

# **Journal of Continuing Education and Extension (JCEE)**



**A Journal of the Institute of Continuing Education,  
Sokoine University of Agriculture,  
Morogoro, Tanzania**

**Vol.3 No. 2**

**December 2010**

## **EDITORS**

### **Chief Editor**

Prof G.G. Kimbi  
Sokoine University of Agriculture

### **Editors**

Prof. A. Z. Mattee  
Sokoine University of Agriculture

Prof. A.C. Isinika  
Sokoine University of Agriculture

Prof. R. M. Wambura  
Sokoine University of Agriculture

### **Associate Editors**

Prof. S. J. Maghimbi  
University of Dar es salaam

Dr. Angene Wilson  
College of Education  
University of Kentucky, USA

Prof. J. M. R. Semoka  
Sokoine University of Agriculture

Prof. C. A. Onyango  
Egerton University, Kenya

## **Objective and Scope**

The objective of the JCEE is to provide a forum for intellectual discourse on issues that are relevant to continuing education, extension services and development in general.

## **Subscriptions**

The Journal of Continuing Education and Extension is published twice a year. The two issues for each year will constitute one volume. The Journal is operating within an initial circulation of 400 copies per issue, subject to review from time to time.

Subscription fee is US Dollars 10 or Tanzania shillings 10,000.00 per issue. This includes postage by surface mail. All subscriptions should be sent to:

***The Chief Editor,  
Journal of Continuing Education and Extension,  
Sokoine University of Agriculture,  
P. O. Box 3044,  
CHUO KIKUU,  
Morogoro  
Tanzania  
Tel. 255-23-26044549  
E-mail address: ice@suanet.ac.tz***

## Table of Contents

---

|                                                                                                                                                                          |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Influence of mobile phones and broadcast media on rural communicative ecologies in Kilosa and Mvomero Districts, Tanzania.....                                           | 1   |
| <b>A. S Sife; E. Kiondo and J. G. Lyimo-Macha</b>                                                                                                                        |     |
| Attitude of women towards gender based violence in Serengeti District, Tanzania.....                                                                                     | 13  |
| <b>A. N. Sikira; E. A. Mwageni and R. J. Salanga</b>                                                                                                                     |     |
| Coping with AIDS impacts: The role of informal social capital in a Tanzanian village .....                                                                               | 24  |
| <b>C. I. Nombo</b>                                                                                                                                                       |     |
| Effects of farmers' response to formalized land conservation approaches on maize crop productivity in Tanzania: A case of Kilosa and Kiteto Districts.....               | 39  |
| <b>B. D. Sebyiga and J. A. Kuzilwa</b>                                                                                                                                   |     |
| Informal environmental awareness as entry point for formal environmental education programmes: The case of East Uluguru Mountains, Tanzania .....                        | 50  |
| <b>C. P. I. Mahonge; J. V. Nsenga and A. Z. Mattee</b>                                                                                                                   |     |
| An occasional quality of un-official standard seeds used by farmers: A case of Morogoro, Tanzania .....                                                                  | 62  |
| <b>D.G. Msuya and B. F. Mbiling'i</b>                                                                                                                                    |     |
| Potential of indigenous knowledge in climate change adaptation and mitigation: Prospects and challenges for Tanzania .....                                               | 76  |
| <b>G. C. Kajembe; J. S. Mbwambo; A. B. Mwakalobo; D. N. Kimaro and M. A. Njana</b>                                                                                       |     |
| Gender based effectiveness of Agricultural Extension Agents' contacts with smallholder farmers in extension services delivery: A Case of Kilosa District, Tanzania ..... | 85  |
| <b>A. A. M Kyaruzi; M. R. S. Mlozi and I. M Busindi</b>                                                                                                                  |     |
| Financing Vocational Higher Agricultural Institution: the Experience of College of Agriculture Akure, Ondo State, Nigeria.....                                           | 94  |
| <b>M. Borode1</b>                                                                                                                                                        |     |
| Factors Constraining the Development of the Agricultural Education and Extension Profession in Tanzania.....                                                             | 102 |
| <b>M.R.S. Mlozi</b>                                                                                                                                                      |     |

# **Informal environmental awareness as entry point for formal environmental education programmes: A case of East Uluguru Mountains, Tanzania**

C.P.I. Mahonge<sup>1</sup>, J.V. Nsenga<sup>1</sup> and A.Z. Mattee<sup>2</sup>,

<sup>1</sup>Centre for Sustainable Rural Development, Sokoine University of Agriculture  
P.O. Box 3035, Morogoro Tanzania;

<sup>2</sup>Department of Agricultural Education and Extension, Sokoine University of Agriculture;

