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Research Article

Knowledge, Attitudes and Practices of Farmers Pertaining to Agro-biodiversity in the Shiselweni Region, Eswatini, Southern Africa

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Abstract: The purpose of this study was to ascertain farmers' knowledge, attitudes and management practices in conserving agricultural biodiversity in the Shiselweni Region. The study revealed that farmers' livelihoods were quite diversified but were shifting to off-farm income generating activities. Farmers had knowledge of agro-biodiversity and acknowledged the losses of biodiversity. Some farmers practiced agro-biodiversity conservation by practicing agroforestry while others diversified in production of agricultural products. There was a high continuity and heavy reliance on external inputs such as fertilizers, pesticides, herbicides and antibiotics for livestock which are not sustainable and were a threat as they damage the environment, weaken the nutritional value of foods and results in the loss of biodiversity. It was concluded that agro-biodiversity was highly threatened mostly by the spread of modern agricultural practices and that the knowledge and efforts in empowering farmers to adopt best agricultural practices were low. Therefore, it may be recommended that extension officers and agencies need to provide effective support for regional and national development strategies to improve farming, technologies and sustainable agricultural practices.

Keywords: Agro-biodiversity, agricultural systems, climate change, food security, indigenous knowledge (IK), sustainable development

INTRODUCTION

Eswatini (formerly Swaziland) is located in Southern Africa, it is a member of the Southern African Development Community (SADC) and shares a border with South Africa and Mozambique, it has a total area of 17 360 km^2 (Vilakati, 1997). Over 70% of the country's total population depends on subsistence farming for their livelihoods on communal Swazi Nation Land (SNL) which has been radically handicapped by a struggling economy where many survive on only one dollar per day, with one in three people being undernourished and affected by the recent drought (Thompson, 2010).

Eswatini has been facing successive years, 2015 and 2016, of below normal rainfall following poor cropping season which was characterized by long dry spells and uneven rainfall distribution which had a negative effect on subsistence farming. The impacts of the El Nino induced drought therefore compounded an already delicate situation of depleted water and soil moisture reserves, poor grazing conditions and a poor harvest as at the end of the 2014, 2015 season (NDMA, 2016). Loss of forest due to bush-fires and deliberate cutting of trees implies destruction of creeping and climbing plants, reptiles and a wide range of wild animals. Deforestation promotes low soil carbon sequestration, increasing volatilization, thermal impact and severe land, water and air degradation (Duruigbo*et al*., 2013).

According to Jacobsen *et al*. (2015), farmers need to practice traditional agriculture, cultivate local varieties which are basically known as landraces together with their wild relatives. Together, landraces and their wild relatives are the richest fountains of crop genetic diversity (FAO, 2010). Agricultural diversity can provide the underprivileged third world farmer, with alternative resources. It can generate income, secure reliable food supply and guarantee improved nutrition and health among family members (Jacobsen *et al*., 2015). In areas where climatic conditions are unstable, such as in many developing countries, local agriculture customarily relies on a range of crops rather than just a few crops. This strategy of agricultural stake hedging increases the reliability of food production in the face of seasonal variation (Jacobsen *et al*., 2015). Agricultural biodiversity is important for food and nutritional security, a source of nutrients for improved

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dietary diversity and quality and strengthening local food systems and environmental sustainability (Thrupp, 2000). Recently, scientific evidence has demonstrated that agricultural biodiversity used in combination with innovative technologies and approaches has much to offer in addressing food insecurity and biodiversity extinction. About 75% of plant diversity has been lost since 1990 and the main cause is the move for reducing variety to increase productivity. About 30% of animal species is also threatened with extinction while 70% of the population relying only on 12 crop varieties and 5 animal species for food (Thrupp, 2000; FAO, 2005).

The decline in the diversity of cultivated plants, wild plants and livestock species was happening faster and was being neglected in most rural areas yet the protection of the environment and conservation of agro-biodiversity is crucial to food security, ecosystems functioning and health security of people (Hamilton, 2007; FAO, 2009). This study therefore, aimed at finding out knowledge, attitudes and practices of farmers in trying to prevent species extinction and preserve biodiversity in the Shiselweni Region of the Kingdom of Eswatini.

