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Socioeconomic Activities and Their Potential Impacts on Sustainable Food Safety and Livelihood Improvement in the Bahi Wetland, Central Tanzania

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Authors' contributions

This work was carried out in collaboration between all authors. Author WP designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors JSM and MN managed the analyses of the study. Author MN managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A cross-sectional assessment survey was conducted in five villages in central Tanzania to determine the impact of socioeconomic activities on food safety and livelihood improvement in the Bahi Wetland. The study, involving 209 randomly selected respondents, revealed crop farming, livestock keeping, fishing, beekeeping, salt and sand extraction, forest consumption, grass thatching, and eco-tourism as the main social economic activities in the wetland, but also that these were associated with unsuitable farming systems, overgrazing, illegal and overfishing, uncontrollable salt and sand extraction, deforestation from charcoal production as unsustainable practices with potential negative impacts on biological diversity of flora and fauna available in the

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wetland. The findings suggest that Bahi wetlands has enormous natural and socioeconomic potential, but conservation of wetland biodiversity has not been successful due to insufficient knowledge among communities around the wetland and lack of strong local institutional framework. Therefore, for sustainable management of wetland resources, the training and these frameworks should be well coordinated and implemented.

Keywords: Anthropogenic activities; food safety; potential impacts; sustainability; wetland.

1. INTRODUCTION

Wetlands are species-rich habitats saturated with water, which perform valuable ecosystem services such as food chain support, water quality enhancement, flood protection, and carbon sequestration [1]. Many wetlands are fragile and suffer from deterioration [2]. According to [3], so that wetland ecosystem sustainability is threatened by on-going social economic activities, such as clearing of vegetation for agriculture [4], overgrazing [5], illegal fishing practices [6], water abstraction and siltation due to deposition of eroded materials, which reduces the depth of the wetlands [7]. All these activities have consequences that could undermine supported livelihoods [8].

About 50% of wetlands Worldwide have been drained to convert them into agricultural and industrial lands and urban settlements [9,2]. Population increase and interference from associated activities have depleted these resources to a reduced rate that influence a flow of the ecosystem services [10]. According to [11], degradation and loss of suitable systems have been happening more rapidly in wetlands rather than in any other ecosystems. Degradation of wetlands ecosystem due to socioeconomic activities is severe in countries that have the weak policy and management strategies [6].

The Bahi wetland in central Tanzania plays a significant role in food and economic, cultural and ecological functions [12]. Thus, utilization of this wetland through socioeconomic activities is inevitable. However, scant information is available on this wetland, particularly on the socioeconomic activities that can cause potential impacts on sustainable food production and livelihood improvement. Therefore, a study was conducted to assess socioeconomic activities that could have potential impacts on sustainable food production and livelihood improvement in the Bahi wetland, central Tanzania.

2. RESEARCH METHODOLOGY

2.1 Study Area

The Bahi wetland area (Fig. 1), situated about 56 km west of Tanzania's capital city of Dodoma, is made up of the whole Bahi district and five wards from the Manyoni district. The wetland has a swamp and catchment areas of about 6798.4 km^2 and 23,447 km^2 respectively [13]. The centre of the wetland lies at a latitude of -6.08333 and longitude of 35.16667 with land elevation ranging from 796 to 804m above sea level. The wetland receives water from various seasonal rivers, mainly the Bubu and Mponde Rivers from the north. Other smaller rivers the feed the wetland include the Lawila, Nkojigwe, Msemembo, Maduma and Zuboro Rivers, all of which usually cease to flow during the dry season from May to December [14,15]. The Bahi wetland is surrounded by large saline mudflats, which are nearly devoid of vegetation and where the dominant flora are halophyte herbaceous species [16].

2.2 Data Collection

This study employed a non-experimental research design where cross-sectional research techniques were used. The study involved both quantitative and qualitative approaches to collect the necessary information. Data on assessment of socioeconomic activities with potential impacts on water management for sustainable food production and livelihood improvement in Bahi wetland were collected using the following tools: questionnaires, Focus Group Discussion (FGD), Key Informant Interview (KI) and personal observation. The sampled villages were Bahi Sokoni, Uhelela, Mkakatika, Nagulo Bahi, and Igose from Bahi and Manyoni Districts respectively. Most respondents were local villagers from the named villages, including officers from the Bahi District Council (District agricultural officer, District fisheries officer, and District land officer), local government officers such as VEO, WEO, and Division secretary from

