sampling was also used in the selection of wards, namely Mang'ola and Ngarenanyuki. Wards selected were those from which horticultural production and pesticides application was typically done. From the selected wards, random sampling was used to select four villages from Mang'ola and two from Ngarenanyuki due to the heterogeneity in the farming and pesticides use and homogeneity in farming systems and pesticides use in Mang'ola and Ngarenanyuki respectively. Farmers' households were randomly selected in proportional to the number of farmers involved in horticultural production in respective villages. Table1 below summarizes the distribution of respondents according to their villages.

Table 1: *Distribution of respondents according to their villages*

Ward	Village	n	%
Mang'ola	Barazani	30	15.0
	Maleckchand	35	17.5
	Mbuga Nyekundu	10	5.0
	Qangded	25	12.5
Ngarenanyuki	Olkung'wado	35	17.5
	Uwiro	45	22.5
	Total	**200**	**100.0**

The sample size was determined using precision criterion determination of the sample size which assumes that the dominant characteristics of the study would occur if the confidence interval set at 5% marginal error and 95% level of confidence. The sample size of the study was 200 respondents. This expression was used to estimate the sample.

$$n = \frac{z^2 . pq}{e^2} \quad \text{.....(i)}$$

Where n = Sample size
Z = % point of the standard normal distribution which is 1.96 in this case corresponding to 95% confidence level
e = marginal error which is 5%, =0.05
P = expected proportion of the respondents taken as 5%, =0.05
q = 1-p

According to Kothari (2008), in order to improve the precision in generalizations from the sample, the allowed error for the sample mean should be ±3% of the population mean. Upon substitution in the above formula:

$$n = \frac{(1.96)^2 \text{ X } 005\ (1\text{-}0.05)}{(0.03)^2}$$

$$= 202.75$$

$$\approx 200$$

3.6 DATA COLLECTION PROCEDURE AND TOOLS
Primary data were collected from the households involved in production of horticultural crops in Mang'ola and Ngarenanyuki wards while secondary data such as information communication, pesticides labeling and pesticides application technologies were gathered from available literature, library, pesticides labels and internet. Primary data was collected using an interview schedule containing both closed and open-ended question and checklists. A checklist was used in collecting information during focus group discussions. Data collected through FDGs included praying practices, main source of information on pesticide use, pesticides exposure and health impacts of pesticides use among farmers.

3.7 DATA ANALYSIS AND PRESENTATION
Data collected from the interview schedules were analyzed using SPSS 12.0 version computer software whereby descriptive statistics such as frequency and percentage were also used to obtain the general picture of respondent's profile and general view of their understanding and use of information on pesticide labels. Data collected using checklist was analyzed using content analysis. Simple descriptive statistics and cross tabulation were used in the analysis.

4. RESULTS AND DISCUSSION

4.1 INTRODUCTION
This chapter presents the findings from the study. It contains findings that are presented logically with respect to the objectives of the study. Results are presented in graphs, charts and tables. Discussion is made accordingly supported by literature explaining where the findings agrees or not with existing literature

4.3 DEMOGRAPHIC CHARACTERISTICS

4.3.1 Respondents' Profile
The profile of respondents was determined with reference to gender, age, education level, and types of horticultural crops grown. The study found that majority of the responds were males (81.5%); between 30-39 years old (50%); able to read and write (78.5%); educated to primary level (89.2%); and mainly grew tomatoes (26.6%), Onions (21.9%) and Kale (17.8%)

Table 1 *Profile of Respondents*

Variable	n	%
Sex of the respondent		
Male	163	81.5
Female	37	18.5
Total	**200**	**100**
Age of respondents in years		
Under 30	75	38.3
30-49	98	50

50-69	23	11.7
Total	**196**	**100**
Knows to read and write		
Yes	157	78.5
No	43	21.5
Total	**200**	**100**
Highest level of you education		
Primary education	140	89.2
Secondary education	17	10.8
Total	**157**	**100**
Main horticultural crops grown		
Tomatoes	53	26.6
Onions	44	21.9
Kale	36	17.8
Chinese cabbage	32	16.2
Amaranths	25	12.5
Cabbage	10	5.1
Total	**200**	**100**