METHODOLOGY

Research design: This was a descriptive research design: the study aimed at exploring farmers' knowledge, behavioural and management practices in preserving and conserving agricultural biodiversity. To achieve the objectives of the study, the qualitative research approach was used to gain an understanding of underlying reasons, opinions, motivations as well as insights into challenges. Qualitative research is especially effective in obtaining information about the values, opinions, behaviors and shared contexts of particular populations (Gill *et al*., 2008). This study involved observations, where livelihood assets and farming practices were recorded and in-depth interviews, using a semi-structured interview guide were carried out. A cellphone was used to record and take pictures of the sites visited and responses from respondents.

Sampling: The participants of this study comprised of farmers and extension officers from the four targeted RDAs. A purposive sampling also known as judgmental, selective or subjective sampling was used where respondents were selected intentionally based on their ability to give the necessary data, followed by snowballing where the first respondent that was selected using the purposive sampling approach was asked to suggest other farmers who might be appropriate for the study. The four RDAs were the Debedebe, Dumako, Hluthi and Matimatima where a minimum of five farmers were interviewed per RDA.

Instrumentation: Two research instruments were formulated and used for collecting data. There were two interview guides, one for farmers and the other for extension officers. An observation checklist was also used. Interviews were conducted with twenty four farmers in the Shiselweni Region from the four different RDAs. Four extension officers were interviewed, one from each RDA. The researchers noted the body language which indicated the level of discomfort with the questions asked and the level of enthusiasm for the subject discussed (Gill *et al*., 2008). Nonetheless, the instruments which were the interview guides developed by the researchers from the literature review, were given to two lecturers in the Food Science Department, one in the Agricultural Extension Department, one from the Agriculture and Bio-Systems Engineering Department and one from the Horticulture Department for validity testing. The respondents were assured of confidentiality of their responses and that participation was voluntary. Data was collected in the middle of the production season which was between February and March 2017.

Observations: Direct observations were made mainly on the assets, farming practices employed by farmers and the variability of plants and animals. Observations helped the researchers to relate on what was said and what the participants actually did to conserve biodiversity.

Data analysis: The data collected was transcribed, organized and grouped using thematic coding and analysis to achieve the objectives of the study.

RESULTS

General household characteristics: There were twenty four farmers interviewed, where thirteen were male farmers and eleven were female farmers. Households consisted of members with a minimum number of four and a maximum of eight. Family members consisted of parents, children and sometimes grandchildren. School going members ranged from the ages of seven to twenty five. Parents tended to encourage their children to become better educated than themselves. Most of the households were headed by fathers or husbands and decisions were made and determined by them. Other households however, were headed by mothers but decision making was determined by their first born children who were employed and were labelled as the breadwinners of their respective households.

Livelihood strategies: Some farmers practiced subsistence farming and made a living from involvement in off-farm activities. Some farmers made a living on on-farm activities only, that is, they made a living through crop and/or livestock rearing. Other farmers produced mainly vegetables and fruits as a means of making an income. Some farmers were involved in businesses such as passenger transportation, bricklaying and vending. Women tookmore

Table 1: Assets owned by the farmers

Farming implements	Livestock	Irrigation equipment	Other assets
Sprayers	Cattle	Pipes	Cars
Tractor	Chickens	Pumps or	Wheelbarrows
Cultivators	Sheep	Generators	Bush knives
Planters	Goats		Hoes
Disc plough	Ducks		Houses
Ridger	Pigs		Shovels & spades
			Saws

Table 2: Crop and crop variation

Crop	Variation
Maize (*Zea mays*)	White and yellow maize
Sweet potato (*Ipomoea batatas*)	White/yellow and Red/orange fleshed

Table 3: Livestock and livestock variation

Livestock	Variation
Cattle	Indigenous/Nguni, frisians, jerseys, brahman
Chickens	Indigenous, broilers, layers
Pigs	White hybrid and the indigenous pigs

responsibility for the farm while men went to work in towns. Some female farmers were involved in vending, others sold local beer which they brewed. Males, were employed by private companies while others were civil servants.

