Knowledge and Attitude of Agricultural Extension Providers on Use of Agrochemicals in Migori County, Kenya

Ouma P. O[1]$_a$., Gichuki C[2]$_b$. and Muthiani N[2]$_c$

Centre for Teacher Education, University of Eldoret, P.O. Box 1125 Eldoret, Kenya[1]
Emails: $_a$ookouma@gmail.com

Department of Environmental Education, Kenyatta University, P.O Box 43844, Kenya[2]
Emails: $_b$ceciliagichuki@yahoo.com; $_c$muthiani.nelson@ku.ac.ke

Abstract

Migori County located in South Western Kenya is currently experiencing severe environmental problems as a result of use of various agrochemicals in crop cultivation approaches and cropping methods meant to ensure increased economic productivity but are a great threat towards sustainable agriculture. The research explored education background and competence of Agricultural Extension Service Providers against their attitude towards the use of various agrochemicals in Migori County. The County is located between latitude $0^0 24^{'}$ South and $0^0 40^{'}$ South and longitude $0^0 34^{'}$ East and $0^0 50^{'}$ East. It covers an area of 2,595Km^2 including approximately 478 Km^2 of water surface. The researcher administered a questionnaire with items focusing on environmental effects of agrochemicals was administered to a target population of 1000 persons enlisted in formal employment by agro-industries, government and private sector who specialize in advisory services to farmers and other extension clients in Migori County. A sample of 120 extension service providers obtained by stratified random sampling based on agro ecological zone derived from the study population was used. The research design was descriptive. Data analysis was done by descriptive statistics, frequencies, percentages, means and standard deviations. Hypothesis testing was done using Chi square at 0.05 level of confidence. The results revealed that 62.6% were well educated with 94.4% being professionally trained. However only 9.32% o had proper knowledge on various agrochemicals and only 13.85% had knowledge on their long term effects on the environment. The test on academic and professional training against attitude revealed a $\chi^2 = 72.14$. The extension service providers focused on increased production, extending product value and intensive use of agrochemicals at the expense of long term agricultural production. A moderate positive correlation on the need for in service training in sustainable agriculture and professional training was obtained ($r= 0.49$, $p= 0.05$) implying that the higher the professional training the more positive their attitude was towards use of agrochemicals. In service training on use of agrochemicals for agriculture as well as establishment of a legal framework to enforce environmental protection was therefore recommended.

Key Words: Agrochemicals, Agriculture Extension Provider, Attitude, Knowledge

Introduction

The population of the world continues to increase especially in developing countries calling for increased food production. This has resulted to inefficient natural resource management, higher energy demand and increased use of agrochemicals to increase production (FAO, 2010). Increased production of goods and services has been sought through different combinations of labour, raw materials, accumulated capital and available technology. Highly industrialized societies realized the adverse consequences of varied practices and technology on the environment (Rebecca, 2013). Environmental issues are indeed of great importance to the developing countries and should be considered as an integral aspect of the development process.

Worldwide pesticide usage has increased tremendously since 1960s and has been largely responsible for the massive increase in food production obtained from the surface of the land. Notwithstanding the beneficial effects of the pesticide, their adverse effects on environmental quality and human health have been documented worldwide. Residues of pesticides contaminate soil and water, persist in crops and enter the food chain, and are finally ingested by humans with foodstuffs and water. Pesticides are responsible for contributing to biodiversity losses and deterioration of natural habitats (Sattler *et al.,* 2006). Despite the fact that pesticides are also applied in other sectors, agriculture can undoubtedly be seen as the most important source of adverse effects. Throughout the world agriculture is under pressure to develop to a more sustainable economic activity. Sustainability issues in agriculture in developed countries are concerned with food quality and food health while in developing countries the concern is on poverty and population pressure. Sustainable agriculture globally aims to achieve environmental sustainability, economic profitability and productivity in terms of maintaining food supplies to the non-farm population and support for rural community.