4.2 Sources of Information on Use of Pesticides

The survey identified different sources of information on use of pesticides. These included pesticides retailer/shop (66.7%), labels (38.8%), own experience (27.2%) and extension officers (14.4%) (Table2). Similar findings have been reported by Damalas et al. (2006). They noted; that when deciding to use a pesticide product majority of farmers (57%) primarily rely on pesticide salesmen's information, while nearly a third (32%) reported that they rely on their own experience and only a few farmers (6%) rely primarily on the information found on the product labels. This is contrary to findings on the use of labels in electronic appliances. For Boston (2007) reported that, more than 86% of electronic consumer respondents cited the user manual as the first place they turn to learn about the products they own. Besides, more than 77% noted that one of most frequent reasons for consulting a user manual is to learn about using product features before buying them.

Table 2 *Sources of information on pesticides use*

Variable	n	%
Get information from pesticides labels		
Yes	76	38.8
No	120	61.2
Total	**196**	**100.0**
Get information from extension officer		
Yes	28	14.4
No	167	85.6
Total	**195**	**100.0**
Get information from pesticides retailer/shop		
Yes	130	66.7
No	65	33.3
Total	**195**	**100.0**
Get information from my friend/neighbour		
Yes	13	6.7
No	182	93.3
Total	**195**	**100.0**
Use own experience		
Yes	53	27.2
No	142	72.8
Total	**195**	**100.0**

4.3 Extent to which Farmers Understand Symbols and Pictograms on Labels

The study showed that most farmers (91%) interpreted correctly the pictogram for 'wear gloves'. Likewise, about 63% of the respondents interpreted correctly the 'wash after use' pictogram. Besides, 70.9% of famers did not understand the 'keep locked away and out of reach of children' pictogram while only 17.6% interpreted it correctly. The results also revealed that 44.5% did not understand the 'wear protection over nose and mouth' pictogram while less than half (44%) interpreted it correctly. About two third (61%) did not understand the 'wear respirator' pictogram and only 29% managed to interpret it correctly (Table 3). Focus group discussions with farmers indicated that there were no explanations about the symbols and pictograms used are complicated to understand. In their study Damalas et al. (2006) reported that pesticide labels are hard to understand (incomprehensible). Their survey revealed that a large proportion of the farmers (72%) agreed that most information on pesticide labels is hard to read, whereas the vast majority (94%) agreed that most of the information on pesticide labels is hard to understand

Table 3a: *Understanding of symbols and pictograms on labels*

Variable	Response	n	%
 Wear glove	Wear gloves	182	91.0
	I don't know	17	8.5
	Poison	1	0.5
	Total	**200**	**100.0**
 Keep locked away and out of reach of children	Don't know	141	70.9
	Keep locked away and out of reach of children	35	17.6
	Store pesticides in the store	10	5.0
	Store pesticides in the cupboard	5	2.5
	Keep pesticides away from fire	3	1.5
	How to open a pesticides store	2	1.0
	Do not handle pesticides without cloves	1	0.5
	Disposal of empty containers	1	0.5
	Don't store pesticides up	1	0.5
	Total	**199**	**100.0**
 Wash after use	Wash after use	126	63.3
	Don't know	65	32.7
	Mix pesticides	4	2.0
	Follow direction of wind	1	0.5
	Get prepared	1	0.5
	Do not pour pesticides in the water	2	1.0
	Total	**199**	**100.0**

Table 3b: *Understanding of symbols and pictograms on labels*

Variable	Response	n	%
 Wear protection over nose and mouth	Don't know	89	44.5
	Wear protection over nose and mouth	88	44.0
	Cover your nose with a piece of cloth	23	11.5
	Total	**200**	**100.0**
 Wear boots	Wear boots	168	84.0
	Don't know	32	16.0
	Total	**200**	**100.0**
 Wear respirator	Don't know	122	61.0
	Wear respirator	58	29.0
	Protect/cover your face during spraying	15	7.5
	Use/wear oxygen equipment	3	1.5
	Don't use your mouth	2	1.0
	Total	**200**	**100.0**