Land use and size: Livelihood of farmers was mainly dependent on land. A minimum number of fields owned by farmers was nine and twenty-five fields were the maximum. Some fields were rented. A field is about an acre (4000 m^2). Most of the land was lying idle. Most of the female farmers rented out land compared to male farmers.

Ownership of assets: Farmers owned a variety of assets for their livelihood (Table 1).

Crop production: All farmers in all the RDAs grew white maize but some from the Debedebe RDA grew yellow maize, groundnuts, sweet potatoes of different types and jugo beans (Table 2). They also produced a variety of vegetables which included tomatoes, onion, cabbages, carrots, spinach, lettuce and beetroot. Fruits grown included bananas, litchis, peaches, avocadoes, mango, grapes, oranges, grape fruits, apples and granadillas. Mangoes, oranges and avocadoes were of different varieties for each species. Other crops grown included cotton, common beans, cassava, sorghum, cowpeas, pumpkins, melons and Irish potatoes (*Solanumtuberosum*).

Livestock production: The common types of livestock owned by the farmers were the domestic or indigenous chicken, goats and cattle (Table 3). Most of the female farmers owned pigs, sheep, ducks and geese in all the RDAs. Few farmers from the Hluthi RDA practiced aquaculture, that is the growing of fish in ponds and these farmers were the ones owning relatively big farms.

Farmers' awareness of agro-biodiversity loss: Almost all the farmers were aware of the variability of plants and animals. Farmers acknowledged loss of species that existed during the time of their forefathers. Even the ones that are present, most farmers said they were not the original varieties they used to have in previous years as they were quoted saying, "When you look at the maize varieties that we are growing, they are not typically the types we were used to grow. The yellow maize for instance, we call it yellow maize because it possesses that yellow color, otherwise we have lost it.

Farmers' attitudes towards agro-biodiversity loss and management: Most of the farmers regarded agro-biodiversity as an integral part of families and the community. They were quoted blaming the government in the disappearance of species as government's focus was on cash crops. They also blamed the ever advancing technological innovations that were being introduced every now and then, increase in unemployment rate which resulted in the youth in opting for the cultivation of marijuana (*Cannabis sativa*). Some farmers said, "Times have changed, it does not rain from January to December, so why would we be worrying ourselves about agro-biodiversity yet at the end of the day we do not gain anything. The market is not there for certain crops such as cowpeas, the generation of today have become weak and spoiled, they claim to be educated therefore all they want on their plate is beef, chicken, pork or turkey, so you see, growing crops is just a waste of time and resources, even the fruits get rot under the trees, no one cares."

Other farmers said the loss in biodiversity is something they cannot do anything about because the youth want to live in towns and that farming was not in their system. However, quite a few farmers voiced out their heartfelt sadness in the losses as it limited their choice of dishes and regarded the losses as the major reason for hunger. "It is very sad because due to the losses we are experiencing hunger, poverty and the number of orphans is escalating".

Most farmers argued that local varieties of crops were not productive enough, could not do well with the quality of the soil they had and cannot tolerate the harsh weather conditions they were currently facing. Some farmers were quoted saying, "We are very much happy with the yield levels brought about by the improved seeds, taking into consideration that the land is exhausted, the soils are poor so the improved varieties were convincingly suitable for our land." Other farmers said that "Growing the improved varieties of crops was inevitable because they were high yielding and matured early than traditional varieties of crops." "As long as the new varieties are there, give relatively higher yield, I do not worry about the local varieties and those that are disappearing".Some farmerssaid that as much as they would like to keep the traditional varieties,

Table 4: Strategies employed by farmers to conserve agro-biodiversity

Indigenous strategies	Introduced/Technological strategies
1. Crop diversification	1. Improved varieties or breeds
2. Multiple cropping/ Intercropping	2. Integrated pests and disease management
3. Crop rotation	3. Agroforestry
4. Variety diversification	4. Reduced tillage
5. Homestead gardening	
6.Integration of livestock and crop production	
7. Livestock diversification	
8. Engaging in non-farm activities	

continuous usage made them more susceptible to diseases and they were also not encouraged to use the seeds from the previous harvest since they resulted in subsequent decrease in yield, as advised by their extension agents.