---

## **Abstract**

*In all communities where formal arrangements exist, informal arrangements which directly or indirectly support, oppose or are neutral to such formal arrangements are inevitable. Informal arrangements can be institutionalised to formal arrangements or can enrich, transform or revolutionize the existing formal arrangements. In environmental education field, formal environmental education programmes implemented at the community level can be influenced by informal conditions. One of such conditions is people's awareness on the natural resources that manifest in their practices in the use of these resources. Formal environmental education arrangements imposed without prior comprehension of the existing environmental awareness undermine existing and useful interactions or exacerbate existing counteractions between human and environmental resources. This study aimed at determining farmers' awareness on degradation of water sources and streams in private farm plots (micro-water resources) in East Uluguru Mountains in Tanzania so as to provide insight to planning formal environmental education programmes. Farmers owning farm plots where micro-water resources are located were interviewed. Transect walk was also conducted to implement the interviews. Findings indicated that farmers were aware of the degrading micro-water resources but could not link the degradation with their anthropogenic practices. Following insights on farmers' awareness and knowledge on field realities, a formal environmental education was given to the farmers. This study recommended that a thorough understanding of interactions among socio-economic, market, ecological and cognitive factors is imperative for sustainability of micro-water resources (private farms) and therefore further research is recommended in this direction.*

**Key words:** Farmers awareness, degradation, micro-water resources, farming practices, conservation

## **Introduction**

**I**n all communities where formal arrangements exist, informal arrangements which directly or indirectly support, oppose or are neutral to such formal arrangements are inevitable (Yongnian and Fook, 2003; Tatenhove *et al.*, 2006; Wing-Yat, 2007; Cho, 2008; Rico, 2010). In fact for specific communities informal arrangements can precede or dominate formal arrangements at various spatial and temporal points. Informal arrangements can be institutionalised to formal arrangements or they can enrich, transform or revolutionize the existing

formal arrangements. In environmental education field, undoubtedly formal environmental education programmes implemented at the community level are influenced by informal conditions. One of such conditions is people's awareness about the natural resources that are part and parcel of their practices of using resources. In this study formal environmental education means education based on formal knowledge provided to the local people outside school systems to enhance their awareness whereas informal arrangements are those based on the local knowledge of a particular area

(Boniventura, 1993). Formal environmental education arrangements imposed without prior insights on the existing environmental awareness and natural resources may undermine existing useful interactions or exacerbate existing counteractions between human and natural resources. In other words, ignorance on the existing human-ecology interactions may lead to ineffective and inefficient formal environmental education programmes.

Uluguru Mountains, where this study was conducted, are part of Eastern Arc Mountains comprised of Kenya and Tanzania. The mountains are potential as habitats of biological diversity of both fauna and flora (Newmark, 1996, Lovett and Wasser, 1993), and as origin of water sources and stream which supply water to Morogoro, Coast and Dar es Salaam regions (Hymas, 2000). Also, the mountains support significant numbers of people whose livelihood depend directly or indirectly on resources contained in these mountains (Mhagama and Lehmborg, 1999).

Natural resources management in Uluguru Mountains has been the subject of concern since colonial times (e.g. Temple, 1972; Munishi *et al*, 2006). This concern has involved a range of initiatives, from those which principally involved Tanzania government (e.g. Temple, 1972) to those that involved local communities living these resources. Literature shows that number of scholars have attempted to find out how to sustain natural forest for catchment purposes (e.g. Mwihomeke *et al.*, 2000), for protecting a variety of biodiversity (e.g. Nummelin and Nshubemuki, 1998), wild foods (Msuya *et al.*, 2004) and for integrated land use and environmental management as a whole (Mattee *et al*, 2005). Less attention is still given to studying micro-water resources.

In Nyachilo village where the data for this study were collected, water resources can be categorised in two groups. There are water resources that ooze from natural

forests on one hand and those which originate from individual people's farm plots, referred to as 'micro-water resources' in the present study. The micro-water resources are crucial contributors of water for irrigation, for domestic consumption and for livestock. Consecutive three years monitoring of these water resourceful areas has found that the micro-water resources are under severe pressure exerted by livelihood practices especially crops farming. Already water in some farm plots has either decreased or completely dried. While formal environmental education programmes are imperative for enhancing farmers' knowledge on sustainable use of water resources, knowledge on existing informal environmental awareness of the community is equally important as an entry point for implementing formal environmental education intervention. The aim of the present study was to determine community's awareness on water sources degradation in individual farm plots, in this study termed as 'micro-water resources', in order to come up with insights for operationalizing environmental education programmes.

## Methodology

The study was conducted in Nyachilo village situated in East Uluguru Mountains. The Uluguru Mountains stretch between 06°51' and 07° 12' south and between 37 ° 36' and 37 ° 45' east and form one of the component blocks of Eastern Arc Mountains of Kenya and Tanzania (Lovett, 1990). The area is inhabited by Waluguru people.

