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Wetlands Exploitation along the Bafoussam – Bamenda Road Axis of the Western Highlands of Cameroon

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ABSTRACT This paper is focused on how wetlands have been exploited for economic and environmental reasons and some resultant environmental consequences. The rapid colonization of these wet areas is the result of an ever rising density of population and continuous cultivation throughout the year. Since water is essential for plant and animal life, it is important to figure out the possibilities of regulating population pressure and wetland utilization since the water table in these wetlands and the surrounding areas within this region falls drastically in the dry season. The study utilized field surveys and measurements, interviews, questionnaires and secondary sources, data was generated and analyzed on the exploitation of these ecological niches. For the short term economic benefits, the exploitation of these areas is good but the environmental and hydrological implications in the long run are likely be disastrous. An alternative landuse for this area has to be adopted in order to maintain sustainably the importance of these wetlands ecosystem. The application of chemical fertilizers should be regulated as they contaminate and eventually pollute water bodies with increasing aspects of poor water quality in the area.

INTRODUCTION

Wetlands are specific ecosystems like bogs, bottomlands, fens, flood plains, mangroves, sloughs, swamps, wet meadows, marshes, moors, peat lands, reed swamps and wet prairies. These have their formation, processes and characteristics controlled by water (Richardson 1994, 1995). Wetlands are havens for some scarce and valuable natural resources (Maltby 1986). They are usually surrounded by uplands; so they have surface water outlet within geographic depressions or transitional zones between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. This determines the nature of soil development and the types of plant and animal communities living in the soil and on its surface (Cowardin 1979). Wetlands are found in every climate from the tropics to the frozen tundra and comprise approximately 6 percent (8.5 $km^2 \times 10^3$) of the world's land surface (Maltby and Turner 1983). Wetlands are usually found in depressions or along rivers, lakes and coastal waters, where they are subjected to periodic flooding (Tiner et al.2002). They can also occur on slopes adjacent to groundwater seeps or can cover an entire landscape, where precipitation levels exceed evapo-transpiration. They can also be formed by blocked drainage and constitute over 90% water by volume (Novitzki 1979).

The value of a wetland is an estimate, usually subjective of the worth, merit, quality or importance of a particular ecosystem (Mays 1996). The term imposes an anthropocentric focus, which connotes something of use or desirable to man. Any activity therefore that significantly impacts the hydrologic function of wetlands may result in loss of the wetland itself or a loss in the ability of the wetland to perform flood control, flood storage, sediment and erosion control as well as water quality and water supply. In spite of the importance of wetlands, world wetlands are deteriorating rapidly being the most threatened ecosystems on earth because of their exploitation for economic, and cultural purposes, thus action to preserve them is necessary. Over 1/3 of wetlands in the Bafoussam-Bamenda axis of the Western Highland of Cameroon have been transformed. Agriculture is the leading cause of wetland transformation in this area. Short-term gains of intensive agriculture may lead to the permanent destruction of wetland environments and their resources.

A vast majority of wetland benefits accrue to the local population which makes it important to conserve these valuable natural resources. Today, their exploitation particularly for economic purpose is alarming. The Bafoussam – Bamenda road axis, the focus of this study is part of the Western highlands of Cameroon. Here, these

ecological niches have been drained for vegetable cultivation. These valuable areas are not only exploited for market gardening involved in the cultivation of vegetables, carrots, tomatoes, green beans, Irish potatoes but also for the planting of eucalyptus which help to drain the water in these wetlands. Vegetable and eucalyptus cultivation are expanding at the expense of the existing swampy raffia palm vegetation. The drainage and conversion of gallery swamp forests here is threatening the future existence of *Raphia* palms. A project in the Western Region sponsored by the Government of Cameroon through the Ministry of Agriculture and the French Co-operation enable people drain wetlands and use them for market gardening as a means of reducing land pressure and as a means of fighting poverty is on. The manner of exploitation of these wetlands is not only affecting the biodiversity of those areas, but also the ability of these wetlands to supply and store water for streams and rivers that flow in this area. On the whole a drier climate resulting from global warming is likely to lead to the shrinkage and loss of wetland habitats, as well as increase habitat fragmentation. It is therefore important to protect these wetlands. To protect them, we must know what kinds of wetlands they are, where they are, and the extent and magnitude of their exploitation, that is, their current utilization status and the trends and their biogeographic and ecological characteristics.

