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Research article

Socio-economic impacts of the exploitation of the marshes of Kayanza province in the Northern Burundi: case of marshes of the average Ruvubu and its tributaries

Gilbert Nijimbere[1]*, Anatoly I. Suprunov[1], Gaspard Banyankimbona[2]

[1]Kuban State Agrarian University, *Krasnodar, Russian Federation*

[2]University of Burundi, *Bujumbura, Burundi*

Corresponding author: gilbert.nijimbere@ub.edu.bi

Abstract. The wetlands whose marshes are currently under pressure from the growing population require a consequent increase in production. The marshes are now agricultural reserves coveted because, firstly, the scarcity of arable land, of the other problems of erosion and soil fertility decline affecting land in hills uphill. The mostly poor people resort to these marginal lands, to the suppression of fallows and to afforestation. This results in overexploitation that accelerates the degradation of soil and biological and abiotic resources. However, farmers do not have the knowledge and technologies to enable them to sustainably manage wetlands. The results of this study show that the population of our study area is largely dependent on marshes for drinking and irrigation water supply, building and basketry materials, and plant species to feed the farm animals. The majority of farmers have a portion of land in the marshes. The main crops are currently leguminous and tuberous plants with rice and beans which are successively the most productive crops. The majority exploit the marshes in both dry and rain seasons. The marshes provide 78% of the farmers with an average income between 0 and $ 30 per plot/season. The income is very low given the needs of farmers. These activities have resulted in the disappearance of the original fauna and vegetation of these marshes more than 13 years ago. The results of the study led us to conclude that these marshes were dominated by *Cyperus papyrus*. The draining of marshes has led to the drying up of springs, the loss of many animal and plant species.

Key words: impact, exploitation, marsh, vegetation, fauna, plants, income, Burundi, Kayanza

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Introduction

Marshes are one of the variants of wetlands. Around the world, rural development specialists have long considered wetlands as sterile and unhealthy environments, disease epidemics and a haven for mosquitoes. With the evolution of technology, many efforts have been made to develop and dedicate the space they occupy to use supposed "more productive", such as irrigated agriculture. Some have even been totally dried out [1]. In the last decade, about 60% of wetlands have been destroyed in the world, mainly because of drainage (for agriculture), pollution and dams [2]. One of the reasons for the alarming disappearance of wetlands is that they are multifunctional (biodiversity reserve, recreational activities, carbon storage) and have a certain economic interest for different activities (fish farming, agriculture, mining materials). People always need water, whether for consumption, for cooking or for any type of domestic or industrial use. To obtain water, many rural communities without access to surface water use groundwater [3].

Apart from marshes, other wetlands encountered in Burundi are the lakes, rivers and bogs from the definition adopted by 98 countries of the Ramsar Convention. According to the Water Act of 1992 of the same Convention, wetlands which include the marshes are developed land or not, usually flooded or waterlogged fresh, salt or brackish permanently or temporarily. The vegetation, when it exists, is dominated by hygrophilous plants for at least part of the year. In Burundi, the word 'marsh' is used in a rather particular sense. Commonly, the term 'marsh' refers to wet valley bottoms excluding dry shallows, the shade being sometimes held. Beyond their common feature, physical marshes stand out in various ways: the point of view of soil texture (peat, clay or sandy areas) and natural vegetation (papyrus, reeds, grasses) and their geographical location (altitude) and groundwater level [4].

Article 2 of Burundian law on the marshes stipulates that they are usually inundated depression in land or waterlogged, either permanently or temporarily. When dry, marshes are distinguished from dry marshes by the existence, on all or part of their surface, of a network of natural or artificial emissaries [4]. A marsh is defined as the lower part of a hill or valley; it is flat or concave with a slope and composed of either alluvial soils, or organic soils or peat depending on the water conditions and/or its altitude [5].

That it is laid out and therefore does not have stagnant water in the rainy season, whether it is sterile as a result of a poor exploitation of peat or clay or that it is a floating peat, a marsh keep its meaning. It is the result of a deposit of solids torn off the hill or the valley overlooking low slope. Generally, a shallow bed can be grown in the rainy season with or without surface drainage and in the dry season with irrigation.

A marsh is also defined as a part between two ranges of hills and drained by one or more streams. The water flows at a very low speed or is stagnant on a thin layer with specific vegetation (papyrus) [6]. Their characterization differs according to soil and hydrological conditions [4]. Water flows at very low speed or stagnates on a thin layer with specific vegetation (papyrus) [4]. Their exploitation dates from the year 1920 at the instigation of the Belgian tutelary administration. Previously, the low density on the hill did not encourage people to consider the use of marshes.