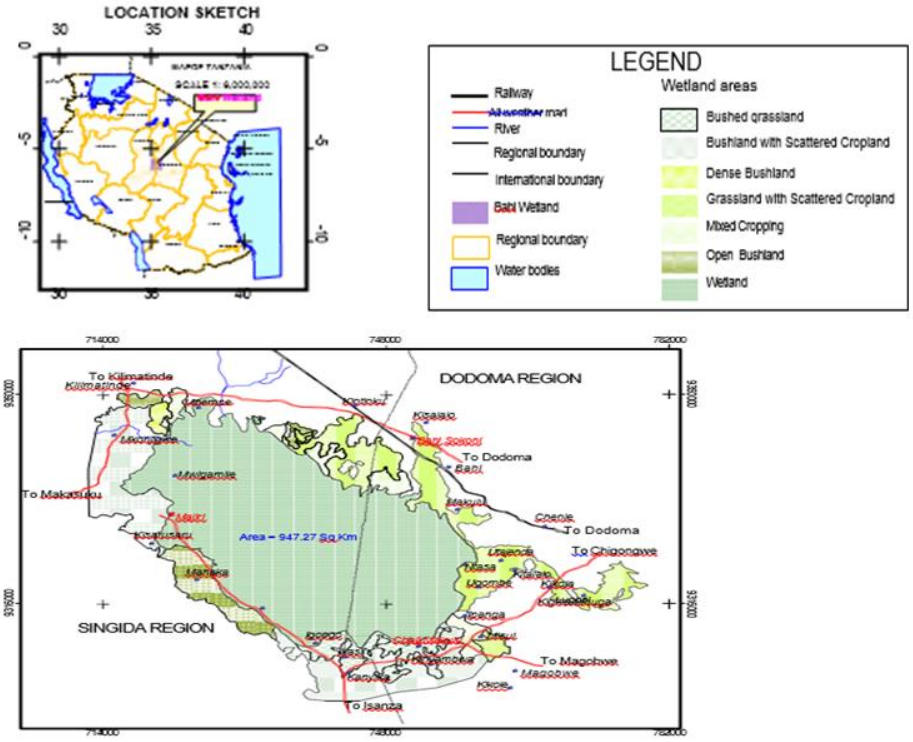

Fig. 1. Location of the Bahi Wetlands Source: [17]

Bahi division and extension officers from Bahi Sokoni and Igose villages. Selection of households for an interview was done randomly by picking names until 10% of the population was obtained. In this study, a total of 70, 19, 50, 37, and 37 households were interviewed from Bahi Sokoni, Uhelela, Nagulo Bahi, Mkakatika and Igose villages respectively to make a total of 209 respondents. About 10 questionnaires were administered to prospective respondents to observe their understanding of questions. Secondary data on socioeconomic activities were collected through review of various documents and reports from Bahi district council and reports, bulletins, books, and journals.

2.3 Data Analysis

The Statistical Package for Social Science Studies (SPSS) version 20 and Microsoft Excel 2010 software were applied to analyze quantitative data at 95% confidence interval. Quantitative data collected through questionnaires were coded, analyzed and summarized in frequencies and percentages to produce tables. Descriptive statistics were used to obtain frequency and percentages of various coded responses.

3. RESULTS AND DISCUSSION

3.1 Main Socioeconomic Activities

The on-going socioeconomic activities in Bahi wetland as gathered from respondents are presented in Table 1. Crop farming, livestock keeping, fishing, beekeeping, salt and sand extraction, forest consumption, grass thatching, and eco-tourism were the main socioeconomic activities in Bahi wetland by 34.0, 15.0, 12.8, 9.7, 9.1, 7.9, 6.7 and 4.8% respectively.

Table 1. Socioeconomic activities in Bahi wetland *(N*=146)*

Activities	Responses	Percent (%)
Crop farming	56	34.0
Livestock keeping	24	15.0
Fishing	21	12.8
Beekeeping	16	9.7
Salt and sand extraction	15	9.1
Forest consumption	13	7.9
Grass thatching	11	6.7
Eco-tourism	8	4.8

The majority of people who reside in this wetland basin are members of the Gogo local ethnic

group. Other ethnic groups represented in the wetland population were from other parts of the country, namely: Nyakyusa, Sukuma, Nyiramba, Nyaturu, and Maasai who were mainly involved in above-mentioned activities.

