FARMERS KNOWLEDGE, ATTITUDES AND PRACTICES (KAP) IN EMBU AND TAITA BENCHMARK SITES BEFORE AND AFTER BELOW-GROUND BIODIVERSITY PROJECT INTERVENTIONS

[CONOCIMIENTO CAMPESINO, ACTITUDES Y PRÁCTICAS EN LOS SITIOS DE TRABAJO DE EMBU Y TAITA ANTES Y DESPUÉS DE LA INTERVENCIÓN DEL PROYECTO "BELOW-GROUND BIODIVERSITY"]

Beneah Mutsotso[1*], Edward Muya[2] and Henry Roimen[3]

[1]University of Nairobi, Department of Sociology and Social Work,
[2] Kenya Agricultural Research Institute,
[3] Department of Resource Survey and Remote Sensing
Email: bmutsotso@yahoo.com
**Corresponding author*

SUMMARY

In Kenya the belowground biodiversity project was implemented in Embu and Taita which are biodiversity hotspots. The objective of the BGBD project was to enhance awareness, knowledge and understanding of below ground biological diversity important for sustainable agricultural production by demonstration of methods for conservation and sustainable man power. The objective of the paper is to present and analyze farmers' knowledge, attitudes and practices at different timelines of the project, as well as identify factors limiting adoption of the best bet technologies of enhanced biodiversity conservation and increased agricultural production. In early 1960's when natural forest was cleared for farming activities no farm inputs were introduced in food crops until after 10 years. Ever since, to the present similar farm imputs and crops have been propagated continuously leading to declined food production hence the BGBD project interventions. A triangulation of methods, both quantitative and qualitative participatory approaches were used to obtain data from farmers in both benchmark sites. The results showed that most farmers were more aware of the diversity of organisms in the soil at the end of the project compared to the beginning. As much as the best bet technologies were identified, their adoption was constrained by the unavailability of the technologies in local agro shops. This forced farmers to continue using the farming techniques that had deleterious effects on the soil. Hence farmers adopt what works, but which must be locally available. In this, cost considerations did not matter, but simply inaccessibility.

Key words: Knowledge; Attitudes; Practices; best bet technologies; adoption.

INTRODUCTION

The scope of the paper

In Kenya the Below Ground Biodiversity (BGBD) project was implemented in Embu and Taita benchmark sites which were identified as biodiversity hotspots. The objective of this paper is to present and analyze farmers' knowledge and practices before and after the intervention by the BGBD project so as to assess impacts of the BGBD interventions on soil productivity and identify factors limiting adoption the introduced technologies as well as the challenges facing the farmers in their efforts to adopt the technologies.

Background

The aim of the BGBD project was to enhance farmers awareness, knowledge and understanding of belowground biodiversity important to sustainable agricultural production in tropical landscapes. This was to be achieved through demonstrations of selected interventions that would ensure conservation and sustainable management of soil biodiversity in smallholder agro ecosystems. The project hypothesis was that appropriate management of above and below ground biota, optimal conservation of biodiversity for national and global benefits can be achieved in mosaics of land use at differing intensities of management and result in sustainable agricultural production.

In Phase I, the project objectives were characterization of benchmark sites, inventories selected soil organisms and standardized BGBD methods. The main objective for Phase 1 were to evaluate and demonstrate sustainable management approaches for enhanced BGBD and agricultural productivity, provide recommendation for the development of policy framework for their implementation as well as build capacity of farmers, youth, CBOs, policy makers as well for the technical and scientists. This was to be achieved through public awareness, on farm experimentation and demonstration, use of inoculums ANF, fertilizers introduced and demonstrated, and involvement of postgraduate students.