Purposive sampling was employed whereby farmers whose farm plots had water sources and streams (micro-water resources) were selected to form a sampling frame. Then from the sampling frame a total of 30 farmers were randomly selected for interviews. A semi-structured questionnaire was prepared and used for interviewing the selected respondents. Another method used for data collection was a transect walk through farm plots where micro-water resources were found.



This enabled researchers to understand the field realities on the status of the micro-water resources. During transect walks insight on local natural resources (soil, water and vegetation conditions), planted crops and on-going field activities was gained. This insight was compared with the verbal answers provided by the respondents during formal interviews.

Based on the insight on the field realities, an on-field training seminar was conducted. This training seminar aimed at building on what farmers knew, enhancing their knowledge and skills on the knowledge they already had, and imparting them with new knowledge as regards the interdependences and linkages among various natural resources such as land, forest, plant vegetation and water, and between these natural resources on the one hand and anthropogenic practices on the other.

### **Results and discussion**

This results and discussion section is organized into five parts namely understanding the field realities on the interactions between people and micro-water resources; driving factors for people's exploitation of the micro-water resources; limited alternative livelihoods and threat from food insecurity; coping strategies due to threats to food security; awareness of the farmers on declining of water flow in micro-water resources and enhancing farmers' awareness on sustainable micro-water resources use through environmental education.

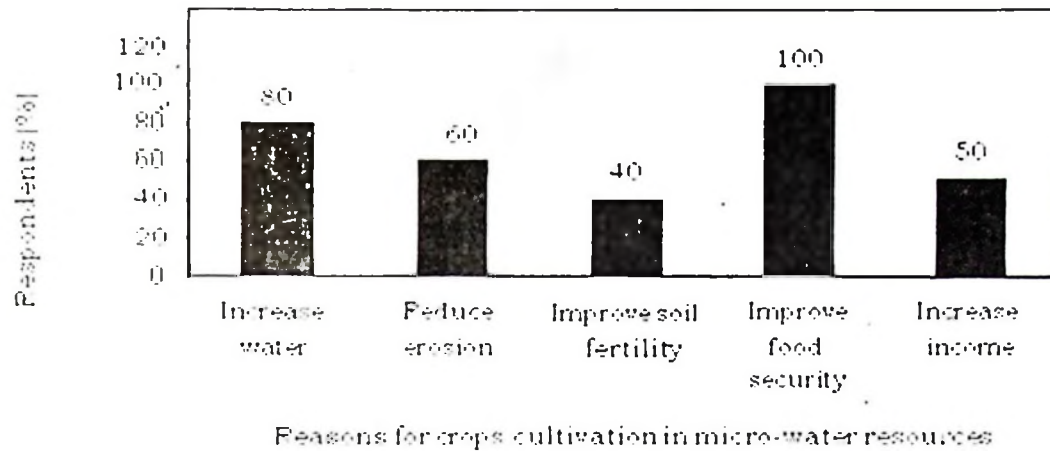
#### **Interactions between micro-water resources and anthropogenic practices**

Through transect walks we realised that the main anthropogenic practices undertaken in or around micro-water

resources are farming practices. Two farming methods adopted in these areas are ridge farming and slash and burn flat cultivation. Traditionally, Nyachilo farmers use slash and burn flat cultivation. Grasses and bushes in the farm are slashed usually by men and are left to spread on the farm and after they dry are burnt to yield ash which farmers believe releases nutrients for supporting vigorous plant growth. Farmers also believe that burning destroys thorns and destructive insect pests. However, during rain season debris cannot be easily burnt but instead they are collected and placed aside in bundles to create sowing space.

Ridge farming is a relatively new innovation in Nyachilo village, which was adopted from the neighbouring villages (e.g. Mgeta and Langali). The adoption also results from inter-marriages between people of Nyachilo farmers and those from these neighbouring villages. The early adopters of ridge cultivation method were farmers who resided at the border of Nyachilo and Mgeta villages.

According to farmers the use of ridges enables management of many farm plots because germination of weeds is delayed. Also, it is easy to carry out weeding in ridges than in flat cultivated plot, and therefore to them, ridges are labour-saving and effective in crop production. Besides, ridge organic residues can be buried under the soil, burnt to obtain ash or just left on the furrow between the ridges to dry and become compost manure in the next planting season. Usually when there are abundant organic residues, burning or alignment of the organic residues in furrows is done while burying of organic residue is done when there is organic matter.