For a long time they were used as pasture for cattle, especially during the dry season, when the hills were dry. They are also rich in clay, sand, gravel and rubble that are building materials and peat that is a source of thermal energy. Because of their almost constant moisture, marshes are important tracts of valuable land for various crops, especially during the dry season, when hills are not cultivated without irrigation [7]. Burundian marshes are fragile and made even more vulnerable as their exploitation is increasing. They have a clear diversity in terms of their shape and size, as well as their vocations and their agro-ecological characteristics [4]. Nevertheless, their development is not yet the subject of a strategy that responds to imperatives of sustainable development [8].

If for a long time the marshes escaped intensive exploitation for reasons including cultural and climatic reasons, they now constitute highly coveted agricultural reserves because, on the one hand, the scarcity of arable land, on the other hand, erosion problems and declining soil fertility which affect upland stream hills. Marshes also lend themselves to productive uses of less socio-economic importance, such as fish farming in small ponds, the exploitation of clay for the brick and tile industry or the extraction of peat for energy purposes or for the manufacture of fertilizers. In the past, they were only grown during the dry season (flood recession cultivation), using a drainage system dug to maintain the water level, so that the ecosystem was not disturbed.

The recent introduction of rice, however, has upset this system: practiced during the rainy season, it was draining because the rice needs a lot of water during its growing cycle [4]. The concern to meet the needs of the population in constant growth requires a consequent increase in production. As a result, poor people use marginal lands, clearing fallows and forestation. This results in overexploitation that accelerates soil degradation and significantly reduces biological diversity. In addition, the desire to diversify sources of income through the creation of income-generating activities is causing serious damage to the environment. The manufacture of bricks and tiles requires huge amounts of wood to cook. Likewise, this activity exports a lot of superficial marshland leaving only gravel and sand. Gravel and peat mining disturbs riverbeds and predisposes fields to flooding during the rainy season.

The province of Kayanza that was the subject of our study is among the most populous provinces of the country, with a population living mainly from agriculture. With a population of 585 412 inhabitants, or 7.2% of the national population [9], the province of Kayanza occupies an area of 7 510 ha occupied by marshes [8]. These marshes are seasonally cultivated and about 11% of the Burundian marsh fields are in this province [10]. The study aims to show the socio-economic impacts of the exploitation of marshes in Kayanza province in the Northern Burundi.

Materials and methods

In order to collect the data related to this study, an investigation completed by the focus group was used. A total of 126 farmers in two communes (Muhanga and Butaganzwa) were investigated. We have chosen a total of 13 census hills. The choice of these hills was motivated mainly by the fact that they underlie the marshes under study. In addition, the two municipalities are home to more of the marshes of Kayanza province.

The survey questionnaire includes questions about marshes attachment/dependence, marshes evolution; land acquisition method, area, fertilization, productivity, plant species in livestock feed, income and legal framework around the marshes. Of our respondents, 61% are male and 39% are female. The vernacular names provided to us during the survey have been translated into scientific names thanks to the information collected in various works of Nzigidahera (2007, 2008, 2009) on biodiversity in Burundi [11—14]. The data related to the area were acquired through the measurements using GPS. The SPSS software allowed us to process the data collected during this study.

Results and discussion

Information specific to survey on farmers and their attachment/dependence on marshes. The results of the survey show that farmers depend on marshes or rivers for a variety of purposes. Almost all farmers (94.4%) obtain drinking water from marshes (the remaining 5.6% drink tap water), 74.6% rely on irrigation water, 66.7% in building materials and 15.9% in basketry materials, these percentages being calculated for each end. The results of the study show that 92% of our respondents have at least a portion of land in the marshes.

Land acquisition mode. The modes of acquisition of the parcels most used at the level of the marshes subjected to our study are especially the inheritance, sharecropping and the purchase. The first is the most common mode of acquisition since the parcel is appropriated by succession. In the case of the purchase, the transfer of the parcel is done against payment. And as for sharecropping, the sharecropper gives the owner of a plot part of the harvest. The results of this study show that 78.5% of parcels are acquired through inheritance. The purchase is the second mode and allows the acquisition of 19.8% of the plots and 1.7% remaining are acquired through sharecropping.

Land area. Of the 126 people surveyed, 116 people gave the estimated area of one of their plots. The latter coupled with the average area of a plot obtained on the basis of measurements of 60 parcels by GPS enabled us to give the characteristics of the parcels (Table 1).