Land use history in both benchmark sites

The period preceding 1960's when the fight against colonialism was intensive to a great extent influenced subsequent land use and the state of above- and belowground biodiversity after independence in 1963. In Embu, when the Mau Mau struggle for independence intensified in the 1950s the British herded all people from the countrywide into protected villages. However, when it became apparent that the crave for independence was resolute, the British appointed chiefs and village elders to apportion and subdivide to male household heads the indigenous/virgin Mt. Kenya forest for settlement and farming between 1961-1962. The land subdivision and allocation was done on the basis of sub clans and ridges. In the same period 1961-1962, forest clearance using an assortment of tools and methods – fire, slash and burn, machete, hoes, axes etc commenced to pave way for farming. The first crops planted in 1962 were maize, arrow roots, bananas, yams, beans, sorghums, cassava and sweet potatoes. All were planted without any agricultural inputs but agricultural production was still sustainable. Chemical fertilizers and other agro-chemicals were first used in 1962 with the introduction of coffee. From 1966, food production drastically declined and in response agriculture extension officers recommended to farmers to use of fertilizers and livestock manure to improve soil fertility and food production. Hence, 1966 marked the turning point in management of agricultural land with serious implications s of significance to BGBD. Growing of tea as an industrial commercial crop was introduced between 1972 and 1974 with massive use of chemical fertilizers (Mutsotso, 2005). From that to date, there has been continuous use of fertilizers. The current decline in biodiversity could be associated with land use and management conversion and utilization trends in Embu district.

The history for Taita is rather different from Embu, but presents a similar historical pattern and similar consequences as those of Embu. Until 1967 all the Taita hills and valleys were densely forested including Werugha (where the benchmark site is located). However, there were isolated and unsystematic slash and burn agriculture activities by the few farmers who ventured into the forest and riparian areas.. In 1967-1968 there was land adjudication and consolidation in which different families were allocated forest land for settlement and farming. The crops initially planted without any inputs were maize, beans, sweet potatoes, cassava, arrow roots, bananas, fruit trees and horticulture crops like tomatoes, kale, cabbage, lettuce etc. The crop varieties initially planted in 1967 have persisted to the present (Mwakio, 1995; Ville, 1993). The only variation though was that the intensity of cultivation which has been enhanced in terms of continuous cropping, intensive cultivation and frequency of using agricultural inputs with little increase in acreage under cultivation (Mutsotso, 2005, Osiro, 2008). By 1983 all the hills were cleared of forest,, causing soil erosion leading to decline in land quality and decreased food production. This situation prompted the Ministry of Agriculture to start an intensive agro-forestry campaign to control soil erosion and restore the landscapes. Grevellia trees were introduced, a situation which explains their existence on 100% of the farmlands.

Phase 1: Baseline on socio-economic factors

Land use

A total of 74 farmers 34(45.9%) in Embu and 40(50.1%) in Taita were selected in each benchmark site using a pre-determined criteria such as practicing farming and location in the project site. The specific farmers were identified though a GPS. In Embu 90% of the farmers grew either tea or coffee and 10% tea and coffee. In Taita 95% farmers grew horticulture which was 100% under irrigation all the year round. In Embu 100% of the tea crop was monocropped. In both benchmark sites 98% of coffee was intercropped with bananas, maize, sweet potatoes, sugarcane, cassava and fruit trees. In Embu 53% of the coffee and tea farmers also plant macadamia trees.

The dominant crops were tea, coffee, macadamia, maize in Embu and maize, beans, cassava and horticulture in Taita. Over 80% of farmers in Embu had appropriate knowledge on farm management compared to 50% in Taita. The average farm size per household was 1.2acres in Embu and 2.2 acres in Taita. In both benchmark sites, 100% farmers practice mixed cropping. Land tillage was continuous especially in Embu, but in Taita in valley bottoms but on the Taita slopes it is twice per season. The literacy rate was 90% in Embu and 85% in Taita. Farming dependency accounts for 90% of household income in Embu and 95% in Taita. Average household income is $93.8 in Embu and $ 81.3 in Taita. In both benchmark sites 99% of the land is registered in the male household head. The population density was per km^2 is 564 in Embu and 40 in Taita and a fertility rate of 5.2 in Embu and 6.0 in Taita. Life expectancy was 66.3 years in Embu and 56 years in Taita. The HDI* index for Embu is 0.637 and 0.528 in Taita respectively. In Embu, the female- male ratio in the total population is 100:96 and 100:97 in Taita compared to the national average of 100:95. The average household size was 8.7 in Embu and 8.2 in Taita. [Republic of Kenya, 2002; Republic of Kenya, 2002]