NOTE: Percentages do not add up to 100 due to multiple responses

**Figure 1: Reasons for crops cultivation in micro-water resources**

Crops grown by Nyachilo farmers in the micro-water resources are principally coco-yams, sugarcane, maize, beans, cowpeas and banana. In these areas, maize and beans are intercropped with coco-yams because farmers believe that maize and beans improve the soil fertility and hence support cocoyam growth. They also find intercropping labour saving technique especially for weeding. Field observation showed that micro-water resources have been cleared-off the protecting vegetation to create plots for growing the mentioned crops. Majority of interviewed farmers (80%) believe that planting coco-yams, sugarcane and banana are helps to conserve water in the micro-water resources (Figure 1). Monitoring of these areas through transect walks over time however showed contrary observations. The micro-water resources where these crops were planted had decreased water flow and some were even about to dry. This suggests that the farmers are ignorant of water management practices, and vegetation suitable for improving or conserving the existing water resource in their farm plots.

#### **Driving factors for anthropogenic practices in the micro-water resources**

Based on our analysis of the information we gained from interviews with farmers

and through transect walks, the main driving factors for exploitation of micro-water resources for agricultural production include food and income insecurity, inappropriate farming practices in dry farm plots, pressure from local, suburb and urban markets and limited livelihood options.

Food and income insecurity may lead to exploitation of fragile areas such as micro-water resources for agricultural production especially when other cultivated areas are not adequately productive. Cultivation of coco-yams, maize and beans around and within micro-water resources is severe during dry seasons. During this time farmers utilize moist conditions due to the influence of the micro-water resources to increase chances of harvesting crops. The decline of harvests due to depletion of soil fertility in frequently cultivated farm plots motivate search for alternative ways to meet food demands for household consumption as well as to produce excess for sale. Inappropriate farming practices on dry farm plots encourage increasing farming near micro-water resources. Since slash and burn flat cultivation does not sustain long-term productivity for rain fed cultivation, and in order to maintain some levels of food security and have excess for sale, farmers have to

extend their farming practices from older farm plots to new farm plots and thus accelerating shifting cultivation towards micro-water resources. According to Hymas (2000) poor farming practices lead to the decline of yields over time. For example, for maize, Hymas reported a decline of maize yields from 3 to 10 bags in the 1997 to 1 to 3 bags in year 2000.

Other drivers of farming near micro-water resources include need for food security, local and external markets for agricultural products. Nyachilo village produces banana, cassava and cocoyams that are sold to local, sub-urban and urban markets. Among the markets where agricultural produce from upstream Nyachilo village are sold include neighbouring Bunduki village (during the market days usually on Sundays), and relatively distant Mlali village. On the other hand, small vendors from Langali and Mlali villages normally come to Nyachilo village to buy cocoyams, beans and banana. In order to keep the constant supply of the cocoyams, banana and beans to these local,

sub-urban and urban markets, farmers are motivated to extend cultivation to micro-water resources especially during dry seasons.

Comparison of the average income per household per crop per season for beans, banana and cocoyam, showed that for cocoyam was comparatively high (Figure 2). On contrast to with the other two crops which can be cultivated in both dry and wetlands areas, cocoyam is only cultivated in wetland areas because it requires higher moist conditions. This implies that cocoyam has potential of improving income at household level, but on the other hand the crop exerts pressure constantly to micro-water resources. Average incomes are generally low because farmers depend on same crops for subsistence. Only the surplus was sold. However, since farmers hardly keep records of their harvests and sales, the incomes given is just indicative figure.

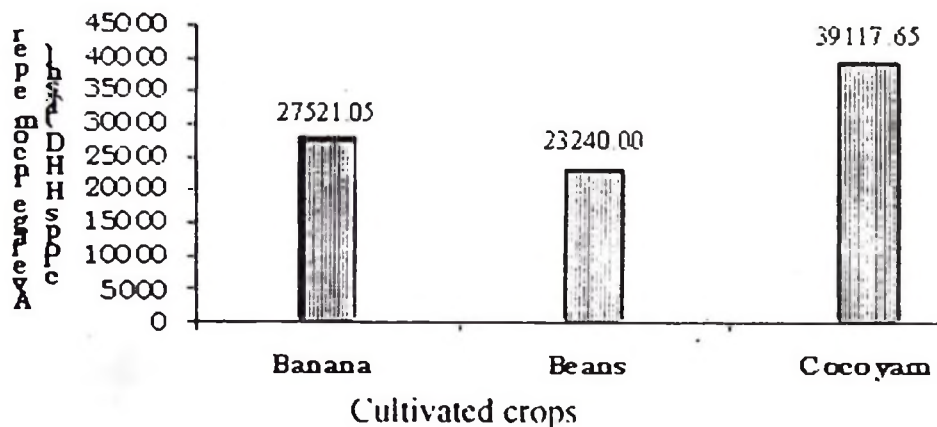


Figure 2: Average income earned from sales of agricultural produces

Apart from crop production Nyachilo community are engaged in alternative activities including livestock keeping, selling farm based produce (as already explained above), selling labour, and small businesses. Labour is sold in terms of carrying luggage from Nyachilo village to Kibogwa or Mgeta village, and working

in other people's farm plots. While porters generally charge Tsh 500 per trip per luggage from one village to another, terms of payment for selling labour in one's farm plot is negotiated based on the plot size. In rare cases, some small businesses might be found in the village. The main commodities sold are salt,



sugar, kerosene and match box. Generally, non-farm household commodities are bought from distant shops located in other villages. One of the possible reasons for lack of big business (e.g. Shops) in Nyachilo village is due to poor road infrastructure which limits transportation of commodities in medium or large scale from purchase centres to the village.