3.2 Cash Crops Grown in Bahi Wetland

Table 2 shows cash crops grown in the Bahi wetland. The majority of respondents revealed that the main cash crop grown in the study area was sesame *(Sesamum indicum) (*44.9%), followed by groundnuts *(Arachis hypogaea)* (34.9%) and sunflower *(Helianthus annuus)* (20.2%).

Table 2. Main cash crops are grown in the Bahi wetland *(N*=69)*

Cash-crops	Responses	Percent (%)
Sesame	31	44.9
Groundnuts	24	34.9
Sunflower	14	20.2

Some of the harvested crops were processed by local factories operating within the area while the rest were transported to Dodoma Municipality where large factories were operating. Dodoma Municipal and neighbouring regions were the major markets for the processed oil from the Bahi wetland basin. However, groundnuts were transported to Northern regions of Arusha and Manyara for sale.

3.3 Subsistent Crops Grown in Bahi Wetland

Table 3 shows main subsistence crops grown in the Bahi wetland. The results have shown the main subsistent crops grown by the farmers in the study area are paddy rice *(Oryza sativa),* pearl millet *(Pennisetum glaucum),* maize *(Zea mays)* and sorghum *(Sorghum bicolor)* by 50.0, 24.5, 14.7 and 10.9% respectively.

Table 3. Subsistence crops grown in Bahi wetlands *(N*=184)*

Subsistence crops	Frequency (N*)	Percent (%)
Rice	92	50.0
Pearl millet	45	24.5
Maize	27	14.7
Sorghum	20	10.9

Findings have revealed that rice was the dominant crop within the wetland whereas other crops: pearl millet, maize, sorghum, sesame, groundnuts, and sunflower were grown on dry land. Minor crops grown in wetland included Bambara-nuts, pigeon peas and cowpeas. The Bahi wetland is suitable for paddy production due to moderately fertile soils with high salinity in some areas, but susceptible to surface run-off. Seeds for farmers were obtained from farmers self-stocks preserved from previous harvests or provided by the Ministry of Agriculture and Food Cooperatives (MAFS) through cash vouchers system. The Bahi wetland was not well managed due to lack of irrigation facilities as most of the farmers were depending on both floods from the Bubu and other Rivers and rain-fed agriculture. Nevertheless, [1] has reported that the Bahi wetland contributes to the national rice production.

3.4 Main Rice Cultivars Grown in Bahi Wetlands

Paddy rice cultivars grown in the Bahi wetland are indicated in Table 4. Observation of the results shows Super Zambia, Super Bahi, Nganyaro, Saro and Super India as paddy cultivars grown by farmers by 36.4, 21.6, 20.5, 13.0 and 8.0%.

Table 4. Main rice cultivars grown in Bahi wetlands *(N*=88)*

Cultivars	Frequency (N*)	Percentage (%)
Super Zambia	32	36.4
Super Bahi	19	21.6
Nganyaro	18	20.5
Saro	12	13.6
Super India	7	8.0

Super Zambia and Super Bahi were the main cultivars grown in the wetlands due to their good aroma and preference to markets. Dodoma Municipality was the main market of paddy rice from Bahi wetland.

3.5 Vegetable Crops Grown in the Bubu River Basin

Table 5 shows the main vegetable crops grown in the wetland especially along the Bubu River basin. Majority of respondents revealed tomato *(Lycopersicon esculentum)*, onion (*Allium cepa*), and amaranths (*Amaranthus* spp.) as the main vegetable crops by 44.3, 19.3, and 13.7%

respectively. Other minor vegetable crops included watermelon *(Citrullus lanatus),* Chinese cabbage *(Brassica rapa)* and okra *(Abelmoschus esculentus)* by 10.8, 7.5 and 4.2% respectively.

Table 5. Vegetable crops grown in the Bubu River basin (*N*=212*)

Subsistence crops	Frequency (N*)	Percent (%)
Tomato	94	44.3
Onion	41	19.3
Amaranths	29	13.7
Watermelon	23	10.8
Chinese cabbage	16	7.5
Okra	9	4.2

Vegetables were also important crops grown by farmers in the Bahi wetland to support them with nutrient food materials in their everyday diets and as to sell for income generation. During the dry season, farmers using diesel engine water pumps were drilling wells to pump water to their farms along the river banks. The farmers were selling harvested vegetable crops to residents in Bahi District as well as supplying to the markets in Dodoma Municipality.