METHODOLOGY

To collect data for this paper, the first step was a reconnaissance survey of the study area to map out the wetlands (Fig. 1) and the deter-

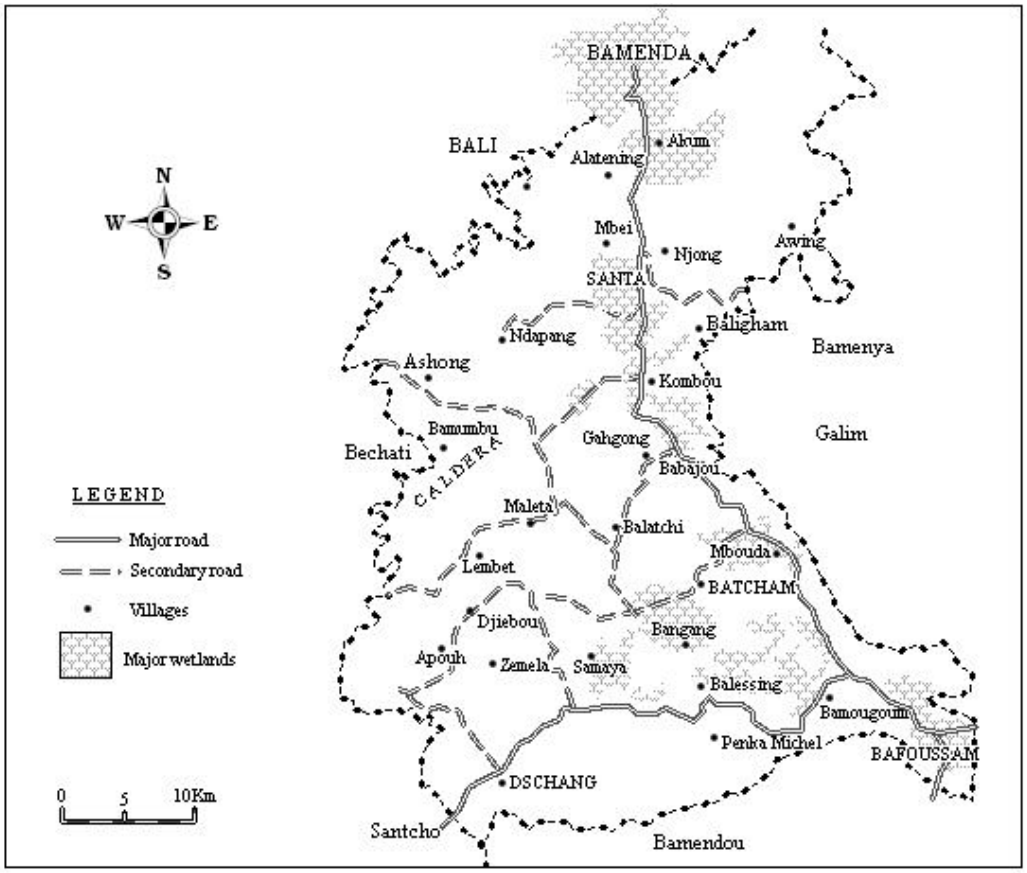

Fig. 1. The study area with some mapped wetlands

mination of the type and number of questionnaires and interviews to be administered. The wetlands were classified as those wholly covered by eucalyptus and market gardens - those partially used for market gardening and those not totally exploited. This enabled an estimate of the level of biodiversity loss. In these wetlands, many economic trees such as *raphia* existed. These plants were used for economic, social and cultural purposes. These have almost been destroyed as well as the areas used for market gardening. Based on estimates made from aerial photographs and satellite images of the area, 16.1km² of wetlands were used for market gardening before 1985 and by 2005, it rose to 48.3 km² and 50.1 km² in 2010. On the other hand, the area used for coffee production dropped from 20. 1km² before 1985 to 8. 0 km² in 2005 and by 2010 it further dropped to 7.8 km².