Generally, at Nyachilo village non-farm activities have meagre contribution to household food security and income. As such, high dependence for livelihood is attached to the use of natural resources for agricultural production. This is the rationale for high pressure on the micro-water resources.

Interactions among complex yet interdependent market, cognitive, socio-economic, ecological, and technical factors surround the encroachment of micro-water resources as has been revealed in the section that unfolded driving factors for anthropogenic practices in the micro-water resources. This suggests that any strategy which strives to attain sustainable micro-water resources management has to entail holistic and multidimensional strategies as the nature of the problem is too complex. Whereas environmental education may be provided to address problem of degrading micro-water resources, socio-economic, market and ecological dimensions and this need to be integrated to enhanced cognitive power to be translated into practice.

### **Coping strategies to food security's threats**

Observation made through transect walk revealed that environmental problem in the study area stem from topographic, climatic, human and ecological problems. Topographic and climatic problems include land slides along water streams and extended fog which destroy cowpea leaves while human induced problems include soil erosion resulting from unsustainable cultivation practices leading to decline in land productivity.

Ecological problems include pests such as rodents which dig out and eat sown maize and bean seeds, and ants (locally called *mamba*) which attack plants roots and consequently the attacked plants turn yellow and experience stunted growth.

Some coping strategies are undertaken to address the mentioned problems. These include the use of traditional traps to catch rodents, and sowing many seeds (for maize and beans, up to six per pit) to off-set loss of seed germination due to devouring of the sown seeds by rodents attack. In case all the sown seeds germinate, some are thinned out and the thinned crops are used as animal fodder though this delayed to allow sufficient crop growth to some levels. On the other hand, this negatively affects the vigour of the ultimately remaining plants due to previous competition for nutrients with thinned plants. Some local knowledge is employed for some challenges. For example small ants (*mamba*) are controlled using ash. Declined land productivity is addressed through opening farm plots in other areas to increase food production. Such areas include micro-water resources (Mattee *et al.*, 2005; Munishi *et al.*, 2006).

Some problems were beyond the capacity of farmers and thus no action was taken against or to lessen such problems. These included landslides and the decrease or drying of water. The study realized that though farmers were aware of the existence of the mentioned problems they were ignorant of the causes of such problems and of how they could avoid the problems. However, these farmers showed readiness to receive advice and environmental education on how to control these problems and in particular how to improve micro-water resources because in farmers' view micro-water resources are in the homestead vicinity and are useful for providing water for both irrigation and for domestic consumption.

**Table 1: Coping strategies undertaken by farmers to various problems**

| <b>Problem/constraint</b>                       | <b>Coping strategies undertaken</b>                               |
|-------------------------------------------------|-------------------------------------------------------------------|
| Low land productivity                           | Extending cultivation to fragile areas e.g. Micro-water resources |
| Small ants ( <i>Mamba</i> ) attack to the crops | Application of ash                                                |
| Rodents                                         | Sow up to six seeds per pit                                       |
| Land slides                                     | NIL                                                               |
| Erosion                                         | NIL                                                               |
| Drying of water sources                         | NIL                                                               |

The coping strategies (Table 1) farmers have undertaken as a result of the endangered food security indicate that when their opportunities are beset, farmers react in a way to cope with, eliminate or reduce the negative impacts. These responses can help in resolving the adverse impacts, can exacerbate the existing problems or even introduce new problems to the environment. While sometimes farmers can react unfavourably due to ignorance, in other cases the issue may not be ignorance but rather the lack of alternative options to switch to (Aukland *et al.*, 2003) and therefore continue practising ecologically unsustainable because they are uncertain of how to live today. Our findings contradict those reported by Walker (1985) who argued that coping strategies undertaken by local resource users tend to reduce risks, to sustain livelihoods and avoid degradation of basic means of livelihoods. In other words, Walker asserts that coping strategies undertaken by local people consider the sustainability of the resource base. This study found that when livelihood problems are severe, farmers may not think about sustainability of resource base because of the lack of alternative livelihood options (in agreement with Aukland *et al.*, 2003). Sometimes farmers practise unsustainable practices due to ignorant about interactions between anthropogenic practices and the resources base. The discrepancy of findings from this study with those presented by other scholars implies that coping strategies against food insecurity can have both positive and negative