Strategies or practices employed by farmers in conserving agricultural biodiversity:

Land preparation/tillage: All farmers used tractors to plough. Female farmers used conventional hand hoeing in their gardens. Ridging was only done for sweet potato production. Male farmers practiced zero tillage or conservational agriculture in their gardens when they failed to get tractors for tillage.

Crop production and management practices: All farmers used improved technology for crop production. They applied fertilizer in their fields to increase yield. Herbicide usage was relatively high especially by male farmers. Farmers reported that they preferred to use herbicides because it saved time and labour. There were relatively less people to work in the fields as most people were ill, the youth stayed in towns and others had migrated to the neighboring country (South Africa). Improved variety use was relatively high for most of the major crops grown.

Lime use was limited. Few farmers practiced crop residue retention in their fields. Intercropping was highly practiced by the female farmers. Male farmers had a challenge in practicing intercropping because they mostly sprayed their fields with herbicides. However, very few farmers applied manure or intercropped their fields with nitrogen fixing crops (legumes).

Most of the farmers practiced crop diversification mainly for maize and sweet potato. Farmers grew white and yellow maize. They produced both the local variety which they claimed they got from SEEDCO (a local company) and the hybrid variety. They grew the early maturing variety which they said enabled them to escape hunger since the local variety took time to mature and sometimes it did not give satisfactory yield where rainfall had become unpredictable. However, farmers did point out that the local variety was no longer pure, it had been modified and for the yellow maize, farmers did say that it was no longer the type they used to have.

Farming systems: Mixed farming or agro-pastoralism was observed by the researchers. Farmers grew crops, vegetables and reared livestock. Some farmers did milk or dairy production and aquaculture. Farmers practiced agroforestry where they integrated trees into crop and animal systems to create environmental, economic and social benefit and this practice was highly prevalent under the Hluthi, Debedebe and Dumako RDA's but was less under Matimatima RDA.

Livestock diversification and care: Farmers raised a variety of livestock. Livestock included cattle, goats, sheep, chickens, ducks, geese and pigs. Vaccination and deworming were commonly done for cattle as compared to other types of livestock. Farmers used veterinary drugs to treat their livestock while a few used traditional medicine including use of indigenous veterinary medicinal plants. They used the dipping tanks to control ticks and fleas. Farmers who practiced milk production used knapsack sprayers to control ticks and fleas on 'Jersey' cows.

Farmers from the Hluthi, Debedebe and Dumako RDAs reared a diverse array of cattle and poultry. However, most of the farmers complained about the rise in theft of livestock.

Farmers employed various strategies to conserve biodiversity (Table 4).

DISCUSSION

The livelihoods of farmers in the Shiselweni region: Livelihood is a mean of living, the capabilities, assets and activities required for it (Chambers and Conway, 1992). Livelihood strategies are the sum of all the different activities that people engage in.

From the findings of this study, each household had an average of six members, where most of the households were headed by men. There were different types of livelihoods strategies practiced by farmers. Some of the farmers' livelihoods were mainly dependent on land which they owned, where they were only producing crops, fruits and rearing livestock as their source of income. Other farmers practiced subsistence farming where they only grew crops for their family consumption but however, they were also involved in off-farm activities as a source of income while other participants were working as civil servants while others were working for private organizations.

Men from other households allowed their women to carry on with farm work as similarly reported by Gikiza and Nastis (2017) whilst they got themselves busy with off-farm activities in trying to diversify their source of income. Similarly to this study, women were identified as the major protectors of the knowledge on indigenous vegetables (Vorster *et al*., 2008), possibly because they were mostly involved in the gathering, cooking and preservation of vegetables.