3.6 Potential Resources in Fishing

The results on the main fishes found in the Bahi wetland are presented in Table 6. Survey results revealed that the main types of fish available in the Bahi wetland were catfish (48.5%) followed by tilapia (29.2%) and ningu (22.3%).

Table 6. Main types of fish available in Bahi wetlands *(N*=202)*

Species of fish	Frequency (N*)	Percent (%)
Catfish	98	48.5
Tilapia	59	29.2
Ningu	45	22.3

The study discovered that fishing was a reliable source of nutrients and income to local people. Fish was harvested mainly during the rainy season and traditionally processed by smoking on firewood to add market value. The fish from Bahi swamp were transported to Dodoma, Dar es Salaam, Mwanza, and Mbeya.

3.7 Eco-tourism

The Bahi wetland is also a habitat for biological diversity that plays a great role in the conservation of flora and fauna and other higher living organisms. The wetland is part of the East African Flamingo-Habitat-Network [17] that has been attracting internal and external tourists to view a wide range of attractions including flamingo *(Phoenicopterus)* and marabou stork *(Leptoptilos crumenifer).* The Bahi wetland is known as wildlife corridor that animals use to cross seasonally. According to [18] elephants from Muhezi and Swagaswaga move along the wetland early in the wet season but return along the wetland later in the year.

3.8 Potential Impacts from Unsustainable Socioeconomic Practices

Table 7 shows socioeconomic practices with potential impacts on sustainable food production and livelihood improvement in the Bahi wetland. Most respondents (33.9%) revealed that unsustainable agricultural systems were the main socio-economic practices with potential negative impacts on the wetland. Other practices with negative impacts in the wetland were overgrazing and Illegal & overfishing by 18.6 and 16.9%, respectively. The least impacts came from deforestation, unsustainable charcoal and salt production as well as unmanageable sand extraction by 11.2, 10.2, 7.2 and 2.0% respectively.

3.9 Main Sources of Water for Socioeconomic Activities

Results on sources of water for the mentioned socioeconomic activities are presented in Table 8. The majority of respondents (62.0%) used the Bubu River as the main source of water for their socioeconomic activities, mainly crop production, while the minority (22.3%) were dependent on other sources, such as the Mponde River basin. Rainfall was also an important source of water to sustain socioeconomic activities, with 15.7% of the activities utilizing that source.

The Bahi wetland was discovered to provide significant support to food safety and livelihood sustainability for many people in the central semi-arid zone of Tanzania. This was supported by water availability, mainly from the Bubu River as seen above. According to findings by [19], wetlands, especially those occurring in arid and semi-arid areas have unique characteristics in supporting human activities and biodiversity. They do so by making water available as a resource for crop production, livestock keeping, wild-animal and plant life and many other benefits. Availability of water attracts humans,

thereby making the wetland an important area for livelihood improvement. The changing lifestyles of residential communities, such as increased focus on subsistence and commercial agriculture have reflective impacts on wetlands and the biodiversity that they support.

3.10 Impacts of Unsustainable Practices on Water Management

Impacts of unsustainable practices on water management, especially on the Bubu River as the main source of water to the wetland, are shown in Table 9. About 32.1% of responding farmers ascertained that main the impact from anthropogenic activities on the river was siltation from unsustainable agricultural production. This was followed by banks erosion and diversion of river flow by 23.4 and 16.0%, respectively. Other effects were excessive flooding, seasonality due to drought condition, illegal and overfishing, over-grazing and un-recommended irrigation regime by 7.8, 6.4, 5.5, 4.6 and 4.1% respectively.

Farmers were used to excavating wells within the river during the dry season that was leading to silt accumulation in the Bahi wetland. Riverbank erosion and diversion of the river flow during the rainy season is another effect of anthropogenic activities. In some parts, the flow of the River was changed in direction due to unstable banks, especially in the rainy season. This finding is not far from the report of [20] who talks about 80% of residents in Bahi district relying on agro-pastoralism. This in response is clearing vegetation and land, and overutilization of the basin and water available for crop production, livestock keeping, and fishing every season and therefore great impact on the River. This is in agreement with other studies in Africa, which explain how unsustainable anthropogenic activities affect biodiversity management. According to [21,22], clearing of land and thickets for crop cultivation and wrong utilization of water bodies has the negative impact on water management. This finding has further revealed communities living adjacent to the wetland influencing the utilization of the Bubu River. The

