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Assessment of the Impact of Environment Protection in Rwanda: A Case Study of Rugezi Marshland

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ABSTRACT

Environmental protection is one of the most important measures to achieve the long run and sustainability of living organisms in the world. The study was conducted in Burera and Gicumbi districts with the main aim of assessing the impact of environment protection in Rwanda. A case study of Rugezi Marchland. Data were collected using a structured questionnaire and analyzed using SPSS statistical software version 20 and STATA statistical software vision 13. Off-farm income, occupation, educational level, age, and farm size, showed a positive relationship with Rugezi marchland protection. Variables such as value of product distance to Rugezi marchland, gender, and family size had a negative influence on Rugezi marchland protection. The study also indicated that factors such as water management, increase of grass species, increase of wild animals and birds, modern house construction, zero grazing keeping revealing a positive relationship with Rugezi marchland protection. Two most serious problems encountered are the lack of occupation and low level of education.

1. Introduction

Rwanda is one of the most overpopulated countries in Africa and in the world. It causes the farming land to become insufficient while this land is expected to produce a good harvest to feed this mass of population. The consequence is that the population farm all possible

land, marshlands included and those activities are done in a high vagrancy where the environment is damaged. It is currently suffering from tremendous pressure on agricultural land due to the rapid demographic growth and the limited availability of productive land where 90% of the working population in Rwanda is employed in the agriculture sector^[1].

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Marshlands are important elements of Rwanda's watershed systems. A great deal of the hydrological and water resources problems currently experienced in Rwanda are the resultant effects of wetland degradation in the country. The challenges posed by the degradation can better be understood and better appreciated when viewed against the backdrop of the benefits derivable from the wetlands. The total area of marshland in Rwanda is approximately 278,000 ha of which, in 2009, 53% was used for cultivation. This accounts for 12% of the total cultivated land in the country ^[2]. Day to day men and women of study area use these above grasses from Rugezi marshland for making different materials in hand crafts that are economically resources of income for people of the region. Its restoration reopened a corridor for migratory birds and fishes, and provides good conditions for many plants and animal species, particularly the endangered and threatened species ^[2].

Wetlands are one of the world's most productive ecosystems and they provide valuable goods and services for humankind. Development projects often destroy wetland functions and degrade the true value of wetlands, resulting in unsustainable development with gains that are only short-term ^[3].

They are sinks into which surface waters or groundwater flows from a surrounding catchment. Within landscapes, they are natural harvesters of rainwater and, by definition; they are sites where water occurs at or close to the ground surface ^[4]. On the other hand, in their study of the relationship between wetlands and urban growth in Bindura, Zimbabwe define them as lands where saturation with water is the dominant factor determining the nature of the soil development, types of soil development and the types of plant and animal community living in the soil and on its surface, and generally includes swamps, marshes, bogs and similar areas ^[5].

The United States Environmental Protection Agency defines wetlands as land areas covered with water or where water is present at or near the soil surface all year or varying periods of the year ^[6].

The current use and management of water and wetland resources is dominated by the construction of large dams to store much of the available water for hydropower, irrigation and urban water supply and fish ponds. This practice, which serves to exacerbate the climate variability and change impacts, has often left too little for maintaining the traditional wetland function downstream and caused significant stream flow regime change in most of the major wetlands in Rwanda. For many years ago, different wetlands including Rugezi were not well-protected and dried due to different factors including

human being activities particularly crop farming ^[7]. In 2001, thanks to African Development Bank (ADB) funds, the MINAGRI developed a master plan of marshlands development, soil conservation and watersheds protection. This scheme led to wetland classification in accordance with their hydrological aspects, their level of degradation and recommended the conservation of highland wetlands as integral part in water resources management ^[7].

Rugezi marshland is located in the Northern and bounded by two districts namely Burara and Gicumbi. It is surrounded by the higher mountains of the country that provide permanent freshwater. Due to its value on the international level, this marsh has been protected under the Ramsar Convention. A few years ago, this marshland got dried because of intensive crop farming; the consequences had affected all Rwandans, water from lakes of Burera and Ruhondo had decreased, thus causing a lack of hydropower in the whole country ^[8].

The Rugezi marshland is a protected area, covering 6,735 ha and one of headwaters of the Nile River. At 2,100 m, the marshland is a high altitude peat bog. The wetland functions as a regulating basin to moderate the flows inflows and outflows. The marsh controls, preserves, and filters water resources, which flow into the downstream lakes of Bulera and Ruhondo ^[9].