**HDI for a country or region shows how far that region succeeded in attaining the average life expectancy of 85years, access to education for all and a decent standard of life.*

In terms of fertilizer use, 95% of the farmers in both benchmark sites used inorganic fertilizers two times in Embu and three to four times in Taita per season. The commonly used fertilizer for planting is Complete name (DAP) 93% in Embu and 86% in Taita. Complete name (CAN) was used for topdressing in both benchmark sites though about 10% also used urea. In both Embu and Taita 100% farmers used pesticides, in Embu two times a season but three to four times in Taita. In Embu 95% farmers used livestock manure while 90% in Taita in addition to complete name (DAP). In both benchmark sites the main tools of land tillage were; hand hoe, machete, fork and knife.

The farm management technologies applied in both benchmark sites were dependent on the slope of the land. In Taita 100% and Embu 60% farmers had constructed bench terraces and practiced strip cropping, cultivation across contours, trash line or *fanya juu* (a Swahili word for a soil conservation method commonly used in Kenya) or a combination of them. These soil conservation technologies were introduced in early 1960s in Embu but 1983 in Taita. The Ministry of Agriculture was instrumental in the sensitization of farmers in Embu and Taita districts. In Embu 95% farmers have cows, goats or chicken compared to 86% in Taita. The average number of cows per household in both benchmark sites, is one even though relatively affluent households owned four to six cows which provided insufficient manure for their farming activities even though manure was extensively used in farming activities. No farmer in both benchmark sites used compost manure.

Farmers knowledge of the importance of belowground fauna contribution to soil fertility

In Embu farmers mentioned the following animals/insects that lived below the ground: catworm, thrips, igunyo (caterpillar), marindi, nthigiriri (ants), termite, minyongoro (earthworm) and mole (fuko). In Taita the farmers mentioned the following: red ant (shakana), chiriri, kitambala, catworm (vivunyu), mavumbulo, msangu and ants. In Embu 92% and 86% in Taita indicated that the belowground fauna were destructive to crops and had no usefulness to the soil (Table 1a and b). Given this they applied various concoctions and/or pesticides to decimate them. For instance in Embu wood ash, mole trap livestock manure, tobacco, pepper were applied. In Taita wood ash, crashed leaves of indigenous trees and pesticides were used.

Table 1a: Farmers’ perception of the importance of below ground fauna to soil fertility in Embu, April, 2005

Belowground fauna useful to soil	Count	%
Yes	6	19.4
No	25	80.6
Total	31	100

Table Ib: Farmers’ perception of the importance of below ground fauna to soil fertility in Taita, June, 2005

Belowground fauna useful to soil	Count	%
Yes	12	30.8
No	27	69.2
Total	39	100

As observed in Table (1a & b) Embu and Taita respectively most farmers 25(80.6%) in Embu and 27 (69.2%) in Taita believed belowground fauna was largely destructive to crops and of no value to the soil.

Phase 2: Experiments, demonstrations and impact on farmers knowledge, attitudes and practices

The following were the objectives of the study

i) To find out the level of farmer adoption of the different types of interventions
ii) Establish the enabling and constraining factors for adoption

METHODOLOGIES

Socio-economic survey

A triangulation of methods incorporating qualitative, quantitative and participatory techniques were adopted in order to ensure accuracy of data obtained. A short questionnaire was randomly administered to individual farmers at the two benchmark sites. Field visits (2 in germination stage, 2 at weeding and 2 at harvest time) to the demonstration /experiment plots were made and variations observed. Open ended discussions were held with farmers either at the demonstration / experiment plots or in their homesteads. A total of 70 farmers 31(44.3%) in Embu and 39 (55.7%) Taita were interviewed using a questionnaire. Respondents were 19 (27.1%) female and 51 (72.9%) male. In Embu the interviewees were randomly drawn from the following villages within the two windows: Kithiga, Gicherori, Kibugu, Kathakwa, Kathiria, Karumiri, Ndunduri, Kamavindi, Kianguru and Ithine. In Taita they were from: Mkiyayo, Mwakishi, Mashaghi, Saghasa, Ngolia, Kisheni, Sasenyi, Matasenyi, Kesse, Marumange, Misindunyi and Mtalo.