Source: *WHO (1985)*

4.4 Farmers Misinterpretation of Pictograms and Symbols

The study found that 60% of the farmers interviewed were not able to interpret correctly the "Dangerous/harmful to fish - do not contaminate lakes, rivers, ponds or streams" while 55% were not able to interpret correctly the 'Dangerous/harmful to animals' pictograms. Only 39.5% and 41% respectively interpreted the pictograms correctly. Likewise, the 'Wear face-shield' was correctly interpreted (73.5%). The 'Handling liquid concentrate' was not understood by 53.1% of the farmers and misinterpreted as 'Measure using special measurement container (Cubic Centimeters-Cc) before use' and only 6.3% interpreted it correctly. Close to 60% (58.5%) of the respondents did not understand the meaning of 'Handling dry concentrate' pictogram and about 21% (20.7%) of them misinterpreted it as 'measurements (Cubic centimeters) for measuring pesticides'.

Table 4 *Misinterpretation of Pictograms and Symbols*

Variable	Responses	n	%
 Dangerous/harmful to fish	Don't know	120	60.0
	Dangerous/harmful to fish	79	39.5
	Used for fishing	1	0.5
	Total	**200**	**100.0**
 Dangerous/harmful to animals	Don't know	110	55.0
	Dangerous to animals	82	41.0
	Do not use pesticide to domesticated animals	5	2.5
	Pesticide can be used to domesticated animals	3	1.5
	Total	**200**	**100.0**
 Wear face shield	Wear face shield	53	26.5
	Don't know	147	73.5
	Total	**200**	**100.0**
Expire date of the chemical	I don't know	89	49.4
	Spraying time	61	33.9
	Expire date of the chemical	30	16.7
	Total	**180**	**100.0**

Table 4 *Misinterpretation of Pictograms and Symbols (Conti…)*

Variable	Responses	n	%
 Handling liquid concentrate	Don't understand	102	53.1
	Measure using special measurement container (Cc) before use	68	35.4
	Handling liquid concentrates	12	6.3
	Measure using small measurement container	9	4.7
	Eating while spraying	1	0.5
	Total	**192**	**100.0**
 Handling dry concentrate	Don't understand	113	58.5
	Use measurements (Cc) to measure pesticides	40	20.7
	Mix in the drum	20	10.4
	Measure using large pesticides measurement container	10	5.2
	Handling dry concentrates	9	4.7
	Put pesticides in the knapsack	1	0.5
	Total	**193**	**100.0**
 Pesticides Application	Pesticides Application	139	71.6
Pesticides Application	Don't understand	55	28.4
	Total	**194**	**100.0**

4.5 Farmers Understanding and Interpretation of Colour Codes

The study found that farmers did not, to a large extent, understand the colour codes. This was the case for yellow, blue and green colour codes. However, 62.1% understood the 'Extremely hazardous/dangerous (Very Toxic)' presented in red. This might be due to the conversional meaning of 'danger'

traditionally associated with red colour. Other colour codes including yellow representing 'moderately hazardous (harmful)' was not understood by 95% of the farmers. Similarly, most respondents (98%) did not understand blue representing 'Slightly hazardous (Caution)'and 97% of them did not understand green representing 'Pesticides unlikely to present acute hazard in normal use (Caution)' (Table 5). During focus group discussions, farmers pointed out that they were unaware that the colours on the labels had some meaning and thus did not pay any attention to them. This implies that farmers do not get all intended knowledge by the manufacturer leading to misuse of pesticides. Furthermore, during focus group discussions farmers reported that the language, symbols and colour codes on the pesticide labels were found to be the main source problems in using information on the labels. This also implies that information on pesticides labels is not fully communicated to the farmers. Correlation test indicated a positive association (r=0.605; p=0.003) between understanding and the usefulness of the information on pesticides labels (Table 5). This means that for the information on the pesticides label to be effectively used by the farmers, it should be easily understood. Farmer's perception on the use of information on the label of pesticides is influenced by the complexity of the information. Farmers perceive information provided on pesticides labels to be not understood, and hence affecting their interest and awareness to use it.