Table 1

Characteristics of parcels

Characteristics	Estimated area *a*, are	Measured area *b*, are	Difference (*b* – *a*)
Mean	1.65	1.95	0.3
Median	1.3	1.43	0.13
Mode	1.5	1.08	–0.42
Variance	1.36	2.13	0.77
Minimum	0.12	0.15	0.03
Maximum	6.4	7.9	1.5

The results in Table 1 above show that the estimated average area of a plot is 1.65 are. The size of a plot is an important element in the planning of agricultural activities, the results of the survey allowed us to give its distribution shows that 38% of our respondents have plots of area ranging from 0—1 are, 43% 1—2 are and the rest (19%) has more than 2 are. The results show that each farmer has about 2 parcels on average in the marshes. The results of our statistical analysis show that the asymmetry or Knewness coefficient (CA) is 1.4 and the Kurtosis coefficient (CK) is 2.15. These values are different from the theoretical values (CA < |1| and CK < |1.5|). This indicates that the distribution of plot areas does not follow a normal distribution.

Types and importance of swamp crops. The main types of crops include cereals, leguminous and tuberous plants. The importance was evaluated on the basis of 101 responses of our respondents and the results are as follows: 49.1% are leguminous, 47.8% cereals and tuberous plants 3.1%.

Fertilization. Our study shows that only 25.6% of farmers use fertilizer to increase production. According to 53.3% of respondents, these are chemical and the remaining 46.7% are organic fertilizers. Small-scale fertilization is explained by the fact that few farmers allocate little money for any agricultural activity, only 1.7% takes out loans.

Marsh productivity. Marsh productivity has taken into account the importance of crops. Beans are the most productive crop (at 49.2%) followed by rice (42.8%). The other crops come in the following order: potato (5.1%), corn (2.7%), and finally sweet potato (0.3%).

Legal framework for the exploitation of marshes. In Burundi, there is law on marshes. The latter contains information related to sustainable management. Nevertheless, the majority (80%) of farmers interviewed say they have not been aware of it.

Impacts of agricultural activities on the biological resources of marshes. The results of our investigation show that the marshes of our study area lost the original vegetation more than 13 years ago as 30.2% of our respondents testify.

They were dominated by the species *Cyperus papyrus* (43.5%), *Phragmites mauritianus* (17.7%), *Cyperus distans* (16.1%), and remaining species (*Acacia sieberana*, *Polygonum pulchrum*, *Cyperus pseudocladus*, *Cyperus latifolius*) are cited by 22.7% of respondents (Table 2). These results allow conclude that the land was occupied by marshes of *Cyperus papyrus*.

Among animals in the marshes, fish are the best known and have very diverse vernacular names. Among them are the species *Clarias gariepinus*, *Haplochromis sp*. (Table 3). It should be noted that 76.9% of the 126 people interviewed (97) provided us information on marsh biodiversity and regret their decline.

Table 2

Formerly dominant plant species in marsh

Scientific name	Vernacular name	Percentage, %
1. *Acacia sieberana*	Iminyinya	8.1
2. *Cyperus distans*	Intaretare	16.1
3. *Phragmites mauritianus*	Amarenga	17.7
4. *Polygonum pulchrum*	Ibigorogonzo	4.8
5. *Cyperus pseudocladus*	Ibikamo	1.6
6. *Cyperus papyrus*	Urufunzo	43.5
7. *Cyperus latifolius*	Urukangaga	8.1
Total		100.0

Table 3

Summary on marsh fauna

Scientific name	Vernacular name
Cercopithecus aethiops	Inkende
Hippopotamus amphibius	Imvubu
Crocuta crocuta	Imfyisi
Clarias liocephalus	Isomvyi
Haplochromis sp.	Injori
Clarias gariepinus	Imare