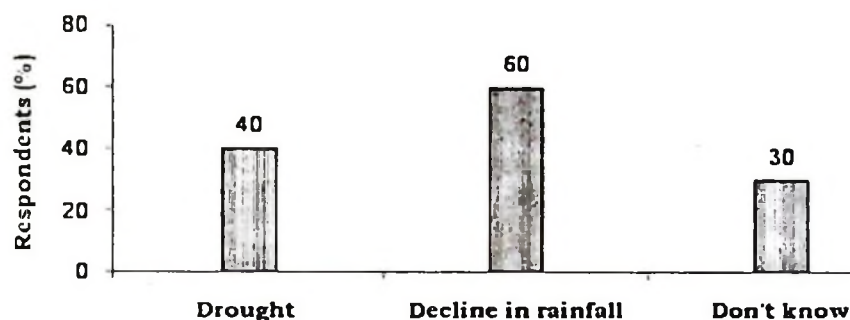
effects to the environment or particular resource base depending on spatial and contextual variations of resources and alternative options, and therefore generalisation may not work in light of diverse environments of social and ecological resources.

#### **Farmers' awareness on decreasing water flow in micro-water resources**

Interviews with farmers who own farm plots which have micro-water resources, this study uncovered that the farmers were aware of the decrease of water in micro-water resources. This is probably due to high evaporation rates from the soil surface due to direct sun rays impact on the bare micro-water resources. Through transect walks to the micro-water resources we observed that most of these areas have been completely cleared off vegetation cover such as water weeds, reeds and trees, and instead, coco-yams, bananas, sugarcane, cowpeas and beans have been grown. The tracking of farmers' memories on the availability of water in these areas for the past five to ten years revealed their general awareness on decreasing water in the micro-water resources in the recent years compared to the past years.

As to the reasons for this decrease, most of the farmers (60%) attributed the decrease of water flow to the decline in rainfall, while 37% percent viewed drought as the reason for the decline in water and 3% did not know any cause for the decline of water in micro-water resources (Figure 3).





NOTE: Percentages do not add up to 100 due to multiple responses

**Figure 3: Reasons for the decline of water in micro-water resources at Nyachilo village**

The figure depicts low awareness on the link between anthropogenic livelihood practices and micro-water resources degradation among Nyachilo farmers. The low awareness on links of the two phenomena was probably due to the lack of traditional and formal water and environmental management institutions during the period of study. According to the farmers, reason for the lack of such institutions is because they have never experienced serious water problem in their village. However, in recent years, it was noted that some micro-water resources which used to have water throughout the year experience declined water flow during dry season. These changes were noted particularly by women and girls who traditionally have the role of fetching water. They said, currently they have to move to distant micro-water resources to fetch water during dry seasons (cf Gillepsie *et al.*, 1999, p. 12). These changes highlight the importance of having water management organs in the community to enforce sustainable water management. This would probably enhance the community awareness on the linkages between anthropogenic activities and sustainable use of water resources.

Although both farmers and outsiders may see an existent problem, they may differ in views as regards the cause of the observed problem. The acknowledgement of the problem may be easy when

farmers' livelihood activities and basic needs are directly affected rather than the opposite. The prevailing need of water for irrigation and for domestic consumption and the declined availability of water resource make farmers see a difference and therefore perceive the deteriorating water status. While farmers realized the decline of water in the micro-water resources, they could not view their livelihoods activities as negatively influencing the micro-water resources (Gillepsie *et al.*, 1999, p. 11). Although this study did not use any quantitative measurements of water flow, monitoring of micro-water resources wherein bananas, sugarcane, cocoyam, beans etc had been planted indicates decrease water flow in micro-water resources. Since farmers were ignorant of the interdependence between anthropogenic activities and the declined water flow, formal environmental education seminar was meaningful after understanding the existed social-ecological interactions (cf Gillepsie *et al.*, 1999, p. 14).

Nonetheless, the existing food insecurity in the study area may render operationalisation of the acquired knowledge difficult. While environmental education is certainly imperative for enhancing farmers' awareness, implementation of appropriate measures to conserve the environment needs a concurrent existence of alternative options for obtaining basic socio-

economic needs (Aukland *et al.*, 2003; Seixas and Davy, 2008). Enhanced awareness on a particular problem is one thing but practical operationalisation of the acquired awareness is another thing, and hence the enhanced awareness may not necessarily guarantee positive implementation. Effective implementation of a solution may depend on the provision of solution on how compensate lost opportunities in the implementation processes. It may be difficult for farmers to stop growing yams, sugarcane and banana in micro-water resource areas when loss of crops is severely experienced in dry farm plots. Balancing of socio-economic demands and ecological concerns may simultaneously be optimized through provision of environmental education while improving and restoring the productivity of less productive farm plots through improved agronomic practices. Such a balance can also be sought through integrated systems which use vegetation that conserve micro-water resources and simultaneously generating socio-economic benefits (e.g. Fruit trees) although this may need a thorough prior investigation and farm experimentation.