Data Analysis

The data was processed and analyzed using the Statistical Package for Social Science (SPSS) and values of mean, totals, frequency tables and percentages were subsequently used to summarize the data for presentation in a meaningful way. Descriptive statistics were used in report presentation to bring out the dominant feelings or perceptions of the farmers and stakeholders.

The Demonstrations and Experiments

The experiment and demonstration plots demonstrating most commonly used and recommended soil fertility improvement inputs were intended to provide learning and information to farmers in terms of sustainable conservation of biodiversity, increase fertility and productivity. The experiment and demonstrations were carried out within selected farms in the two benchmark sites whose owners willingly provided the land for this purpose. The farmers in the two sites (both in the project and the general community) were involved in all aspects of this enterprise from farm selection, farm preparation, planting, weeding, harvesting and quantifying the harvest from each plot. In the course of the trials farmers were free to visit the plots to see comparisons between the different types of farm inputs vis-à-vis the crop quality and eventually crop yield. The farmers were expected to learn from the trials and transfer the knowledge and practice to their own farms.

RESULTS AND DISCUSSION

Respondents level of education was primary (elementary) 17(54.8%), post primary 11(35.5%) and 3(9.7%) had no education in Embu while in Taita 24 (51.5%) had primary education, 10(25.6%) secondary education and 5(12.8%) had no education. This implies that most farmers were literate, and therefore able to do basic reading and comprehension.

In Embu 30(96.8%) of the farmers were aware of the BGBD project compared to 33 (84.6%) in Taita. This difference in low level of awareness in Taita was mainly attributed to the migrant nature of many farmers from the hills into the lowland savanna where they practice rain fed agriculture and pastoralism. Such farmers maintained a permanent home on the upland where the project was implemented but spent much longer periods of time ranging from weeks to months in a year in the lowlands which have now became the food basket since the depletion of the hill slopes and intense population pressure.

In order to gauge the appropriateness of information the farmers knew or had heard about bgbd project, they indicated as follows (Table 2a):

Table 2a: Embu*: Farmers perception of the bgbd project

Response type	Frequency	%
Testing of different types of fertilizers	12	19.4
Undertaking soil analysis	18	29.0
Undertaking farming experiments	20	32.3
How to improve farm production	8	12.9
Not sure	4	6.5
Total	62	100

*multiple responses

Table 2b: Taita*: Farmers perception of the bgbd project

Response type	Frequency	%
Testing of different types of fertilizers	5	10.0
Undertaking soil analysis	21	42.0
Undertaking farming experiments	10	20.0
How to improve farm production	9	18.0
Not sure	5	10.0
Total	50	100

Multiple responses

As observed in table 2a and 2b above farmers in both benchmark sites 51.5% in Embu and 41.1% in Taita had relevant information about the bgbd project.

During Phase 1, soil samples were collected from selected farmers for analysis. Each farmer received a written report from the project team about the fertility or infertility status of his/her farm. The soil analysis report also indicated recommendations on how to restore and conserve soil biodiversity from a landscape point of view. Although the farm report was specific to the farm, the findings and the recommendations were applicable to neighboring farms since farmers in a locality tended to have generally similar farm management practices. Therefore the farmers were asked if they ever utilized the farm reports from their neighbours whose soil samples had been taken. The responses were as follows: in Embu 21 (67.7%) and 27(69.2%) in Taita had sought to read their neighbour's farm reports and recommendations on how to restore soil fertility respectively. Those farmers who received the report did not however tell other farmers or their neighbour about the soil analysis report instead it was incumbent upon each farmer to have interest and find out on their own. It was also observed that 28(90.3%) farmers in Embu and 33(84.6 %) in Taita read the soil analysis findings. However, 23(74.2 %) farmers in Embu and 16(41.0 %) in Taita had lost the soil sample analysis report by the time of the impact study.