Table 4

Marsh plant species involved in livestock feeding

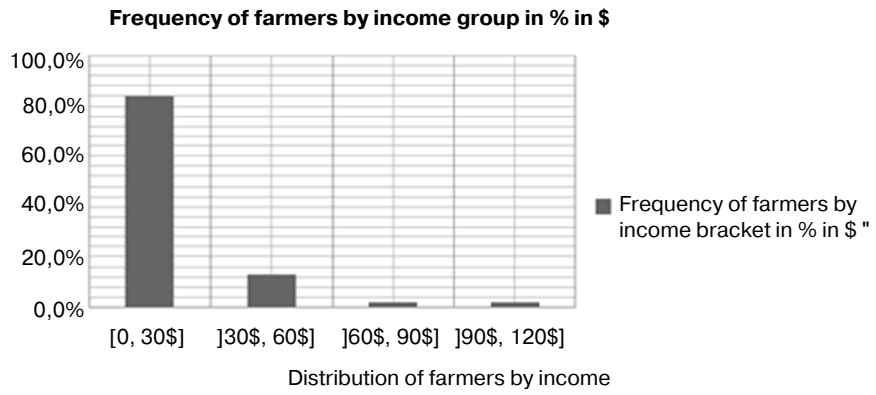
Scientific name	Vernacular name	Number of responses	Percentage, %
1. *Bidens pilosa*	Icanda	6	7.0
2. *Commelina diffusa*	Uruteza	17	19.8
3. *Cyperus latifolius*	Urukangaga	6	7.0
4. *Digitaria vestita*	Urwiri	43	50.0
5. *Cyperus pseudocladus*	Urukamo	2	2.3
6. *Crassocephalum montuosum*	Ibifurifuri	5	5.8
7. *Panicum maximum*	Igikaranka	2	2.3
8. *Bothriocline longipes*	Imibebe	3	3.5
9. *Polygonum pulchrum*	Ibigorogonzo	2	2.3
Total		86	100.0

Plant species of marshes participating in the feeding of livestock. The results of this work reveal that 41.9% of farmers find forage for their livestock in the marshes. Table 4 shows which plant species are the most common fodder.

According to the analysis of the results of this table 4, *Digitaria vestita* (50%) and *Commelina diffusa* (19.8%) are the most recognized species in the marshes and used in cattle feeding followed by *Bidens pilosa* and *Cyperus latifolius* (7% each of these species).

Income from farming activities. The income of marsh farmers in our study area has been calculated on the basis of production from food crops such as rice, beans, maize, potatoes and sweet potatoes. This allowed us to give the distribution of the farmers in different income groups by plot and season of cultivation.

The figure above shows that 78% of farmers have an income / parcel / season in US dollars in the range [$ 0.28, 18% in the interval] $ 30, $ 60] and 4% of [$ 60, $ 120]. The average income is $ 18 while the average income /are is estimated at $ 10.



Conclusions

Although marshes have long been unexploited, they are now under considerable pressure to search for cropland. The growing population in Burundi is a problem in view of the need to ensure the survival of the current population and future generations. The destruction of marshes is a result of agricultural activities that are unsustainable. Few marshes are well maintained, and farmers are not aware of some land laws in general. The areas are very fragmented, and farmers do not have the knowledge and technologies to improve production.

The continuous work of land without fallow depletes the soil with nutrients and is accompanied by a decline in soil fertility. Farmers do not have sufficient resources to modernize the agricultural sector. This results in the lack of quality seeds and fertilizers which lead to poor harvests. The animal and plant species are threatened with extinction as a result of the clearing and drainage of marshes. There is today the risks of losing forever the ecological services offered by marshes, which are mainly water storage, a reservoir of genetics for many animal and plant species. The disappearance of vegetation in the marshes is the cause of drying up of sources of water supply and the death or escape of animals caused by the loss of biotopes. Of all the foregoing, it is urgent to educate marsh users about sustainable marsh management.

References

1. Skinner J, Beaumond N, Pirot JY. *Manuel de formation pour sur la gestion des zones humides tropicales.* Gland, Suisse: UICN; 1994.
2. Djondo M. Note conceptuelle pour la célébration de la journée mondiale des zones humides, Coalition verte, Bénin; 2011. 2 p.
3. DNCN. *Politique nationale des zones humides du Mali.* 2003.
4. Loulidi S, Mekouar MA. *Projet de loi sur les marais au Burundi.* Etudes juridiques de la FAO en ligne; 2001.
5. Sheta T. Schéma directeur d'aménagement et de mise en valeur des marais. Projet PNUD/FAO «Appui à la restauration et à la gestion de l'environnement», Bujumbura; 1999. 87 p.
6. Gahiro L. Compétitivité des filières rizicoles burundaises: le riz de Imbo et le riz des marais [Dissertation]. Gembloux; 2011.
7. MINGRIE: Production et superficie de cultures vivrières au Burundi, Bujumbura; 2010. 122 p.
8. FAO / PNUD, 2004: Plan directeur pour le développement et l'aménagement des marais, 42 p.
9. ISTEEBU. *Rapport sur les projections démographiques 2008—2030.* Bujumbura; 2013.
10. Sidi MT, Yameogo MAE. *Enquête Nationale agricole du Burundi 2011—2012. Saison A.* 2013.
11. Nzigidahera B. *Ressources biologiques sauvages du Burundi: Etat des savoirs traditionnels.* Bujumbura; 2007.
12. Nzigidahera B. *Etude de base pour la réhabilitation de la réserve naturelle de la Rusizi.* Bujumbura; 2008.
13. Nzigidahera B. Plan de gestion et de développement de la réserve naturelle de Malagarazi, Bujumbura, 71; 2009. p. 16—23.
14. Nzigidahera B. Plan de gestion et d'aménagement des paysages aquatiques protégés de Bugesera, 79; 2009. p. 31—37.