Most farmers resorted to engaging themselves in off-farm labor activities, other farmers, especially the female farmers sold local beer (*umkhombotsi*), other involved in vending as a means of earning income and to support their families. The majority of the farmers relied on rain fed agriculture as quite a few of them owned irrigation equipment and were situated near water sources. Most of the land owned by the farmers was left lying idle due to the El Nino drought (Manyatsi *et al*., 2010).

Types of crops and livestock reared by farmers: From the findings of this study, it was observed that almost all the farmers from the four RDAs grew white maize, sweet potato, groundnuts and jugo beans. However, very few of them produced different varieties. Other crops grown included cotton, beans, cassava, sorghum, cowpeas, pumpkins, melons and potatoes. Similar crops were reported in the findings of Mashinini *et al*. (2011). They also grew vegetables in their gardens, which is important in crop biodiversity and to achieve food security as reported by Jackson *et al*. (2007).

Farmers also diversified their livestock rearing as they reared cattle, goats, sheep, pigs, chickens, ducks and geese. Diverse livestock was reared, which were cattle and the chickens as they kept or reared the indigenous species as well as the hybrid variety including broilers, layers in chickens; and Brahman, Frisians, Jersey cows in cattle for dairy. According to FAO (2010), livestock production plays a major role in the socio- economic development and contributes towards household food and nutritional security. They also had a variety of plants bearing fruits which included peaches, avocadoes, mangoes, apple trees, banana, grapes, orange trees, grape trees; and all these fruit trees had different varieties within each tree. This means farmers produced a variety of plants and animals that are directly or indirectly used for food, as per agro-biodiversity definition made by FAO (2005).

The extent of farmers' awareness on agro-biodiversity loss: From the findings of the study, it was worth noting that all farmers had knowledge on the varieties and variability of plants and animals. Farmers acknowledged agro-biodiversity loss recognition of species which existed before and those existed during the period of the study. This symbolized and gave the idea that farmers were aware of the losses of crops and plants but, however, put the blame on the ever advancing technology and the changing weather patterns which caused them to abandoning their old ways of living. According to Mavengahama*et al*. (2013) the reason that contributed in the decline of use of wild vegetables and food plants for example was that there was very limited knowledge in the population and among Agricultural Extension workers on their identification and usage. For this reason, indigenous vegetables did not significantly contribute to most household incomes.

Farmers' attitudes towards agro-biodiversity management: Attitudes are driven by local knowledge and according to FAO (2005), local knowledge is the collection of facts, related to the entire system of beliefs, concepts, perceptions which genuinely include the way people observe, measure, interpret and solve problems. From the findings of the study, farmers believed that the losses observed were something that was completely out of their control. They blamed the government for pressurizing them to focus on cash crops and technological advancements.

It is the rural people's role however, to manage and sustain the use of agro-biodiversity since knowledge and skills concerning crop varieties, animal breeds, agricultural systems and the nutritional value of underutilized plants have been accumulated through their daily work (FAO, 2015; Masayi and Netondo, 2013).

Strategies or practices employed by farmers in conserving agricultural biodiversity: Farmers from all the RDAs used tractors to prepare land for planting which literally disrupted the soil structure. Female farmers used conventional hand hoeing, while the male farmers practiced zero tillage or conservational agriculture in their gardens. Conservation agriculture is a set of agricultural practices that minimize soil disturbances. (Machado and Silva, 2001; Jacobsen *et al*., 2015; Knowler and Bradshaw, 2007). This practice nourishes and enhances natural biological processes, which in turn generate a host of agricultural benefits.Therefore in the context of this study, conservation agriculture may be encouraged.

Farmers practiced intercropping where they intercropped maize with legumes (which are nitrogen fixing species) and or sunflower. They also practiced crop rotation which helps maintain soil health while reducing pests and disease problems (Oerke and Dehne, 1997). Crop rotation plays an important role in conservation agriculture where it supplements soil fertility replenishment (Trenbath, 1993).