Since this paper is aimed at establishing the economics of wetlands and their environmental consequences, a survey of vegetable and food items marketed along this axis was conducted. A total of 76 questionnaires were administered randomly to those farmers involved in the exploitation of these wetlands. This was to get the types of crops cultivated per locality (Table 1), number of ridges, how much is generated in terms of income per ridge, how many times per year a piece of land cultivated and evolution in terms of crop production and market price

From the 76 questionnaires administered, 50 of the respondents used fertilizers to boost their production. Interviews were also conducted with some staff of the Delegations of Agriculture for the West and North West Regions; Cooperative Union of Arabica Coffee Producer of the West (UCCAO) and the Investment Fund for Agricultural and Community Micro Projects (FIMAC) in Bamenda, to get information on the number of persons involved in the exploitation of these wetlands and their perception of wetland ecology.

From the data collected on income returns from farmers occupying these wetlands, it was

Table 1: Seasonal crop productivity within the locality of study for 2000. 2005 and 2009

Locality	*Population sampled*	*Crop type sample*		*Estimated quantity produced per season*		
		Crop	*Unit measure*	*2000*	*2005*	*2009*
Akum	8	Huckleberry	10kg/heaps	2500	2000	3006
		Parsley	30 large bags	589	410	401
		Celery	5kg bunches	298	350	300
Santa	15	Potatoes		950	600	405
		Carrots		413	560	610
		Green cabbage	100kg bags	70	78	60
		Red cabbage		378	210	164
		Green beans		25	40	31
Kombou	19	Potatoes		750	900	950
		Carrots		540	670	650
		Green cabbage	100kg bags	89	86	81
		Red cabbage		298	301	300
		Green beans		30	20	37
		Tomatoes	Baskets (25kg)Q	100	370	480
		Leeks	Packets (10kg)	460	310	340
		Beet roots	Bags (100kg)	15	35	30
Mbouda	12	Carrots		243	263	269
		Green cabbage	100kg bags	45	53	49
		Red cabbage		175	161	186
		Leeks	Packets (10kg)	278	207	201
Bafoussam	10	Carrots		163	166	152
		Green cabbage		35	50	43
		Red cabbage	100kg bags	100	186	166
		Green beans		26	23	32
Babadjou	6	Green cabbage	Bags (100kg)	60	68	54
		Leeks	Packets (10kg)	560	430	574
Bafou	6	Red cabbage	Bags (100kg)	390	250	247
		Tomatoes	Baskets (25kg)	80	310	498
Total	76					

Source: Field work 2010

realized that crop cycles go to about 3 times a year for some crops and a lot of income is generated as shown on Table 2. Data and information on stream discharge was collected from the Bafoussam water scheme and the Santa water project. This gave the study an idea of streams volume and flow.

WETLAND EXPLOITATION AND DEGRADATION

Wetlands are the only ecosystems to have their own international convention designed to protect them from further destruction. The convention on wetlands calls on all signatories to conserve wetlands, promote their sound utilization, and set aside special areas as wildlife reserves. Unfortunately, many of the contracting parties to the Convention have done little to conserve wetlands other than declare one or two sites as conservation zones.

Since the 1980s, there has been a decline in coffee, cocoa and oil output. By 1993, per capita income in Cameroon declined by 50% among lower income producers of export crops such as coffee and cocoa. Rural poverty spread rapidly with the decline in output of cash crops and a rapid increase in population, there was pressure on land. Farmers then reacted by substituting export crop (coffee) production with market gardening and food crop production along water courses and wetlands. Arabica Coffee which was the main economic crop in this area was cut down following the low prices offered for the crop in the world market. The quantity of coffee produced dropped severely. Hence, when the economic crisis struck in 1986, where there was a 50% cut in the salary of civil servants in Cameroon and a withdrawal of subsidies for the producers by the government. The response of the population to the coffee crisis was varied. Some farmers cut down the plants while others abandoned the crop completely and adopted market gardening for the urban markets and the cultivation of eucalyptus trees. Some however remained in the activity and others embarked on *raphia* palm exploitation.