Table 5 *Understanding and Interpretation of Colour Codes*

Variable	Responses	n	%
Danger-Extremely hazardous			
	Extremely dangerous (very toxic)	123	62.1
	Don't understand	75	37.9
	Total	**198**	**100.0**
Moderately hazardous (harmful)			
	Don't understand	189	95.0
	Moderately dangerous (harmful)	8	4.0
	Not harmful	2	1.0
	Total	**199**	**100.0**
Slightly hazardous			
	Don't understanding	195	98.0
	Slightly hazardous **(Caution)**	4	2.0
	Total	**199**	**100.0**
Unlikely to present acute hazard in normal use			
	Don't understand	193	97.0
	Unlikely to present acute hazards	4	2.0
	Helpful to crops	2	1.0
	Total	**199**	**100.0**

4.6 Factors influencing choices and use of pesticides by farmers

This study showed that the presence of pesticide label on pesticides container did not necessarily influence the farmers' choice and use of pesticides. The use of pesticides was found to be influenced by the experience in the use of such product by other farmers and the extent to which pesticides salesmen and company agents promote the use and efficiency of pesticide products. A similar finding was reported by Grieshop and Stiles (1989) cited by Damalas et al. (2006). They found that pesticide labels did not influence users' practices, mainly because they were not so effective in their warnings and recommendations.

4.7 Factors limiting the use of information on pesticide labels

The association between language used on the labels and problems faced by farmers in using pesticides labels was tested using chi square test. The results show that there is statistically significant relationship between language used on the label and the problems faced by users in utilizing the information on the labels (χ^2 = 21.45; df =2; p = 0.000). The relation between language used and problem faced in using labels was found to be statistically significant (r= -0.323; p= 000). The negative correlation implies that the more complicated language used on the label the less farmers understand and make use of the information. This implies that the use of difficult language on the labels leads to serious problems and hence failure of pesticides users to understand and make use of the information from the pesticide labels (Table 6).

Table 6: *Problems in using pesticides labels and Language used Distribution*

Variable	Language used on pesticide label							
Face problems of using pesticides labels	**Easily understood**		**Hardly understood**		**Not understood at all**		**Total**	
	n	%	n	%	n	%	n	%
Yes	42	41.6	31	54.4	29	87.9	102	53.4
No	59	58.4	26	45.6	4	12.1	89	46.6
Total	**101**	**100.0**	**57**	**100.0**	**33**	**100.0**	**191**	**100.0**

χ^2 = 21.454; df =2; p = 0.000 r= -0.323; p=0.000 Correlation is significant at the 0.01 level (2-tailed).

Farmers indicated various problems they encountered when using pesticides label. According to the study, the three most important problems are words being too many and congested (94.2%), words not clearly seen (71.74%), and words being too small to read (60.6%) (Table 7). Similarly, Damalas et al. (2006) in their study found that the vast majority of farmers (94%) agreed that most of the information on pesticide labels is hard to understand while 72% of them agreed that most information on pesticide labels is hard to read. Farmers facing problems in the use of the labels implies that the label do not provide a learning environment by attracting the attention of farmers in a manner that stimulates learning and change of attitude with regards to pesticides safe use.

Table 7 *Factors limiting the use of labels*

Variable	n	%
Words not clearly visible, wiped-out		
Yes	71	71.7
No	28	28.3
Total	**99**	**100.0**
Words are too small to read		
Yes	60	60.6
No	39	39.4
Total	**99**	**100.0**
Words are too many, congested and poor		
Yes	97	94.2
No	6	5.8
Total	**103**	**100.0**

Chi square test also revealed a significant relationship between reading habit and the ability to of farmers to acquire knowledge from pesticides labels (χ^2 = 4.652; df =1; p = 0.031). Correlation test (Table 8) for the association between reading habit and ability to acquire knowledge from the labels shows a positive relationship (r=0.165; p=0.031). This implies acquiring knowledge from pesticides label is associated with reading habit of an individual, hence individuals with a reading habit are more likely to read, understand and acquire some knowledge from the information than individuals who do not have reading habits.