#### **Enhancing farmers' awareness through environmental education on sustainable micro-water resources**

In practical sense, the interplay between formal and informal knowledge is inevitable in the interactions between social actors and ecological arena. Though formal interventions (e.g. externally imposed environmental education programme) are operationalized in settings with intricate of social actors and ecological resources, sometimes the role of informal knowledge interplaying between social and ecological dimensions may be ignored. This can result in operationalizing formal arrangements in conflicting, contradictory and disconnected with local setting leading to failure of the intervention. Having this in mind and in order to unfold constraints of the local

context and to capitalise on the local potential, this study preceded by understanding the existing interactions between social actors and the ecological resource environment before intervening with on-field environmental education. Following our study on farmers' awareness status on and their interactions with micro-water resources, we conducted an on-field micro-water resources management seminar. The seminar allowed direct contact and reflection of the participants on environmental resources such as water, forest, vegetation cover etc. While this seminar covered not only knowledge on appropriate vegetation for planting around micro-water resources, it also enlightened the imperativeness of protecting the vegetation cover around micro-water resources. Among the aspects that were covered in the on-field environmental seminars included:

- Appropriate tree species and vegetation that can be planted around micro-water resources in order to enhance and promote restoration of water regeneration in these areas
- Appropriate farming and agronomic practices around and close to micro-water resources so that to avoid land slides, soil erosion and pollution of water resources in micro-water resources.
- Potential positive and negative consequences from the anthropogenic exploitation of water and related natural resources
- Interdependencies among water, anthropogenic practices and water conserving vegetation cover (cf Bonaventura, 1993, p. 180-181)

Formal environmental education is imperative for enhancing cognitive awareness of local stakeholders in environmental management decision making. According to Sudarmadi *et al.* (2001) the imperativeness of formal environmental education rests on the rationale that every decision making process in the contemporary world has an environmental component.



Environmental education has important and strategic role of preparing people to solve environmental problems and challenges (Keating, 1993). Teaching people about the environment is central to its future protection (Stoney, 1995). Besides, understanding of what people know about the environment, their feelings and actions with relation to the environment is critical in establishing the sustainability of a particular society (Sudarmadi et al., 2001).

The provision of formal environmental education to the farmers through prior understanding of the existing local realities was way of enhancing the assimilation of the knowledge based on contextual realities. Environmental management programmes become rational when they start from where the players (actors) are and advance by building the capacity of these players to overcome the primary constraints. Such approach may enable the determination of a solution to a complex problem using appropriate holistic and multi-dimensional strategies (cf Gillepsie *et al.*, 1999, p. 13).

## **Conclusion and Recommendation**

This study has determined farmers' awareness on the cause of water sources degradation particularly for water sources and streams situated in private farm plots, in this study referred to as micro-water resources. The study has found that, farming practices conducted within and around micro-water resources degrade the micro-water resources. Although farmers were aware of the deterioration of water in the micro-water resources, they could not link this degradation with their farming practices. Farmers were also not knowledgeable on appropriate agricultural vegetation for sustaining micro-water resources as they believed that banana, sugar cane, cocoyams and bean, among others, improved the water status in micro-water resources while monitoring of these micro-water resources indicated the

contrary. The study also indicates that what drives encroachment and thereafter degradation of micro-water resources is intricate complex interaction of ecological, market, socio-economic and natural factors and phenomena. Furthermore, coping strategies taken by farmers in face of food insecurity vulnerability have positive and negative implications. While on the one hand these strategies may improve short term socio-economic benefits, long-term socio-economic and ecological benefits may become vulnerable on the other hand. Moreover, environmental educational programmes become more meaningful if they start from where people are by understanding opportunities and constraints existent within the community and through such understanding tailor-made environmental awareness programmes can be devised based on local opportunities and obstacles realities. This enhances chances for assimilation of formal environmental knowledge by the target beneficiaries.

This study has highlighted the complex link between micro-water resources and the driving factors for their exploitation, and how these factors can be combined for appropriate and sustainable use of the resources. It is recommended that further research on this direction is imperative to understand how this complex link among market, ecological, and cognitive factors can sustain micro-water resources in a way that allows achievement of socio-economic and ecological benefits in a sustainable way.