Of the soil analysis, general recommendations in Phase I, 9(29%) in Embu and 12(30.8%) in Taita adopted the recommendations and applied on their farms. Other farmers did not adopt the recommendations for a variety of reasons: did not understand what was to be done or they assumed that the report was specifically for the relevant farmer while others found the recommendations particularly manure quantities too costly.

During the Phase 2 demonstrations and experiment plots were established on farms and in farmer training institutes one at each site and were planted for three consecutive seasons in 2007, 2008 and 2009. In Embu 24 (77.4%) and Taita 26(66.6%) of the farmers were aware of the existence of the demonstration and experiment plots. In Taita in particular, the high number of farmers without knowledge was attributed to their migratory nature to the Kishushe lowlands where they spent a considerable period of time in year therefore not very conversant of the activities in the slopes. Again of those aware of the existence of the experiment / demonstration plots (24 in Embu and 26 in Taita) 6 (25.0%) of them in Embu and 19(73.1%) in Taita had personally visited the plots to observe the plant behaviour in the different treatments. They found differences in the quality of crops on the different plots. They were particularly impressed by the quality of the crop in plots with Mavuno, Mavuno-Bacillus, and Mavuno-Trichoderma and TSP-CAN treatments in both benchmark sites. They were however disappointed by all the treatments in the demonstration plots in both benchmarks sites. Given the variations in crop quality based on the different treatments the adoption rate was as follows:

Table 3a: Treatments and patterns of farmers' adoption in Embu

Treatment adopted	Count	%
Mavuno	12	38.7
Mavuno-bacillus	-	-
Mavuno-trichoderma	-	-
TSP-CAN	8	25.8
No adoption	11	35.5
Total	31	100

In both benchmark sites application of Mavuno fertilizer was adopted and TSP-CAN in Embu. This implies that farmers adopt what they observe. Foster and Rosezweight (1995) reported that farmers' own experience significantly increases adoption of the high yielding varieties. Nyangena, (2004) in a study of farmers in Machakos district found that technology adoption significantly depended on their neighbours farm output. However Besley and Case (1993) used a model of learning where profitability of adopting the new innovation changes significantly once farmers discover the potential/true profits of adopting the new technology. Franz, J.B, William, J and Kurt, J.P (2003) showed that farmers adoption behavior depended on the utility considerations after comparing the old technologies in use with the new ones, they will adopt the latter if the expected utility is greater than that of the former. Amek, (2006) found that adoption of integrated pest management technologies increased significantly based on permanent ownership of land, farmers group membership, frequency of extension visits and availability of labour. Even though Mavuno + Bacillus and Mavuno + Trichoderma improved crop growth, they were not adopted because they were not available and had not been heard of in the agro-dealer shops. Again no farmer in the wider locality was known to use them.

Table 3b: Treatments and patterns of farmers' adoption in Taita

Treatment adopted	Count	%
Mavuno	9	23.1
Mavuno-bacillus	-	-
Mavuno-trichoderma	-	-
TSP-CAN	-	-
No adoption	30	76.9
Total	39	100

Therefore farmers easily adopted what they knew or had seen good results from. Although Mavuno was not in use in the benchmark sites before the project intervention some shopkeepers had stocked but it was not selling compared to DAP. Following impressive project results, stockists had enhanced its stock level and supply while TSP which was more expensive had also become a favourable option in Embu but not Taita. A visit to the local shops and stockists in the benchmark sites was undertaken to find out the availability and affordability of Mavuno and TSP-CAN vis-à-vis other commonly used fertilizers like DAP. In Embu out of 10 agrovets selling fertilizers at Kangethia, Kibugu, Ndunduri, Kathagariri and Kianjokoma market centres only two sold Mavuno and TSP however, their supply was irregular. In Taita there were 10 agrovets found in Embakasi, Saghasa, Kesse and Makandenyi trading centres and only two sold Mavuno while none stocked TSP. This explains why TSP was not adopted in Taita inpsite of it producing good crops. In this context it wass observed that innovations with positive results to farmers will not be adopted if they are not available or within reach of the farmers. Agrovets and stockists insisted that they stock fertilizers that are on demand such as DAP but not Mavuno or TSP. One agrovet indicated that in 2005 he stocked 50kg of Mavuno which took 4months to clear compared with 50kg DAP which took on average of 14days to clear. In terms of price of TSP and Mavuno where available, the prices were competitive compared to others. Prices of fertilizers at Embu and Taita are presented in Table 4a&b