It is also an important bird area recognized by the Bird Life International in 2001. The zone of important bird area is identified as 8,500 ha. The floral species found in the marsh include *Miscanthidium violaceum*, *Cyperus latifolius* and papyrus *C. papyrus* species. Of the 43 species of birds in the swamp and its surrounding afro-tropical highlands biome, the globally threatened species are *Bradypterus graueri* (Grauer's swamp-warbler), *Laniarius mufumbiri* (papyrus gonolek), *Calamonastides gracilirostris* (papyrus yellow warbler) and *Baelearica regulorum* (Grey crowned crane). The species of least concern are *Cisticola carruthersi* (Carruthers's cisticola), *Bradypterus carpalis* (white-winged scrub-warbler), *Onychognathus tenuirostris* (slender-billed starling), *Ploceus baglafecht* (baglafecht weaver), *Nesocharis ansorgei* (white-collared oliveback), *Crithagra frontalis* (yellow-browed citril), *Crithagra koliensis* (papyrus canary) and *Crithagra burtoni* (thick-billed seedeater) ^[9].

Environmental issues related to Rugezi Marsh include of agricultural reclamation and generating hydropower from water supply systems. Its success as water balancing of the resources has been damaged in recent years due to high anthropogenic pressure and as well due to the development specific project of agricultural reclamation and drainage of the marsh ^[9].

The degradation has complicated water resources management in Lakes Bulera and Ruhondo catchments and the cost to replace or rehabilitate the hydrological functions of Rugezi Marsh is putting a heavy burden to the government, local authorities and international organizations.

Rwanda is naturally endowed with abundant groundwater resources, but the water supply situation in some area of the country for various uses remains far below expectation^[10]. Marshlands are one of the world's most important resources because of the many environmental and socioeconomic benefits they provide. Different products from Rugezi marshland are grasses resources for manure, wildlife resources, fisheries, Medicinal Plant, Wild honey, forage resources, mulch resources, agricultural resources, and water supply directly for home use (cooking, construction, clothes washing, and irrigation) and indirectly for electricity generation. Different functions of Rugezi marshland protection are also groundwater recharge, flood control/regulation shoreline stabilization /erosion control, sediment or toxicant retention, nutrient retention, biomass export, Fertility, Water conservation, storm protection/windbreak, microclimate stabilisation, water transport, recreation, and tourism. However, the paradox is that they are still being degraded at a rapid rate worldwide despite their relative importance to the general ecosystem^[11].

Wetlands ecosystems play a key role in water quality and quantity management, and vice versa, the water resources quantity and quality provide key services to ecosystem health. The water quality and quantity that they provide maintains the habitat for animal and plant biodiversity^[12].

There was ample evidence that rural households used environmental resources quite extensively quantitatively proved environmental resources contribution to household's income^[13]. The main functions of wetlands such as flood control, groundwater recharge, coastal protection, sediment traps, atmospheric equilibrium and waste treatments as well as biological productivity, which provide nurseries for aquatic life and habitat for upland mammals such as deer, raccoons and Salamande. All over the world, wetlands are used as recreational sites in various ways boating, picnics, yachting, fishing, boat regatta^[14].

In a latter study of the economic consequences of wetland degradation for local populations in Africa, acknowledge the importance of wetlands for the sustenance of rural dwellers in Africa^[15].

Discussions on the services these ones provided are numerous^[16]. Considerable research has been carried

out on specific roles they play in the livelihoods of local residents and local environmental interactions^[17]. Rugezi Marshland is one of the wetlands found in Rwanda, which is located in the Northern Province in two districts namely Burera and Gicumbi. This marshland has around 7000 ha and it is surrounded by the higher mountains of the country that provide permanent freshwater^[18]. It offers both directly and indirectly many products used in different functions important in the livelihoods of local people.

The marshland protection is also the most important ecosystem service and forms a large potential for recreation and ecotourism. In Rwanda, it supports the livelihoods of many poor people through agriculture for both food and income^[19]. The protection of Rugezi marshland will increase the *Clarias liocephalus* *Haplochromis* (*Ishonzi*) in water and *Sitatunga* (*Tragelaphus Speke*:Inzobe) that have in past have reduced by hunters.