Table 7. Socioeconomic practices with potential impacts in wetland *(N*=295)*

Anthropogenic activities	Frequency (N)	Percentage (%)
Unsustainable agricultural systems	100	33.9
Overgrazing	55	18.6
Illegal and overfishing	50	16.9
Deforestation	33	11.2
Uncontrollable charcoal production	30	10.2
Unsustainable salt production	21	7.2
Unmanageable sand extraction	6	2.0

Table 8. Major sources of water for economic activities *(N*=158)*

Source of water	Frequency (N)	Percentage (%)
Bubu River	98	62.0
Mponde River	26	16.6
Other Rivers	9	5.7
Rainwater	25	15.7

Table 9. Impacts of unsustainable practices on water management *(N*=218)*

Effects of socioeconomic activities	Frequency	Percentage (%)
Siltation	70	32.1
Banks erosion	51	23.4
Diversion of river flow	35	16.1
Excessive flooding	17	7.8
Seasonality due drought condition	14	6.4
Illegal and overfishing	12	5.5
Over-grazing	10	4.6
Un-recommended irrigation regime	9	4.1

Table 10. Challenges affecting agricultural and livestock production *(N*=122)*

Challenges in crop production	Responses	Percent (%)
Poor practices in farming & livestock keeping	35	31.5
Overflooding & seasonality of Bubu & other rivers	25	22.5
Insect-pests, bird-pests & parasites	22	19.8
Diseases	15	13.5
Drought condition and lack of pasture	14	12.6

study by [23] shows that over 60% of the population in Africa depends directly and indirectly on land and water bodies available to sustain their food safety and improved livelihoods, but such uses have always influenced the sustainable management of those resources. Similarly, [24] demonstrated that socioeconomic demands could have devastating effects on the river catchments in many wetlands and thereafter resulting in the deterioration of water quality.

3.11 Challenges Affecting Agricultural and Livestock Production

Challenges affecting agricultural and livestock production are indicated in Table 10. The main challenges affecting agricultural and livestock production were poor practices in farming and livestock keeping; over flooding and seasonality of Bubu and other rivers; insect-pests and bird-pests in crops and livestock parasites; diseases in both crops and livestock and drought conditions with lack of pasture by 31.5, 22.5, 19.8, 13.5, and 12.6%, respectively.

These findings have revealed that the residents are agro-pastoralists and they depend on the Bubu River and other rivers for crop and livestock production.

4. CONCLUSION

Wetlands are among the most important ecosystems with rich biological diversity of both flora and fauna species, including a variety of species of microbes, plants, insects, amphibians, reptiles, birds, fish, and mammals. Due to their importance to the livelihood of the local communities, wetlands have been exposed to anthropogenic activities that pose potential threats to biological diversity. Analysis from the study has indicated that crop cultivation is the main socioeconomic activity that has potential negative impacts on flora and fauna in the Bahi wetland. Crop cultivation is associated with vegetation clearing to make room for intensive monocultures, as in the case of paddy rice irrigation farming in Bahi.

5. RECOMMENDATIONS

Formation of a Community-Based Natural Resource Management (CBNRM) program to manage resource use in Bahi wetland is recommended to combat the potential negative impacts from local socioeconomic activities. The value of sustainable use to local people should be promoted through an appropriate combination of the best traditional practices and the scientific understanding. The communities adjacent to the wetland need to form a trans-boundary committee to coordinate the management of the wetland because it is not listed as the Ramsar Convention site and can be used by anybody, resulting in its frequently being subjected to unsustainable use. The Bahi District Council should encourage the establishment of bylaws and regulation in order to carry out restoration measures such as afforestation and reforestation as well as encourages the community on the sustainable use of the Bahi wetland resources.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ngailo JA, Kaswamila AL, Senkoro CJ. Rice Production in the Maswa District, Tanzania and its Contribution to Poverty Alleviation. Research on Poverty Alleviation (REPOA). Mkuki na Nyota Publishers, Dar es Salaam, Tanzania; 2007.