About authors:
Nijimbere Gilbert — PhD student, Kuban State Agrarian University, Faculty of Agriculture and Ecology, Department of Genetics and Plant Breeding, 13, Kalinina st., Krasnodar, 350044, Russian Federation, e-mail: gilbert.nijimbere@ub.edu.bi

Suprunov Anatoly Ivanovich — Doctor of Agricultural Sciences, Professor, Department of Selection, Genetics and Seed production, Kuban State Agrarian University, Head of the Department of Selection and Seed Production of Maize, Lukyanenko National Grain Center; 1, Tsentralnaya usadba KNIISKH quarter, Krasnodar, 350012, Russian Federation, e-mail: suprunov-kniisx@mail.ru

Banyankimbona Gaspard — Doctor of Sciences, University of Burundi, Faculty of Sciences, Department of Biology, Bujumbura, 1233, Burundi, e-mail: gaspard.banyankimbona@ub.edu.bi

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Научная статья

Социально-экономические последствия эксплуатации болот реки Рувубу и ее притоков в провинции Каянза на севере Бурунди

Ж. Нижимбере[1]*, А.И. Супрунов[1], Г. Банянкимбона[2]

[1]Кубанский государственный аграрный университет,
Краснодар, Российская Федерация

[2]Университет Бурунди, *Бужумбура, Бурунди*

*gilbert.nijimbere@ub.edu.bi

Аннотация. На водно-болотных угодьях, которые в настоящее время находятся под воздействием возрастающей плотности населения, необходимо последовательно увеличить объемы производства сельскохозяйственной продукции. Болота в настоящее время являются весьма востребованными сельскохозяйственными территориями из-за существующей проблемы нехватки пахотных земель, а также эрозии и снижения плодородия почв, наблюдающихся на возвышенностях. Бедное население вынуждено использовать маргинальные земли, не оставлять земли под паром, вызывая облесение осушенных территорий. Все это создает чрезмерную нагрузку на экосистему и приводит к деградации почв, сокращению биоразнообразия и истощению ресурсов. Местные фермеры не обладают необходимыми знаниями и технологиями, позволяющими им безопасно использовать эти территории. Результаты данного исследования показывают, что население исследованного района в значительной степени зависит от болотных угодий, используя их для получения питьевой и поливной воды, строительных материалов, плетеных изделий и кормовых растений. Большинство фермеров имеют часть земли, расположенной на водно-болотных угодьях. Основные культуры, выращиваемые в настоящее время, — бобовые и клубненосные культуры, а также рис. Большинство фермеров собирают урожай на болотах и в сухой сезон, и в сезон дождей. Болота обеспечивают 78% фермеров средним доходом от 0 до 30 долл. за участок/сезон, что, учитывая потребности местного населения, является очень низким. Результаты исследования привели авторов к выводу, что на этих болотах преобладали растения *Cyperus papyrus*. Осушение болот стало причиной высыхания родников, гибели многих видов животных и растений: более 13 лет назад исчезли первоначальная флора и фауна болот.

Ключевые слова: последствие, эксплуатация, болото, растительность, фауна, урожай, доходы, Бурунди, Каянза

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Об авторах:
Ниджимбере Гилберт — аспирант кафедры генетики и селекции растений, Кубанский государственный аграрный университет, факультет сельского хозяйства и экологии, 350044, Российская Федерация, Краснодар, ул. Калинина, д. 13; e-mail: gilbert.nijimbere@ub.edu.bi

Супрунов Анатолий Иванович — доктор сельскохозяйственных наук, профессор кафедры селекции, генетики и семеноводства, Кубанский государственный аграрный университет, заведующий кафедрой селекции и семеноводства кукурузы, Национальный центр зерна имени П.П. Лукьяненко; Российская Федерация, 350012, Краснодар, квартал Центральная усадьба КНИИСХ, 1, e-mail: suprunov-kniisx@mail.ru

Банянкимбона Гаспард — доктор наук, кафедра биологии, Университет Бурунди, Бужумбура, 1233, Бурунди; e-mail: gaspard.banyankimbona@ub.edu.bi