Leeuis, 2004 observed that soil degradation, erosion, pollution of water, excessive use of chemicals, waste of water, decreasing water table, destruction of natural habitats of wildlife and insect pest resistance against insecticides were some of the few concerns expressed by ecologists, environmentalists agricultural professionals, policy makers, farmers and the public. This is further confirmed by Al Sabaiee, *et al*, 2005 on the perception of extension workers towards sustainable agriculture. Current methods used by farmers to ensure increased production involve use of agrochemicals and stiff competition for arable land which interferes with the fragile ecosystem Poor farmers and farm workers are the most affected victims of pesticide intoxication due to their low education backgrounds and lack of protection measures. Indiscriminate use of agrochemicals emerges as a great threat towards the environment (Thornton, 2008). Sustainable agriculture is based upon three pillars; allowing agricultural producers a means of to maintain profitability over the long term, promoting stewardship of natural resources and provision of quality of life to producers of all kinds (Sustainable Agriculture Research Education, 2010).

Knowledge management by extension educators concerning the dimensions of sustainable agriculture can be used to understand sustainable agriculture (Boone *et al*., 2007). Knowledge approach is the key factor regarding sustainability. Farmers may be considered as

human information processing systems. However, human activity is the cause of severe environmental threats and the cognitive or mental dimension give more insight to people's alignment to sustainable agriculture (Suvedi & Kaplowitz, 2016)

Materials and Methods

Descriptive survey design was used to investigate the knowledge of Agriculture Extension Service Providers (AESP) on the use of agrochemicals for attainment of sustainable agriculture. Stratified random sampling was used to arrive at a sample of 120 AESP based on position held within the organization then randomized within the agro ecological zones. Questionnaires with items measuring the participant's knowledge about use of agro chemicals for sustainable agriculture were administered. Knowledge measured an awareness of sustainable agriculture practices and effects of agrochemicals to the environment as well as their uses. Statistical Package for Social Sciences (SPSS) version 17 was used to analyze the data collected. An observation schedule was used for practices carried out in the farm in relation to attainment of sustainable agriculture. Practices were broadly grouped into those that support sustainable agriculture and those that did not. Descriptive statistics, which included frequencies, means, Standard deviations and percentages, were used to analyze the scores on the attitude scale for the variables. The variability from the means was measured by variance and standard deviations. Hypothesis testing was done using Chi square tests at .05 confidence level.

Results and Discussion

Chauhan (2006) defined agricultural extension as a professional method of non-formal education aimed at inducing behavioural changes in the farmers for increasing their income through increased production and productivity by establishing firm linkages with research for solving farmers' problems, ensuring adequate and timely supply of inputs and using proven methods of communication for speeding the process of diffusion and adoption of innovations. An extension service provider is one who specializes in the provision of extension service that is educational or advisory service to farmers and other extension clients (GoK, 2001; Suvedi & Kaplowitz, 2016).

Sustainable agriculture practices put emphasis on methods and processes that improve soil productivity while minimising harmful effects on the climate, soil, water, air, biodiversity and human health. This entails minimising inputs from non-renewable sources, empowering the local people's knowledge and skills, socio cultural values and institutional structures. These practices are only achievable when the extension service providers have the necessary capacity. A profile of Agricultural Extension Service Providers (AESP) in Migori County was developed over a period of ten years covering from 2005 to 2015**.**One hundred and eleven respondents indicated their positions which showed a response rate of 94% while seven did not indicate their positions. Majority of the staff interviewed were field staff (48.3%), followed by agriculture specialists who were 26.3% while the least percentage was that of administrators (5.1%). Those that did not respond to the question on position were those that were self-employed in their own

farms or worked in agro-vets hence were unable to classify themselves in any of the positions listed in the questionnaire. In response to a question concerning their previous position within agricultural extension service provision, 44.1% had previously served as field staff, 29.75% as agriculture specialists, 6.8% as departmental heads while 11% were fresh recruits. Generally field staffs have more direct contact with farmers and exert a lot of influence on farmers' practices (Suvedi & Kaplowitz, 2016).

A profile of the AESP interviewed was developed to ensure proper coverage and distribution. Demographic data revealed that of the sample size n = 118, one hundred and eleven respondents indicated their positions which showed a response rate of 94.067%. In response to a question concerning their previous position 44.1% had previously served as field staff, 29.75% as agriculture specialists, and 6.8% as departmental heads while 11% were fresh recruits. Generally field staffs have direct contact with farmers and exert a lot of influence on farmers' practices (Suvedi & Kaplowitz, 2016).