Various studies on Rugezi marshland did not show the importance of marshland protection. It is in this regards that this study will focus on an economic analysis of the impact of wetlands protection in Rwanda. A case study of Rugezi marshland in located in Burera and Gicumbi districts. Specific objectives are to identify the economic factors influencing Rugezi marshland protection in the study area and to determine the social economic impact of Rugezi marshland protection.

2. Material and Methods

2.1 Description of Study Area

This study was conducted in two districts namely Burera and Gicumbi of the Northern Province. The Rugezi Marshland located between 1° 21'30" and 1°36'11" of south latitude and 29°49'59" and 29°59'50" east longitude. It covers an area of 6,735 ha. The annual mean rainfall on the hillsides is 1200 mm/year at 'Rwerere-Colline' site whereas at the marsh surface it is 1050mm/year^[20].

2.2 Sampling Design and Sample Size

A multistage sampling technique was employed in this study. The first stage was the purposive selection of two districts namely Burera and Gicumbi where the Rugezi wetland located. The second stage was the sample random sampling of seven sectors such as Gatebe, Kivuye, Gutaro, Cyeru, Rwere, Ruhunde and Miyove selected based on their proximity to Rugezi wetland. Twenty (20) respondents were selected from each of the seven sectors making one hundred and forty (140) sample size

of targeted respondents living in the proximity of this marshland.

2.3 Data Collection

Data were collected from seven sectors by using a structured questionnaire. Field observation, focus group discussion, formal and informal interviews were used for collecting data used in this study.

2.4 Data and Analysis

The logit regression model was chosen for this study because it is computationally simpler. It gives the effect of the various factors on Rugezi Marshland protection and Social economic impact of Rugezi marshland protection in the study area. Descriptive analysis was done using SPSS version 20 and regression analysis using STATA version 13.

3. Results and Discussions

3.1 Socio-Economic Characteristics of Sampled Respondents

Table 1 shows that the male population as about (76)54.293% of them dominated in the protection of Rugezi marshland. This is actually indicated by female who use different grasses such as (*Cyperus latifolius*, *Juncus sp*, *Typha*, *Papyrus sp*, *Miscanthus Violaceus*) in hand craft that generate household's income. In the other hands, the majority of women use same grasses in agriculture as mulch and fodder for livestock keeping more than men do and fuel for energy for cooking. Generally, these activities degrade wetland more than to protect it. This is sometimes because women do not have other occupation than cultivation and handcraft making. The results indicated that the majority of the study are in the range between four and seven persons per household with 69 (49.28%). This shows that due to the lack of other occupation in region as, family size increase the protection of wetland reduce because most of members of family will go cuts some species of grasses for doing hand craft for women and for men they go to fish some specie like *Clarias liocephalus Haplochromis* (Ishonzi) and hunt Sitatunga (*Tragelaphus Speke*: Inzobe) if any. These two actions are the main degrading Rugezi marshland rather than protecting it.

In this study, the results pertaining to the age of respondents are presented in Table 1. The findings revealed that the most of respondents are in range between thirty-one and fourth years with 60 (42.86%). The three groups indicated that the majority of respondents were

in the active labor force. This implies that as these three categories have other occupation should be held in the development of the study area but in contrast the lack of other occupation these groups should degrade the wetland. Especially young men are the most to fish some specie like *Clarias liocephalus Haplochromis* (Ishonzi) whether there is no other option.

It has been found that about 63 (45%) of respondents were respondents without formal education followed by primary with 45 (32.14%) and the third class was secondary school with 15 (10.71%). The fourth place was occupied by vocation with 10 (7.15%) where the last class was for university. Considering the results, the sum of respondents educated presented 77 (55%) of the study population. This means that the Rugezi marshland will be more protected when the number of respondents without formal education reduce at lowest level. This is because as the number of educated population increases the choice for other occupation also increase which reduce the degradation of natural resources and receptive to innovations as the number of educated increase. The study was supported by the study of Botlhoko G. J and Oladele O. I. ^[21], indicated that literate farmers are likely to adopt innovation than respondents without formal education farmers, hence, their productivity increases and greater farms' returns. For this reason, the protection of Rugezi marshland will be more efficiency as the number of educated people increase as more as possible.