Agro-forestry or perennial agriculture was also practiced by few farmers where they deliberately integrated trees with agricultural crops and livestock with the aim of generating multiple products. This practice help diversify food and income sources, thus in

turn helping to fight against poverty and also promote food security. Agro-forestry is one important option that can successfully address the challenges of food security, poverty, environmental and biodiversity degradation under climate change conditions (Ssekabembe, 2003; Luedeling *et al*., 2015). Likewise, conservation agriculture helps to mitigate greenhouse gas effect, improve soil structure and increase soil water infiltration, soil water holding capacity and enhanced biodiversity (Thrupp, 2000). Agro-forestry and perennial plants help in improving rainwater infiltration and groundwater recharge. It also help prevent erosion and the planting of trees transpire sufficient water to create rainclouds, allowing rain to fall further inland and fight drought and desertification (Wartman *et al*., 2018). Agricultural practices such as agroforestry can promote carbon sequestration on degraded land and helps in biodiversity conservation (Lal, 2004).

The traditional vegetables used included imbuya (*Amaranthusspinosus/hybridus*), ligusha (*Corchorusolitorus*) and chuchuza (*Biden spilosa*). The traditional vegetables were of immernse importance to the rural resource poor farmers who often processed them for future use (Masarirambi *et al*., 2010). Growing different types of crops enhanced their survival by acting as an insurance against crop failure due to crop pests and diseases. Furthermore, crop production is integrated with livestock production; crop waste may be used to feed livestock whereas animal waste may serve as manure (Masarirambi *et al*., 2012). The livestock also provide power in agricultural production as means of traction on farms and carting of agricultural produce from farms or fields (Mhazo *et al*., 2012).

CONCLUSION

From the findings of the study, it was concluded that farmers had knowledge, of agrobiodiversity and that the realised that there were losses in species and their varieties. Many farmers showed lack of or poor interest in agrobiodiversity. The importance and emphasis in high yielding varieties gave the idea that agrobiodiversity was relatively less important.

Recommendations:

- It is highly recommended that government through the Ministry of Agriculture should support and promote farmers into integrating livestock and crop production, agroforestry and further discourage farmers from focusing on cash-crop production.
- Extension officers must focus on disseminating information on agro-biodiversity, technologies and sustainable agricultural practices.

Recommendations for further study: A study on factors influencing farmers' choice of practice to prevent agro-biodiversity loss so as to determine what inspires farmers on their choices. The studies are to be done in all four agro-ecological zones of the Kingdom of Eswatini.

REFERENCES

Chambers, R. and G.R. Conway, 1992. Sustainable rural livelihoods. Practical Concepts for 21st Century. Institute of Development Studies (IDS). IDS Discussion Paper 296, Brighton, UK.

Duruigbo, C.I., E.N. Okereke-Ejougu, E.M. Nwokeji, C.A. Peter-Onoh, V.E. Ogwudire and P.A. Onoh, 2013. Integrated remediation strategies for sustaining agrobiodiversity degradation in Africa. IOSR J. Agric. Vet. Sci. (IOSR-JAVS), 3(4): 16-13.

FAO, 2005. Building on Gender, Agro-biodiversity and Local Knowledge. Training Manual. Rome, Italy.

FAO, 2009. Defining Good Practice for the Conservation, use and Enhancement of Agricultural Biodiversity for More Resilient Farming Systems. Rome, Italy.

FAO, 2010. Biodiversity for Food and Agriculture; Contributing to Food Security and Sustainable Development Goals. Rome, Italy.

FAO, 2015. FAO and the 17 Sustainable Development Goals. Rome: FAO, Rome, Italy.

Gikiza, G.I. and S.A. Nastis, 2017. Health and women's role in agricultural production efficiency. Appl. Econ. Persp. Pol., 39(3): 428-440.

Gill, P., K. Stewart, E. Treasure and B. Chadwick, 2008. Methods of data collection in qualitative research: Interviews and focus groups. Br. Dent. J., 204(6): 291-295.

Hamilton, J.R., 2007. Investing in sustainable crop intensification: The case for health. Report of the International Technical Workshop, FAO, Rome, Italy.

Jackson, R.B., B.C. Hobbs and K. Sayre, 2007. Global Review of Commercialized Transgenic Crops: 2002 Feature: Bt Maize. ISAAA Briefs No. 29. ISAAA: Ithaca, NY.