On the basis of academic training of the AESP interviewed, the largest group had Diploma education (41.5%), followed by Degree (16.9%) then ordinary level (14.4.%), Certificate (13.6%), primary, post graduate and Advanced level in descending order. Groups of diverse education backgrounds show significant differences in attitude towards the environment (Tikka *et al.,* 2010). In overall, 94% of the AESP had some professional training. However, being professionally trained may not necessarily imply competence in agriculture (Majka, Calder & Conroy, 2010). Among the AESP interviewed 62.5% were professionally trained in agriculture while 28.6% were trained in biological sciences, 4.5% were social scientists and another 4.5% trained in other fields**.** Awareness, knowledge and attitude are paramount in the development of environmental education (De Lavega, 2004). However, attitudes depend on personal feelings and values in addition to factual knowledge. On environmental matters people are more likely to change their actions after receiving information about desirable behavior (Tikka *et al,* 2010).

Competencies are capabilities, capacities or potentials that can be understood as characteristics of persons, teams, work units or organizations which enable them to attain desired achievements. Competencies such as teamwork, communication, leadership skills, ability to understand diverse cultures and development issues are critical for agriculture extension officers. Individuals may become more competent as they gain experience after training which in turn influences attitude towards organic farming **(**Bruening & Shao, 2005**).** Sixty nine participants (58.5%) had served in their current positions for between 2 to 6 years, 18.6% had served for between 6 years to 10 years while 17.8% had below 2 years' experience. Only 5.1% had above 10 years' experience. De Lavega (2004) also further affirmed that the more experience one had the better the moral judgement and social behavior. Despite the high level of education (58.4% being holders of Diploma and above) it would appear that the experience level of AESP was low. On knowledge on the effects of the various agrochemicals to the environment seventy seven participants (65.3%) had the knowledge while forty one (34.7%) had no knowledge on the side effects. Knowledge is meant to assist individuals to

initiate action. Follow up open ended question whose responses were analyzed qualitatively showed results as in Figure 1 of the 65.3% who indicated that they had knowledge on the side effects of the various agrochemicals an analysis of their responses was grouped into two, that is correct knowledge of environmental effects and incorrect knowledge. The most popular agrochemicals were Calcium Ammonium Nitrate (CAN) fertilizer, Confidor and Triatix. CAN fertilizer enrich the soil with nitrates (Anderson *et al.*, 2005). Confidor is widely used to control insects in vegetables, fruits, tobacco and sugarcane among other crops (NRA, 2011) while Triatix is a common chemical used to control external parasites in livestock.