Table 8: *Knowledge acquired based on information from the label and Reading habit*

Variable	Have a reading habit					
Acquired knowledge based on information got from the label	**Yes**		**No**		**Total**	
	n	%	n	%	n	%
Yes	28	28.0	10	14.1	38	22.2
No	72	72.0	61	85.9	133	77.8
Total	**100**	**100.0**	**71**	**100.0**	**171**	**100.0**

χ^2 = 4.652; df =1; p = 0.000 r= 0.165; p=0.031 Correlation is significant at the 0.05 level (2-tailed).

The association between language used on the labels and problems faced by farmers in using pesticides labels was tested using chi square test. The results show that there is statistically significant relationship between language used on the label and the problems faced by users in utilizing the information on the labels (χ^2 = 21.45; df =2; p = 0.000). The relation between language used and problem faced in using labels was found to be statistically significant (r= -0.323; p= 000) (Table 8). The negative correlation implies that the more complicated language used on the label the less farmers understand and make use of the information. This implies that the use of difficult language on the labels leads to serious problems and hence failure of pesticides users to understand and make use of the information from the pesticide labels

Problems in using pesticides labels and Language used Distribution

Variable	Language used on pesticide label							
Face problems of using pesticides labels	**Easily understood**		**Hardly understood**		**Not understood at all**		**Total**	
	n	%	n	%	n	%	n	%
Yes	42	41.6	31	54.4	29	87.9	102	53.4
No	59	58.4	26	45.6	4	12.1	89	46.6
Total	**101**	**100.0**	**57**	**100.0**	**33**	**100.0**	**191**	**100.0**

χ^2 = 21.454; df =2; p = 0.000 r= -0.323; p=0.000 Correlation is significant at the 0.01 level (2-tailed).

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSION

The study revealed that farmers misinterpret the information from the labels leading to poor handling of the pesticides products. The WHO Colour code and international standard symbols and pictograms used to give precautions and warnings were found not to be understood to a great extent by farmers. Most labels are poorly designed in terms of font size, size of the label, layout and language such that they cannot be easily read and understood. The problems associated with poor communication of pesticides use information identified during the survey mainly come from the label as a communication tool, hence shifting the attention of the farmer to the pesticides retailers for vital information on pesticides use. Farmers were found to have been exposed and affected by pesticides. This shows that the information provided to farmers do not cater for safety issues and precautions during handling of pesticides. Farmers showed minimal level of knowledge in the use of proper pesticides application techniques and safety information on pesticides labels as compared to that of consumers of food and electronic consumables. The main reasons for farmers failing to make use of the information on pesticide labels were found to originate from the pesticide label. The labels were found to contain complicated information which could not be comprehended by farmers. The use of technical language, small font size of the words, uncommon pictograms and colour codes and the use of foreign languages were found to be the main problems hampering the use of pesticides labels.

5.4 RECOMMENDATIONS

A pesticide safe use education strategy and appropriate programmes should be designed and implemented to raise the level of knowledge and understanding of pesticide labels. The pesticides certifying organ-TPRI under the Ministry of Agriculture, Food Security and Cooperatives should review and enforce the pesticides certifying terms and conditions, such that any pesticides product registered should be in simple Swahili words, technically simplified to suit the rural community which to a large extent have primary education. The colour notation should as well be accompanied by descriptive words to aid easy understanding. Reading habit should be promoted among farmers to impart a sense of reading that will eventually influence reading and understanding of the information provided on the pesticide labels. Pesticides labels should be attractive to capture the attention of farmers to read.

5.5 AREAS FOR FURTHER RESEARCH

Further studies need to be conducted to investigate other aspects of pesticides labeling such as adherence of pesticides manufacturers to international and national regulations for labeling, pesticides business and their certification in Tanzania. Continuous and effective inspection and field monitoring of pesticides should be highly considered to identify counterfeit and expired pesticides products that might as well contribute to poor results associated with the use of information provides on the pesticides labels.

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