Majority 50% of the respondents had experience in agriculture activities between eleven and twenty years with 55 (39.29%) followed by the group of the 21years and above with 46 (32.86%) and finally the range between one and ten years with 39 (27.85%). It was also implies that farmers will increase output given the number of years they have spent farming; they are expected to have gained enough knowledge. ^[22] noted that farmers sometimes count more on their experiences than educational attainment in order to increase their productivity. With this reason given the farmers in study area should not give value on protection rather than cuts grasses for making manure and mulches for agriculture as good agricultural practice that facilitate maximization of productivity.

The findings revealed that respondents have an average farm size less or equal to 0.5 ha with 78 (55.71%) followed by the range between 0.6-0.8 ha with 39 (27.86%). The results showed that respondents of the lowest class was that of 1ha and above with 6 (4.29%). It implies that in one hand respondent with big land should not degrade the wetland because they can be occupied by agriculture activities but in other hand, it should degrade

Rugezi marshland due to the need of grasses for manure and mulches for their big farms.

The results in Table 1 showed that the majority of married respondents represent 63 (45%) followed by the widower with 30 (21.43 %). The third place was for single respondents with 25 (17.86%) and the last one was for divorced with 22 (15.71%). It implies that an effort for Rugezi marshland protection should more made by married people, widower, single, and divorced respectively. This implies that one married people protect marshland than other classes as indicated by the findings pertaining to marital status in Table 1.

Table 1. Socio-Economic Characteristics of Sampled respondents.

	Frequency	%
Gender		
Male	76	54.29
Female	64	45.71
Total	140	100
Family/household size		
1-3	30	21.44
4-7	69	49.28
8 and above	41	29.28
Total	140	100
Fam size(ha)		
≤ 0.5	78	55.71
0.6-0.8	39	27.86
0.9-1	17	12.14
≥ 1	6	4.29
Total	140	100
Age		
≤ 30	44	31.43
31-40	60	42.86
41-50	21	15
≥ 51	15	10.71
Total	140	100
Education level		
Respondents Without Formal	63	45
Education		
Primary	45	32.14
Secondary school	15	10.71
Vocation	10	7.15
University	7	5
Marital status		
Single	22	15.71
Married	63	45
Divorced	25	17.86
Widower	30	21.43
Experience		
1-10	39	32.86
11-20	55	39.29
21 and above	46	27.85
Total	140	100

Table 2. Main different species of grasses in marshland used by people in study area.

No	English name	Local Name (Kinyarwanda)	Use by local community
1	<i>Papyrus sp</i>	Rufunzo	Handcraft(ceiling,fence,chair, basket), fuel
2	<i>Typha angustifolia</i>	Umuberanya	Hand craft(mat, rope), fodder
3	<i>Cyperus latifolius</i>	Urukangaga	Handcraft(mat),fodder, compost, mulch, fuel
4	<i>Joncus sp</i>	Ubusuna/ubuyundo	Handcraft(mat, rope),fodder, compost
5	<i>Miscanthus Violaceus</i>	Uruguhu	Roof cover, fodder, mulch, stakes, fuel
6	<i>Sphagnum</i>	Ubufumfu	Compost, mulch, fuel
7	<i>Vaccinium Stanley</i>	Inturunyunyu	Fodder, compost
8	<i>Shrubs</i>	Amayayu	Fuel, brooms
9	<i>Cyperus dendatus</i>	Umurago	Fodder, baya salt for cattle
10		Ubwina	Hand craft(mat, rope), fodder

3.2 Factors Influencing Rugezi Marshland Protection in the Study Area

The results indicated that five explanatory variables were positively related to the protection of Rugezi marshland and four variables were negatively related to protection of Rugezi marshland. The R² of 0.6958 implied that 69.58% of variation in the Rugezi marshland protection in the area is explained by the independent variables shown in the table below.

Table 3. Factors influencing Rugezi marshland protection in the study area.

Variables	Coefficient	Standard Errors	P- value
Farm size	0.011	0.013	0.075
Family size	-1.541	0.889	0.053
Age	0.026	0.032	0.067
Educational level	0.036	0.013	0.007
Value of product	-0.054	0.378	0.000
Gender	-1.535	2.343	0.004
Experience in agriculture	-1.968	0.994	0.086
Distance to Rugezi	-0.056	0.304	0.000
Occupation	0.037	6.326	0.000
Off-farm Income	0.044	0.052	0.000
Intercept	1.283	0.271	0.001
Number of obs =140 F(10, 129) = 58.44			
Prob > F=0.0000 R-squared = 0.6958			

The results of the regression model indicated that five factors such as off-farm income, occupation, educational level, age, and farm size, showed a positive relationship with Rugezi marshland protection where three factors namely as off-farm income, occupation, educational level were statistically significant at 1% level. This

implies that a 1% increment in the very good occupations than agriculture should increase the Rugezi marshland protection by 3.7%. While a 1%, increase in off-farm income should increase this marshland protection by 4.4%. For the same study 1 % increase in education level, the Rugezi marshland should be protected by 3.6%.