2. Verhoeven J, Setter T. Agricultural use of wetlands: Opportunities and limitations. Annals of botany, mcp 172; 2009.
3. WWF. wwf.panda.org. Retrieved from WWF Global; 2004.
Available:http://wwf.panda.org/wwf_/?10825/The-Economic-Values-of-the-Worlds-Wetlands
(Accessed in October, 2017)
4. Nellemann C, Corcoran E. Dead planet, living planet: Biodiversity and ecosystem restoration for sustainable development. 2010;112.
5. Galbraith H, Amerasinghe P, Huber-Lee A. The effects of agricultural irrigation on wetland ecosystems in developing countries: A literature review. CA Discussion Paper 1. Colombo, Sri Lanka: Comprehensive Assessment Secretariat. 2005;1-23.
6. Aide T, Montoro J, Borras S, Valle H, Devisscher T, Jabbour J. Land-Chapter 3. Nairobi, Kenya: UNEP. 2010;79-118.
7. Wantzen K, Blettler MC, Marchese M, Amsler M, Bacchl M, Ezcurra-de-Drago I. Sandy rivers: a review on general ecohydrological patterns of benthic invertebrate assemblages across continents. International Journal of River Basin Management; 2014.
8. Majule A, Joseph P. Livelihood Zones Analysis: A tool for planning agricultural water management investments. Institute for Resource Assessment (IRA), University of Dar es Salaam. Dar es Salaam-Tanzania: FAO. 2010;1-26.
9. Coops H, Tockner K, Amoros C, Hein T, Quinn G. Restoring lateral connections between rivers and floodplains: Lessons from rehabilitation projects. In Wetlands and Natural Resource Management. Berlin Heidelberg: Springer. 2006;15-32.
10. Daily G. Introduction: What are ecosystem services? Washington DC: Island Press. 1997;1-16.
11. MEA. Ecosystems and Human Well-being. Washington, DC.: Island Press. 2005;1-137.
12. Mwakaje A. Wetlands, livelihoods, and sustainability in Tanzania. African Journal of Ecology. 2009;47(1):179-184.
13. McCartney M. International Water Management Institute (IWMI). Technical Note: Hydrology of the Bahi wetland, Tanzania; 2007.
Available:http://publications.iwmi.org
(Accessed in October, 2017)
14. Mbogoro D, Mwakipesile A, Smith H. Economical and ecological research of Bahi swamp. Darwin, Australia: CESCOPE; 2010.
15. Mamboleo A, Kilungu H, Moe S, Soka G, Munishi1 P. Influence of hydrological fluctuations on vegetation and avifauna species composition, abundance and diversity in the Bahi swamp wetlands central Tanzania. Tanzania Journal of Forestry and Nature. 2012;8(2):61-86.
16. Ramsar Convention Secretariate. Destination wetlands: Supporting sustainable tourism. Gland, Switzerland and Madrid, Spain: Secretariate of Ramsar Convention on Wetlands and World Tourism Organization (UNWTO); 2012.
17. Childress B, Harper D, Wim-van-den-Bossche, Berthold P, Querner U. Satellite tracking Lesser Flamingo movements in the Rift Valley, East Africa: pilot study report. Journal of African Ornithology. 2004;75:57-65. Published online: 12 Nov 2009.
18. Jones T, Caro T, Davenport TRB, Eds. Wildlife Corridors in Tanzania. Unpublished report. Tanzania Wildlife Research Institute (TAWIRI), Arusha. 2009;60.
19. Macharia J, Gichuki N. Socioeconomic dimensions of conservation of wetlands in African dry lands: A case study of River Ewaso Ngiro basin in southern Kenya. University of Nairobi, Nairobi. 2006;364-369.
20. Lazaro E. Scoping study of local knowledge in relation to the management of agrobiodiversity and food safety in Southern Highlands and Central zones – Tanzania. Dar es Salaam: FAO. 2003;(1): 1-83.
21. Stevens W. Declining Biodiversity and Unsustainable Agricultural Production-Common Cause,, Common Solution? Research Paper, Science, Technology, Environment and Resources Group; 2001. Available:http://www.aph.gov.au/library / on February 21, 2017.
22. Spriggs A. World Wildlife Fund. Washington DC: WWF; 2015.
Available:http://www.worldwildlife.org/ecoregions/at0901
(Accessed in October, 2017)

23. Ayivor J, Gordon C. Impact of land use on river systems in Ghana. West African Journal of Applied Ecology. 2012;20(3): 83-95.

24. Ellis E, Pontius R. Encyclopedia of the earth. Environmental Information Coalition, National Council for Science and the Environment; 2007.

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