From the economic perspective, the income derived from market gardening ranged from about $140 US Dollars (70000 FCFA) for the very small scale farmers. However, prosperous farmers who cultivated a number of vegetables got about $600 to $700 US Dollars (about 300000 to 350000 FCFA) a month. During the 1980s also, there was a Cameroon government policy to improve on rural electrification. With this, there was need for electricity poles. The most frequently used trees for electric poles in Cameroon were eucalyptus. These trees were cultivated on hill slopes and hill tops. With the high demand for these trees and the rapid economic returns ($30 to $50 US Dollars (15000 to 25000 FCFA) per tree, the farmers moved to the valleys and wetlands for their rapid cultivation due to the presence of water. Wetlands were then cleared for these two purposes. These transformations were done without consideration of the hydrological and biodiversity consequences on these ecosystems.

Table 2: Revenue generated per ridge in some of the wetlands sampled between 2005-2010

Sampled crop	*Unit measure*	*Average output*		*Income per ridge (FCFA)*
		Yield/Ridge	*Crop cycles (year)*	
Carrot	100kg bag	1.5	3	15,000
Tomatoes	30 basket (25kg)	3	2	22,500
Leeks	5kg bundle	100	2	20,000
Irish potatoes	100kg bag	1	3	18,000
Beet roots	100kg bag	2	1	30,000
Cabbage green	100kg bag	5	2	20,000
red	100kg bag	3	2	24,000
Galics	15 large buckets	3	1	45,000
Huckleberry 2kg heaps	150	2		30,000 after 3 harvest
Parsley	30kg plastic bags	2	3	10,000
Celery	3kg bundles	130	3	10,000

Source: Computed Analysis of Crop Productivity

Along the Bamenda-Bafoussam road axis as well as other areas in the Western Highlands, wetlands constitute the natural habitat for the *Raphia* palm, that is, *Raphia vinifera* which occurred at between 1200m and 2000m of altitude and the *Raphia farinifera* which grow at an altitude of around 800m to 1000m. Where these plants exist, water is always available. To thrive too, these *raphia* palms need water and light. *Raphia* palms are valued for their wine, bamboos and other resources which the population exploits to supplement their cash income. The plant has therefore existed for long in this area following its commercial and hydrological role. Today, it poses a problem for farmers wishing to exploit these valleys for food and cash crops. These problems are however not new as the Cooperative Union of Arabica Coffee Producers of the West (UCCAO) in the past had as priority under the Western Highland Project to drain and manage these wetlands and valleys for the production of vegetables for the market and home consumption. Within Kombou, Sanata, Bafoussam and Mbouda localities, there is unsustainable utilization of these wetlands, massive harvesting of vital organs for various uses and draining of these riparian flood plains for agricultural activities. Hence, the major environmental hazard and threat to these wetlands and the survival of natural *raphia* palm bushes is the unsustainable utilization, harvesting of vital plant organs for various uses and the drainage of these riparian flood plains for food crop cultivation and market gardening.

Therefore, the high demographic density in the Western Highland (115.16 habitants per km²) and the increased market orientation of farming are rapidly transforming *raphia* ecological niches to farms and gardens, notwithstanding the economic potential of the plants (Dongmo 1986). Since the 1980s, these wetlands have been systematically drained in the Bamilike plateau within the framework of an integrated development programme sponsored by the Ministry of Agriculture of Cameroon and the French Cooperation Agency. This project is geared at alleviating poverty among the rural poor as well as relieving the already intense land pressure through the drainage of wetlands for farming.

WETLAND SUSTAINABILITY

This area falls within the three administrative divisions of Mezam, Bamboutos and Mifi of the North West and West Regions. This region has a high population density of 254.73/ km² for Mezam, 264.24/ km² for Bamboutos and 703.09 km² for Mifi for a population of 524127, 292410 and 301456 respectively. The surface area for these three divisions is 1745, 1173 and 1402 respectively (Third General Population and Housing Census of Cameroon 2005). With this high population density, the government of Cameroon, through the Ministry of agriculture thought that by encouraging this programme, the issue of the land problem will be addressed since a great proportion of this population depends on agriculture for their livelihood. With a shift in export crop production, more than 10% of the farmers are involved in market gardening within these wetlands. From data calculated from field work, it was estimated that about 20.1 km² of land was exploited for coffee production in 1985. By 2005, the area had reduced to 8.0 km². On the other hand, 16.1 km² of land was exploited for market gardening in 1985. By 2005, the situation had changed as more land was exploited for market gardening (48.3 km²). With the already high population density of the area, wetlands and river valleys were the only available land for their activities.