Jacobsen, S.E., M. Sorensen and S.M. Petersen, 2015. Using our agrobiodiversity: Plant-based solutions to feed the world. Agron. Sust. Dev., 35(4): 1217-1235.

Knowler, D. and B. Bradshaw, 2007. Farmers' adoption of conservation agriculture: A review and synthesis of recent research. Food Pol., 32(1): 25-48.

Lal, R., 2004. Soil carbon sequestration impacts on global climate change and food security. Science, 304: 1623-1627.

Luedeling, E., M. Blanke and J. Gebauer, 2015. Chilling challenges in a warming world. Acta Hort., 1099: 901-907.

Machado, P.L.O.A. and C.A. Silva, 2001. Soil management under no-tillage systems in the tropics with special reference to Brazil. Nutr. Cycl. Agroeco., 61: 119-130.

Manyatsi, A.M., N. Mhazo and M.T. Masarirambi, 2010. Climate variability and change as perceived by rural communities in Swaziland.Res. J. Environ. Earth Sci.,2(3): 165-170.

Masarirambi, M.T., V. Mavuso, V.D. Shongwe, T.P. Nkambule and N. Mhazo, 2010. Indigenous post-harvest handling and processing of traditional vegetables in Swaziland: A review. Afr. J. Agr. Res., 5(24): 3333-3341.

Masarirambi, M.T., N. Sibandze, P.K. Wahome and T.O. Oseni, 2012. Effects of kraal manure application rates on growth and yield of wild okra (*Corchorusolitorius* L.) in a sub-tropical environment. Asian J. Agr. Sci., 4(1): 89-95.

Masayi, N.N. and G.W. Netondo, 2013. Changes in Agro-biodiversity as a result of sugarcane farming in Mumias division, Western Kenya. Afr. J. Agric. Res., 8(28): 3735-3743.

Mashinini, M.S., M.M. Sithole and M.L. Mabuza, 2011. Contribution of input trade fairs to food security in rural Swaziland: Case study of households under the Ngwempisi rural constituency. Afri. J. Agri. Res., 6(10): 2436-2446.

Mavengahama, S., M. Mclachlan and W.P. de Clercq, 2013. The role of wild vegetable species in household food security in maize based subsistence cropping systems. Food Secur., 5(2): 227-233.

Mhazo, N., A.M. Manyatsi, M.T. Masarirambi and M.L. Mhazo, 2012. Conservation agriculture in an integrated crop and livestock farming system: Challenges and opportunities in Swaziland. Swaziland J. Sustain. Dev., 1(1): 69-90.

NDMA, 2016. National Emergency Response Plan. National Disaster ManagementAgency. Mbabane, Swaziland.

Oerke, E.C. and H.W. Dehne, 1997. Global crop production and the efficacy of crop protection - Current situation and future trends. Eur. J. Plant Path., 103(03): 203-215.

Ssekabembe, C.K., 2003. College Agroforestry. Makerere University Press, Kampala, Uganda.

Thompson, C.F., 2010. Swaziland Business Year Book. Christina Forsyth Thompson, Mbabane, Swaziland.

Thrupp, L.A., 2000. Linking agricultural biodiversity and food security: The valuable role of agrobiodiversity for sustainable agriculture. Int. Affairs, 76(2): 265-281.

Trenbath, B.R., 1993. Intercropping for the management of pests and diseases. Field Crops Res., 34(3-4): 381-405.

Vilakati, S.S., 1997. Geography of Swaziland. MacMillan Boleswa Publishers (Pty) Ltd., Manzini, Swaziland.

Vorster, H.J., J.B. Stevens and G.J. Steyn, 2008. Production systems of traditional leafy vegetables: Challenges for research and extension. S. Afri. J. Agric. Ext., 37: 85-96.

Wartman, P., R. van Acker and R.C. Martin, 2018. Temperate agroforestry: How forest garden systems combined with people-based ethics can transform culture. Sustainability, 10(7): 2246-2259.