Table 4a: Embu: Fertilizer price range per kilogram in all shops

Fertilizer type	Cost per kg in Kshs.
DAP	60
CAN	40
NPK	60
UREA	55
Mavuno	62
TSP	55

Table 4b: Taita: Fertilizer price range per kilogram in all shops

Fertilizer type	Cost per kg in Kshs.
DAP	60
CAN	45
TSP	-
NPK	60
Mavuno	75
UREA	65

From the price range in the two benchmark sites it was clear that Mavuno and TSP prices compared favorable with more familiar DAP. Therefore cost prohibitions are not valid reasons for non-adoption. In conclusion, the irregular supply or unavailability of TSP in Taita or Bacillus and Trichoderma inoculums in both Taita and Embu affected the level of adoption. Even after the experiments / demonstrations, DAP still remained the most widespread used fertilizer in both benchmark sites because of its availability in the local shops.

Issues farmers sought information about

At both benchmark sites farmers sought information about the issues listed in Table 5a & b regarding the experiments / demonstrations.

In table 5a & b it is demonstrated that farmers in the two benchmark sites have appropriate information about the project. It also shows that issues of soil fertility still confront farmers.

Table 5a: Frequently asked questions by farmers in Embu

Issue	Count	%
Benefits of the project	10	8.1
Right fertilizer to use on farm	23	18.5
How to improve soil fertility	25	20.2
Why crops in some plots were poorer than others	14	11.3
Appropriate crops to interchange	8	6.5
Whether fertilizers were locally available	19	15.3
Recommended pesticides	15	12.1
Whether farmers paid to get their soils tasted	10	8.1
Total	128	100

Table b: Frequently asked questions by farmers in Taita

Issue	Count	%
Benefits of the project	25	19.5
Right fertilizer to use on farm	16	12.5
How to improve soil fertility	23	17.9
Whether recommended fertilizers are locally available	21	16.4
Recommended pesticides	28	21.9
Why soil analysis not done in valley bottom	6	4.7
Why some crops in some plot were not good	7	5.5
Whether farmers paid to get their soils analyzed	2	1.6
Total	128	100

**Multiple responses used here since a farmer could ask several questions about the project.*

Importance of belowground fauna to soil fertility

After interventions for several years, the farmers were asked in order to gauge their level of understanding and appreciation of the importance of bgbd.

Table 6a Farmers perception of the importance of belowground fauna to soil fertility in Embu, June 2009

Belowground fauna useful to soil	Count	%
Yes	28	90.3
No	3	9.7
Total	31	100

Table 6b: Farmers perception of the importance of belowground fauna to soil fertility in Taita, August 2009

Belowground fauna useful to soil	Count	%
Yes	33	84.6
No	6	15.4
Total	39	100

Drawing from tables [6a & b] there was a significance enhancement of knowledge compared to the baseline information. Many farmers 28(90.3%) in Embu and 33(84.6%) in Taita now have more positive knowledge more information about the contribution of belowground fauna to soil quality compared to 19.4% in Embu and 30.8% in Taita in 2005.

3.3 Impediments to adoption

It is noted that there were significant adoption of some technologies. However, increased adoption was constrained by the following:

i) Unavailability of appropriate farm inputs in the local markets. Although the project demonstrations / experiments had good results for Mavuno, Mavuno + Bacillus, Mavuno + Trichoderma and TSP + CAN few local shops stock Mavuno. All the shops in both Embu and Taita did not stock Bacillus, Trichoderma and TSP. To 100% stockists and other retailers, they had never heard of bacillus, or trichoderma. Only one stockist in Embu had TSP. Therefore unavailability of the recommended farm inputs undermined increased adoption. The prices of Mavuno, TSP, NPK, Urea, DAP compared favorably hence adoption was not constrained by cost.