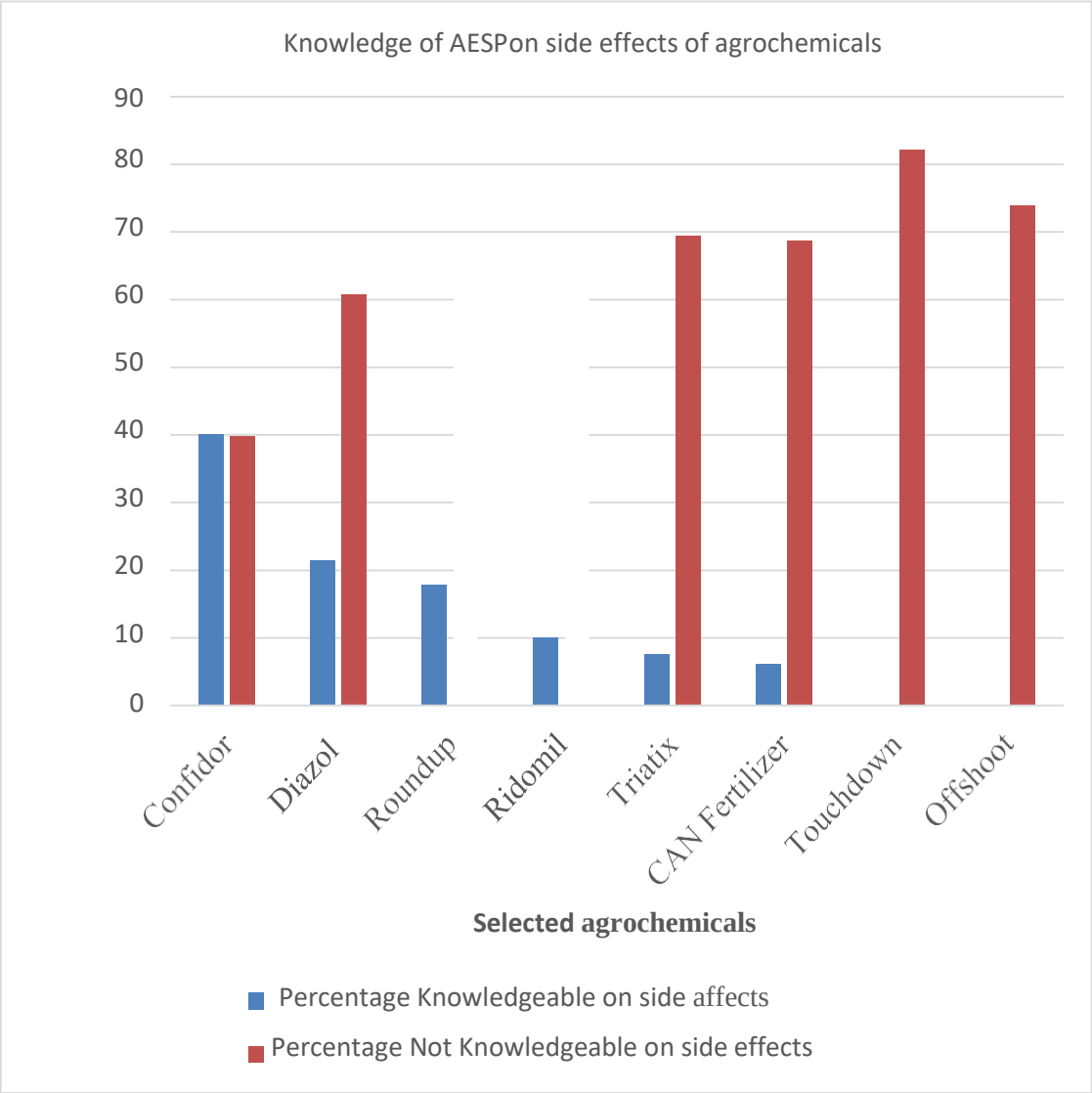

Figure 1: Knowledge of the AESP on the environmental effects of various agrochemicals

$P(\chi^2 \geq 43.443, df\ 16) = 0.000$ at α 0.05 N= 102

The life of many animals is affected by nitrates due to change in PH and salinity (Kitur, 2009). Algae in both sea water and fresh water multiply rapidly (algal bloom) when there is a sudden increase in nutrients particularly nitrates and phosphates. Strong relationships exist in freshwater ecosystems between phosphorous loadings and harmful Cyanobacterial blooms. In a research in the Gulf of Mexico the concentration of potentially toxic diatoms (*Pseudonitzschia spp*) increased due to nitrate loading over past several decades. Gilbert *et al.,* 2005 in a similar study recognized that there had been more coastal algal blooms of greater geographical extent and/or longer duration with more toxic effects. Algal blooms lead to acute diarrhea and even death upon consumption by fish or animals.

An intense bloom of toxigenic diatoms, *Pseudonitzschia pseudodelicatissima* was found after a week of elevated Ammonium levels were reported (Trainer *et al.,* 2007). In Chespiake Bay blooms of *Provocentrum miminium* showed after a week of elevated level of Urea following agricultural applications (Gilbert *et al.,* 2006). Another study showed the existence of a strong relationship in nutrient composition and the development of harmful algal blooms in freshwater, estuaries and marine coastal waters. The emergence of water hyacinth in Lake Victoria choked up small bays and threatened migration. Nitrates found in CAN fertilizer lead to eutrophication, disturbed nutrient recycling, and damage to fish and other aquatic populations which is a threat to rural life. Increased total algal biomass also comes with nutrient loading (Anderson *et al.,* 2005).