The study results also revealed that there was a negative and significant relationship between Rugezi marshland protection and four independent variables Value of product, distance to Rugezi marshland, gender, and family size. Three of these four were statistically significant at ($p < 0.01$). For example, the study indicated that 1 % increase in value of products (mat, basket, rope, hat, chair, desk and ceiling) made from the grass of wetland; the degradation should be increase by 5.4% while a 1% in reduction of distance to Rugezi marshland the degradation should be increase by 5.6% by the easy transportation of grasses for handcraft made, fuel, mulches, fodders for livestock feeding, manure composting, fishing of *Clarias liocephalus* (*Haplochromis* for young men and men and hunting of some wild animals and birds if any. Therefore, if the distance to such facilities is large, the likelihood of using Rugezi marshland products for sales may be less.

3.3 Social Economic Impact of Rugezi Marshland Protection in the Study Area

The results indicated that six explanatory variables were positively related to the protection of Rugezi marshland and four variables were negatively related to protection of Rugezi marshland. The R^2 of 0.7145 implied that 71.45% of variation in the Rugezi marshland protection in the area is explained by the independent variables shown in the table below.

Table 4. Social economic impact of Rugezi marshland protection in the study area.

Variables	Coefficient	Standard Errors	P- value
Constant	1.241	0.639	0.000
Medical insurance	-0.036	0.101	0.544
Payment of school fees	-0.042	0.236	0.912
Zero grazing keeping	0.028	0.089	0.000
Modern house construction	0.248	0.108	0.000
Transport facilities	-0.06	0.096	0.018
Buy of electricity	-0.089	0.148	0.065
Cost of land	-0.059	-0.118	0.048
Increase of wild animals and birds	0.081	0.225	0.037
Increase of grass species	0.074	0.391	0.001
Water management	0.039	0.75	0.006
Ntaruka electricity protection	0.045	1.067	0.000
Number of obs =140 F(11, 128)= 47.39			
Prob > F= 0.0000 R-squared = 0.7145			

The results of the regression model indicated that five factors such as water management, increase of grass species, increase of wild animals and birds, modern house construction, zero grazing keeping revealed a positive and economic impact relationship with Rugezi marshland protection while five factors namely cost of land, buy of electricity, transport facilities, payment of school fees, medical insurance were negatively indicated economic impact with Rugezi marshland protection. This implies that a unit increment in Rugezi marshland protection should increase the water management by 3.9 unit in both quality and volume. Whether Rugezi marshland protection is increased by 1%, then 7.4% should increase different species of grasses both in goodness and in life expectancy. This is a socio-economic impact for population through the ecosystem control and oxygen supply for respiration. The results indicated also that an increase in 1% of Rugezi marshland protection, the wild animals and birds should be increased by 8.1%. This suggests that an increase in Rugezi marshland protection should excellently satisfy tourist demand in study area. However, the increase in tourists' satisfaction directly increase income generation improving livelihood of population. The happiness of tourist facilitates Government to create new jobs for both educated and non-educated people. The results also indicated that 1% increase in Rugezi marshland protection should increase Ntaruka hydroelectricity power stability by 4.5%. Globally, the impact whether Rugezi marshland satisfy the electricity power users very good. Therefore, the protection enhance, the supply of electricity from Ntaruka hydroelectricity power and Mukungwa should be stable as long as possible and well distributed across the whole country very good.

4. Conclusions and Recommendations

This study reveals that off-farm income, occupation, educational level, age, and farm size, showed a positive relationship with Rugezi marshland protection. The study indicated that six factors such as water management, increase of grass species, increase of wild animals and birds, modern house construction, zero grazing keeping, Ntaruka hydroelectricity power revealed had positive and economic impact relationship with Rugezi marshland protection. As recommendation with Rugezi marshland protection government and police makers should make tangible effort in education, jobs creation towards the implementation of policies that enhances Rugezi marshland protection. This will biologically and economically help in water management, increase grass species, increase number and lifespan of wild animals and birds that are the main source of tourism demand in study area.