ii) The quantities of manure recommended were above most farmers' ability to afford from the market. Although 95% of farmers in Embu and 86% in Taita had livestock and used the manure, its production was too low (about 1 tonne per farmer) hence 76% farmers in Embu and 52% in Taita bought manure from the lowlands in small quantities. In both benchmark sites a seven tonne lorry of manure costs Kshs.10,000 (US$133) to be ferried from the lowlands. This was above the ability of most farmers. In the context of manure, cost prohibitions undermined adoption.

iii) Drought. Since 2006-2009 Kenya had experienced deficient rainfall and in the 2008/2009 there was prolonged drought in the benchmark sites. The drought particularly in Taita led to poor performance of the trials hence denying the farmers to realize the full potential of the trials.

CONCLUSIONS

The trials produced good results with positive implication for improved farming and hence food security.. Since farmers adopted what was available or the results of what they saw it would be useful that the positive treatments be made available to farmers. However this can take time until relevant policies are developed to support it. This may call for involvement of several stakeholders at national level. The farmer's feedback meetings held in Embu and Taita in late January 2010 involving other stakeholders have partly fulfilled this need. Farmer's knowledge of bgbd was also enhanced compared to the initial period. The 10year project duration was long enough to afford farmers and scientist's opportunity to interact at various levels and/or activities. Indeed farmers were able to see the positive results from soils analysis and the success of the various trials. The farmer's knowledge of belowground biodiversity is considerably enhanced as well as how to conserve BGBD for increased agricultural production. For example farmers are now more aware that certain farm management practices are harmful to BGBD. Most other farmers are now endowed with considerable knowledge of restoring the depleted BGBD. The farmers now appreciate that restoration of bgbd does not necessarily involve monetary costs but utilization of hitherto taken for granted residues abundant in their farms and homesteads.

REFERENCES

Amek, T. 2006. Economic Analysis of Integrated Pest Management Technology Adoption. A Case of Small Scale Farmers in Taita Taveta District in Kenya. A Masters Degree Project Report, School of Economics, University of Nairobi.

Besley.T. and Case, A. 1993. Modelling Technology Adoption in Developing Countries. American Economic Review 83: 396-402

Foster, A and Rosezweight, M. 1995. Learning by Doing and Learning from Others: Human Capital and Technological Change in Agriculture. Journal of Political Economy 103: 1176-1209

Franz, J.B, William, J and Kurt, J.P. 2003. Predicting Technology Adoption to Improve Research Priority Setting. American Journal of Agricultural Economics. 28:151-164

Mutsotso, B.M. 2005. The Socio Economic Aspects of CSM-Bgbd In Embu and Taita Benchmark Sites. Paper presented at The Global

Conference, Manaus, Brazil, April 11-17, 2005

Mwakio, J.M 1995. The Wataita historically, culturally, politically and economically. Taita Hills biodiversity conservation and resource management workshop, Ngerenyi, 22-27. November 1995. Nairobi

Nyangena, W. 2004. The Effect Of Social Capital On Technology Adoption: Empirical Evidence from Kenya. Phd Thesis Gotenburg University

Osiro, M.A 2008. Exploring The Links Between Intensive Farming and Sustainable Livelihood in Wundanyi Division, Taita District. A Masters Degree Project Paper. Dept of Sociology, University of Nairobi

Republic of Kenya, 2002. Embu District Development Plan [2002-2008] Government Printer, Nairobi

Republic of Kenya, 2002. Taita Taveta District Development Plan [2002-2008] Government Printer, Nairobi

Ville, J.L. 1994. Should man and Wildlife be divorced? Taita Hills *Swara*, East African Wildlife Society November – December, 1994. 17: 23-25

Kinoti, H.W. 1998 A Handbook of Social Research Methods. NCCK Publication. Nairobi

Nachmias, C.F and Nachmias, D. 1996. Research Methods in the Social Sciences. St. Martins Press. London.

Submitted April 11, 2010– Accepted June 15, 2010
Revised received November 4, 2010