Confidor is used to control population of insect pests which reduce the economic yield of several crop plants. Confidor contains Imidaclopid which is moderately persistent in aerobic soils. It also improves plant resistance to drought, heat and other environmental effects that cause stress. It is also toxic to soil environment, terrestrial vertebrates and invertebrates and aquatic life through irritation and damage to exposed organs (Myers, 2014). Imidaclopid is moderately toxic to mammals, highly toxic to birds, earthworms and bees by acute oral transmission. These organisms are important members in an ecosystem and whatever kills them is likely to have a negative effect on the environment. Triatix which is an acaricide is composed of Armitraz, Propelen oxide, Symeronic L64, Syperonic L62, Ponceau Red and Solvesso 200 all of which are harzardous chemicals. They are toxic to aquatic, ground and sea water but it is however broken down easily in soil containing oxygen. There should be effective disposal of storage containers after use.

Four statements that reflected positive attitude towards sustainable agriculture were compared to education background by cross tabulation. The analysis was on whether education, training, experience and field of specialization observed were of any statistical significance on attitude towards use of agrochemicals towards attainment of sustainable agriculture. Chi square test results are as in table 1, 2, 3 and 4.

Table 1: Association between academic level and attitude of AESP on use of agrochemicals for sustainable agriculture

Statements	χ^2	Df	Sig
1. Establishment of an environmental farming system research unit is necessary to reinforce sustainable agriculture	42.215	24	0.012
2. Currently our industry has developed programmes that focus on whole farm agriculture systems	38.408	24	0.031
3. Our industry has a strong commitment to sustainable agriculture	31.713	24	0.134
4. Whole farm research requires collaboration among researchers from social, biological and agricultural sciences	19.094	18	0.386
Total	**131.43**	**90**	

χ^2_{Crit} =113.145 at df = 90 α =0.05

There was a statistically significant relationship between highest academic training and attitude of AESP on use of agrochemicals in sustainable agriculture since χ^2_{Cal} 131.43> χ^2_{Crit}113.145

Table 2: Association between professional training and attitude of AESP on use of agrochemicals for sustainable agriculture

Statements	χ^2	Df	Sig
1. Our industry has a strong commitment to sustainable agriculture	33.411	12	0.001
2. Currently our industry has developed programmes that focus on whole farm agriculture systems	19.963	12	0.068
3. Establishment of an environmental farming system research unit is necessary to reinforce sustainable agriculture	10.515	9	0.310
4. Whole farm research requires collaboration among researchers from social, biological and agricultural sciences	8.248	12	0.765
Total	**72.137**	**45**	

χ^2_{Crit} =61.632 at df = 45 α =0.05

There was a statistically significant relationship between professional training and attitude of AESP on use of agrochemicals in sustainable agriculture

Table 3: Association between length of service and attitude of AESP on use of agrochemicals for sustainable agriculture

Statements	χ^2	Df	Sig
1. Our industry has a strong commitment to sustainable agriculture	18.781	12	0.094
2. Currently our industry has developed programmes that focus on whole farm agriculture systems	17.297	12	0.082
3. Whole farm research requires collaboration among researchers from social, biological and agricultural sciences	14.550	12	0.267
4. Establishment of an environmental farming system research unit is necessary to reinforce sustainable agriculture	11.083	9	0.270
Total	**61.711**	**45**	

χ^2_{Crit} =61.632 at df = 45 α =0.05

For association between length of service and attitude of AESP on use of agrochemicals the chi square tests revealed that there was a statistically significant relationship between length of service and attitude of AESP on use of agrochemicals in sustainable agriculture

Table 4: Association between field of training and attitude of AESP on use of agrochemicals for sustainable agriculture

Statements	χ^2	Df	Sig
1. Establishment of an environmental farming system research unit is necessary to reinforce sustainable agriculture	34.187	9	0.000
2. Our industry has a strong commitment to sustainable agriculture	24.147	12	0.019
3. Whole farm research requires collaboration among researchers from social, biological and agricultural sciences	10.052	12	0.611
4. Currently our industry has developed programmes that focus on whole farm agriculture systems	8.649	12	0.733
Total	**77.035**	**45**	

χ^2_{Crit} =61.632 at df = 45 α =0.05

There was a statistically significant relationship between field of training and attitude of AESP on use of agrochemicals in sustainable agriculture. It could be concluded that there was a statistically significant relationship between academic training, professional training and length of service and attitude.