References

- [1] Nwaru, J.C., 2004. Rural Credit Market and Arable Crop Production in Imo State of Nigeria. Unpublished Ph.D Dissertation, Michael Okpara University of Agriculture, Umudike, Nigeria.
- [2] REMA and MINIRENA, 2008. Regreening Thousand Hills in Rwanda's Wetlands towards 2020 vision.
- [3] Kadziya, L., Chikosha, F., 2013. Wetlands and Urban Growth in Bindura, Zimbabwe: Greener Journal of Environmental Management and Public Safety. 2(6), 195-196.
- [4] MINAGRI, 2001. Schéma directeur d'aménagement des marais. De protection des bassins versants et de la conservation des sols. Rapport global définitif. HYDROPLAN ingénieurs Gesellschaft mbH. Kigali. 38.
- [5] McCartney, M.P., Rebelo, L.M., 2010. Senaratna Sellamuttu, S.; de Silva, S. Wetlands, Agriculture and Poverty Reduction Colombo, Sri Lanka: International Water Management Institute (IWMI). 39.
- [6] www.bureradistrict.gov.rw
- [7] MINALOC, 2004. Mission d'étude de conservation et de gestion intégrée du Marais de Rugezi. Rapport provisoire. Helpage-Rwanda, Kigali. 112.
- [8] Rukundo, E., Liu, S., Dong, Y., Rutebuka, E., Asamoah, E.F., Xu, J., Wu, X., 2018. Spatio-temporal dynamics of critical ecosystem services in response to agricultural expansion in Rwanda, East Africa. Ecological Indicators. 89, 696-705.
- [9] Schuyt, K.D., 2005. Economic Consequences of Wetland Degradation for Local Populations in Africa. 1-14.
- [10] Nabahungu, Visser, S., 2013. Farmers 'knowledge and perception of agricultural wetland management in Rwanda. Land Degradation & Development. 24(4), 363-374.
- [11] MINITERE, 2003. Etudes relatives' à la protection intégrée et conservation des ressources naturelles des zones humides critiques du Rwanda. Évaluation de la diversité biologique des zones humides, Experco des Grands Lacs. Kigali. 78.
- [12] USEPA, 2009. What are Wetlands? <http://www.epa.gov/owow/wetlands/vital/what.html> Retrieved August 2014 from U.S EPA.
- [13] Cavendish, W., 2000. Empirical regularities in the poverty environment relationship of rural households: Evidence from Zimbabwe. World Dev. 702-715.
- [14] Chidi, H.O., Erhabor, F.O., 2009. Biodiversity of wetlands and wealth creation in Niger Delta. International Journal of Development Studies. 4(3), 108 - 115.
- [15] Uluocha, N.O., 2004. Implication of wetlands degradation for water resources management, Lessons from Nigeria. Geojournal. 61, 151-154.
- [16] Hategekimana, S., 2005. La dégradation actuelle du Marais de Rugezi: une catastrophe écologique. Mémoire de Licence, Université Nationale du Rwanda. 115.
- [17] Adger, W.N., Luttrell, C., 2000. Property rights and the utilization of wetlands. Ecological Economics Agrawal. 35, 75-89.
- [18] Nwaru, J.C., 2004. Rural Credit Market and Arable Crop Production in Imo State of Nigeria. Unpublished Ph.D Dissertation, Michael Okpara University of Agriculture, Umudike, Nigeria.
- [19] NISR, 2007. EICV Poverty Analysis for Rwanda's Economic Development and Poverty Reduction Strategy. Final Report. National Institute of Statistics of Rwanda (NISR), Kigali.
- [20] Hollis, G.E., 1990. Environmental impacts of development on wetlands in arid and semi - aridlands. Hydrological Sciences Journal. 35, 411-28.
- [21] Botlhoko, G.J., Oladele, O.I., 2017. Factors Affecting Farmers Participation in Agricultural Projects in Ngaka Modiri Molema District North West Province, South Africa. Journal of Human Ecology. 201-206.
- [22] REMA, 2009. Rwanda State of Environment and Outlook Report. Kigali: Rwanda Environment Management Authority. 245.