## References

- Aukland, L., Moura Costa, P. and Brown, S. (2003). A conceptual framework and its application for addressing leakage: The case of avoided deforestation. *Climate Policy* 3: 123-136.
- Bonaventura, N. (1993). The role of environmental education in developing environmental awareness', *Science* 20, 23-29.
- Cho, Y.N. (2008). Elite politics and the 17<sup>th</sup> Party Congress in China. Changing norms amid continuing question. *Korean Journal of Defense Analysis*, 20(2):155-168
- Gillepsie, J., Saad, L., and Shay, H. (1999). Gender awareness in community based watershed management. A participatory source book. [Http://www.chs.ubc.ca/brazil/Outputs/Gender\\_Awareness.pdf](http://www.chs.ubc.ca/brazil/Outputs/Gender_Awareness.pdf).
- Hymas, O. (2001a). Assessment of the remaining forests of the Uluguru Mountains and the pressures that they face. CARE and WCST, Dar es Salaam
- Keating M.: (1993). *Agenda for Change: A Plain Language Version of Agenda 21 and Other Rio Agreements*, Centre for our Common Future, Geneva, Switzerland, 70 p.
- Lovett, J.C. (1990). Classification and status of the moist forests of Tanzania. *Mitteilungen aus dem Institut für Allgemeine Botanik Hamburg*, 23a: 287- 300
- Lovett, J. C; Wasser, S. K (1993). *Biogeography and Ecology of the Rain Forests of Eastern Africa*, Cambridge University Press.
- Mattee, A.Z., Mahonge, C.P, Nsenga, J.V, Lubida, A.P, and Kayeye, H. (2005). Establishment of the Technical Prototypes of Rural Development Activities for the Integrated Land Resources Management and Environmental Conservation in The Fragile Mountain Landscape. Progress report presented to AICAD, Nairobi, Kenya.
- Mhagama, S. I. and Lehmberg, T. (1999). The Uluguru Mountains Biodiversity Conservation Project (UMBPCP).
- Msuya, T. S.; Kideghesho, J. R. and Luoga, E. J. (2004). Consumption of indigenous fruits in Uluguru North and Ruvu North Forest Reserves, Tanzania. *Tanzania Journal of Forestry and Nature Conservation*. 75: 65 - 73.
- Munishi, P.T.K., Shear, T.H., and Temu, R.P.C. (2006). Household level impacts on forest resources and feasibility of using market based incentives for sustainable management of the forest resources of the eastern arc mountains of Tanzania. [Http://www4.ncsu.edu/unity/users/s/shear/public/household.htm](http://www4.ncsu.edu/unity/users/s/shear/public/household.htm) (accessed 6 October 2006)
- Mwihomeke, S.T.; Zilihona, I.J.E.; Hamisy, W.C. and Mwaseba, D. (2000). Assessment of forest user groups and their relationship to the condition of the natural forests in the Uluguru Mountains. Wildlife Conservation Society of Tanzania (WCST), Uluguru Mountains Biodiversity Conservation Project, Morogoro Tanzania. 57 p.
- Newmark, K.W. (1996). Ecological monitoring: Its importance for conservation of biological diversity in the eastern arc forest. Proceedings of the workshop on ecological monitoring for biodiversity in the east Usambaras, from 8 - 13 July 1996.
- Nummelin, M. and Nshubemuki, L., (1998). Seasonality and structure of the arthropods community in a forested valley in the Uluguru Mountains, eastern Tanzania. *Journal of East African Natural History* 87(1/2): 205-212.
- Rico, I. (2010). Informal politics and the uncertain context of transition: revisiting early stage nondemocratic

- development in Kazakhstan. *Democratization*, 17: 1, 1- 25
- Seixas, C. S. I. and Davy, B. (2008). Self-organization in integrated conservation and development initiatives. *International Journal of the Commons* 2(1): 99-125
- Stoney, S. (1995). Environmental education: teaching approaches and students attitudes, <http://www.sussex.ac.uk/Units/gec/ph3summ/stoney3.htm>
- Sudarmadi, S., Suzuki, S., Kawada, T., Netti, H., Soemantri, S. And Tugawati, A.T. (2001). A survey of perception, knowledge, awareness, and attitude in regard to environmental problems in a sample of two different social groups in Jakarta, Indonesia. *Environment, Development and Sustainability* 3: 169-183.
- Tatenhove, J. P. M.; van Mak, J., and Liefferink, J. D. (2006). The inter-play between formal and informal practices. *Perspectives on European Politics and Society*, 7(1):8-24
- Temple, P.H. and Rapp, R., "Landslides in the Mgeta area, western Uluguru Mountains, Tanzania," *Geografiska Annaler*, 1972, 54A(3-4), pp. 157-194. .
- Walker, P. (1989), *Famine Early Warning Systems: Victims & Destitution*, Earthscan
- Wing-Yat, Y. E. (2007) Formal and Informal Politics in Macao Special Administrative Region Elections 2004-2005, *Journal of Contemporary China*, 16: 52, 417 — 441
- Yongnian, Z and Fook, L. L. (2003). Elites politics and the fourth generation of Chinese leadership. *Journal of Chinese Political Science* 8:1&2