In order to determine the correlation of the independent variables with attitude towards use of agrochemicals for sustainable agriculture selected statements on attitude were correlated to the variables to measure the degree of relationship using Pearson's Correlation Coefficient. Table 5 shows the results of Pearson's correlation

Table 5: Pearson's Correlation results for Academic Training, Professional Training and Experience with attitude of AESP in Migori County

		Academic Training	Professional Training	Length of Service
Commitment to sustainable agriculture	Pearson's correlation	0.12	-0.12	-0.09
	Sig (2-tailed)	0.19	0.22	0.33
	N	118	111	118
Need for in service training in sustainable agriculture	Pearson's correlation	0.12	0.49	-0.15
	Sig (2-tailed)	0.21	0.02	0.12
	N	113	106	113
Use of pesticides necessary to satisfy consumer demand	Pearson's correlation	-0.05	0.02	0.07
	Sig (2-tailed)	0.62	0.80	0.50
	N	114	107	114

Significance (2- tailed) at 0.05 level

There was a low positive correlation (r= 0.12, p= 0.05) for positive statements on attitude to sustainable agriculture and a low negative correlation (r= -0.05, p= 0.05) on a negative statement on attitude towards sustainable agriculture. The higher the academic level the more positive the attitude towards sustainable agriculture but the correlation is weak.

The results of correlation between professional training indicated a very low negative correlation of commitment towards sustainable agriculture and professional training (r= -0.12, p= 0.05) and a moderate positive correlation on the need for in service training in sustainable agriculture and professional training (r= 0.49, p= 0.05) implying that the higher the professional training the more positive the attitude towards sustainable agriculture. On the use of pesticides to satisfy consumer demand which was a negative statement on attitude towards sustainable agriculture there was a low positive correlation (r= 0.02, p= 0.05). Therefore the higher the professional training the more likely the AESP are to recommend the use of agrochemicals to satisfy consumer demands. This correlation though low is likely to work against the attainment of sustainable agriculture.

In terms of work experience a very low negative correlation of commitment towards sustainable agriculture and length of service and the need for in service training (r= -0.09 and r=

-0.15, p= 0.05 respectively) and a very low positive correlation on use of pesticides to satisfy consumer demands and length of service (r= 0.07, p= 0.05) suggested that the longer the length of service the more negative the attitude towards sustainable agriculture. The use of pesticides to satisfy consumer demand which was a negative statement on attitude towards sustainable agriculture there was a low positive correlation implying that longer serving AESP advocate for use of pesticides to satisfy consumer demands.

Conclusions and Recommendations

Of the AESP interviewed 62.5% had some professional training in agriculture while the remaining 28.6% were trained in biological sciences. In terms of academic qualification, 92.4% possessed ordinary level certificate and above with 62.6% of the AESP being holders of ordinary Diploma and above. 82.2% of the AESP had above two years of experience with 23.7% having served as agriculture extension service providers for over six years. Results for hypothesis testing at 0.05 confidence level revealed the existence of statistically significant relationship between attitude of AESP with their education level ($\chi^2 = 131.4$), professional training ($\chi^2 = 72.1$) and length of service ($\chi^2 = 77.0$) towards the use of agrochemicals for sustainable agriculture. It would therefore be concluded that the higher the academic level (r=0.05, p=0.05), the professional training (r=0.02, p=0.05) and the length of service(r=0.07, p=0.05) the more the AESP advocate for use of agrochemicals. However, the correlation of these variables was very low.

The greatest technical challenge in Migori County is to use eco-effective strategies that are sustainable in the sense that that they do not themselves inflict damage on the soil, water and ecological resources as well as the atmospheric conditions on which the future depends. The paper recommends integration of sustainable agriculture into the existing curriculum and in-service training of Agricultural Extension Providers and establishment of a legal framework to enforce sustainable agriculture.

References

Anderson, D.M., Kulis, D., Kaefer, M., Gribble, B.A., Marin, K.E & Scholin, R. (2005). Identification and enumeration of Alexandrium spp from the Gulf of Maine using molecular probes. *Deep Sea Research II 19-21*: 2467-2490

Al-Subaiee, S.S.F., Yoder, E.P. & Thompson, J.S. (2005). Extension Agents' Perceptions of Sustainable Agriculture in the Riyadh Region of Saudi. *Agricultural Organization Journals for Sustainable Agriculture*. Jihad. May 30:14-19

Boone, J.H.N., Hersman, M.E., Boone, A.D. & Gartin, A.J. (2007). Knowledge of sustainable agriculture practices by extension agents in Ohio, Pennsylvania and West Virginia. *J.Ext 45(5); 1-11*

Bruenig, T. & Shao, X. (2005). What should be included in an International Agriculture Undergraduate Course? *Journal of International Agriculture Extension Education* 12(1): 47-54

DeLauwere C., Drost, H., Debuck, A., Smit, A., Balk-Theus, L., Burvma, J. & Prins, H. (2004). To change or not to change? Farmers' motives to convert to intergrated or organic farming. In: *Proceedings of ISHS Acta Horticulturae 655: XV International Symposium on Horticultural economic and management, Berlin, pp235-243.*

De Lavega, E.L. (2004). *Awareness, knowledge and attitude about environmental education: responses from environmental specialists, high school instructors, students and parents.* Unpublished PhD Thesis. Orlando, Florida: University of Central Florida,

FAO, (2010). Agricultural sector strategy: a shared vision 2011-2013. Palestinian National Authority. http://www.lac.ps/documents/

Gilbert, P.M. & Legrand, C. (2006). The diverse nutrient strategies of harmful algal blooms: focus on osmotrophy. In : Granelli, E & Turner, J (Eds). *Ecology of Harmful Algae*. Springer pp 163-176

GoK, (2013) *Migori County Intergrated Development Plan 2013- 2017*. Nairobi: Government Printers.

Kitur, E.C. L (2009). *A comparative study of the influence of variations in environmental factors on phytoplankton properties in selected Kenyan reservoirs*. Unpublished PhD thesis. Kenyatta University, Kenya

Leeuwis, C. (2004). *Communication for Rural Innovation Rethinking Agricultural Extension*. Blackwell, Iowa, USA.

Majka, A., Calder, B. & Conroy, J. (2010). An email model to answer consumer questions during times of staff shortages. *Journal of Extension* [On-line], 48(3) Article 3IAW6. Available at: http://www.joe.org/joe/2010june/iw6.php

McElroy, M.W. (2008). *Social footprints. Measuring the social sustainability performance of organizations*. Phd Dissertation. Sudbury; University of Grorrigen.

Myers, J. P. (February, 2014). Pesticides may be more dangerous than testing reveals, study finds. *Environmental Health News* http://dx.doi.org/10.1155/2014

Parker, G.M. (2006). *Teamwork: 20 steps to success.* Amherst, Massachusetts, USA:HRD Press

Rebecca, G. (2013). *Industrial Ecology. Education Portal.com.* University of Phoenix. Ashford

Sattler, C., Kachele, H., and Verch, G. (2006). Assessing the intensity of pesticide use in Agriculture. *Agriculture Ecosystem and Environment doi: 10.1016.*

Sustainable Agriculture Research Education (2010). What can you do to support sustainable Agriculture? *Sustainable Agriculture Research Education.* http://www.sare.org/highlight/2010 report.

Suvedi, M. & Kaplowitz, M. (2016). What every extension worker should know-core competence handbook. Michigan State University. Michigan, USA.

Thornton, H. (2008). *Permaculture adoption among Malawian farmers: a positive deviance inquiry*. Unpublished Masters thesis, School for International Training, Brattleboro, VT. http://www.neverendingfood.org/page_id=205

Tikka, P.M., Kuitunen, M.T. & Tynys, S.M. (2010). Effects of educational background on students' attitudes, activity levels and knowledge concerning the environment. *The Journal of Environmental Education Vol. 31, issue.3, 2000.*

Trainer, V.L., Cochlan, W.P., Erickson, A., Bill, B.D., Cox, I.H., Borchet, J.A. & Le Febvre, K.A. (2007). Recent domoic acid closures of shellfish harvest areas in Washington State inland waterways. *Harmful Algae* 6, 449-459