Within the study area, wetlands of varying sizes were mapped out. Many of these wetlands were occupied by *raffia* raphia bushes in the past. In some parts of the Western Highlands particularly in the West Region, more than 300 persons were given these areas for vegetable and other cash crop farming (Dongmo 1984). In the Santa-Bamenda area also, about 20% of these wetlands and valleys are colonized by eucalyptus plantations. In some urban areas notably Bamenda, Mbouda and Bafoussam, they are highly exploited for the construction of settlement, market gardening and waste dumping (Mbouda). In this light, these wetlands represent a considerable pull area within which these populations carry out their income generating activity. These areas are generally flooded during the rainy season forcing their occupants to higher elevations. In the dry season, they come back. Out of a total of 76 farmers sampled who are involved in the cultivation and sale of fresh vegetables and other food items, 50 of them apply toxic pesticides and fertilizers for the cultivation of crops in these wetlands. Some of these farmers apply herbicides and toxic pesticides for pest control. Some of these herbicides like *gamaline, amarda* and *gramazone* used for weed and herb destruction are very poisonous. Chemi-

cal fertilizers such as ammonium sulphate are used to improve on crop yields and accelerate growth when their applications are respected.

The application of pesticides reduces damage caused to crops by cut worms, mice, nematodes and caterpillars. This is a short term strategy to the problem of food self –sufficiency as predicated by Esther Boserup's (1965) in situation of population pressure on land. Unrestricted application of these pesticides has shown its impact on the seasonal decline of some crop yield like potatoes, cabbage and carrots. However, due to the rapid and high income generated by these vegetables, their applications are not usually respected contaminating the soil as well as the water bodies that flow out of this area. Sustainable agriculture has three essential long-term goals which range from productive and profitable farming, the conservation of natural resources and the protection of the environment, to ensuring the precarious food situation and quality (Smith 1989).

Eucalyptus planted here was not only sold directly for cash (income) but it was also used to protect the market gardens from stray animals and as a source of fuel wood for domestic purposes. It is the principal forest cover on the land and was introduced in this area in 1945 (Tchamgwe 2000). Generally, eucalyptus trees (Globulus) have an adverse effect on soil water content and plant growth. Eucalyptus transpires more than 1000 cubic mm of water per year (Tchawa 1991). It also destabilizes the soil structure and absorbs a lot of atmospheric nitrogen, which is detrimental to plants. Laboratory analyses show that most of the vegetables grown here need much water before maturity (Hugues et al. 1998). This drains much water needed for farming in the dry season (Table 3).

Table 3: Some vegetables cultivated, their water needs at critical sensitive stages and duration of maturity

Cash crop produce	*Average water needs (mm)*	*Maturity, duration (days)*
Carrot (daucus carrota)	400, Tuber formation	60 -110
Irish potatoes (solanum tuberosum)	500, All stages	60 -65
Leeks (allium porum)	500, All stages	90 -120
Cabbage (brassica oleracea)	300, Bulb formation	55 150
Lettuce	450, heading	40-100

Source: Adapted from Ojuku 2005

Consequently, in the dry season, these farmers colonise these wetlands destabilizing the hydrological cycle of this region as a whole. With this high rate of water consumption, their roles (wetlands) as sponges are greatly affected. There are now threats on water supply in this region. Many streams have reduced in volume; so rural pipe-borne water supply is low and in some areas they are contaminated. Statistics from the Bafoussam water scheme shows that the volume of water collected at the scheme has reduced. That is why all human exploitation of wetland above this scheme has been prohibited. The researchers can therefore summarize the consequences on the environment on simple flow diagram as shown in Figure 2.

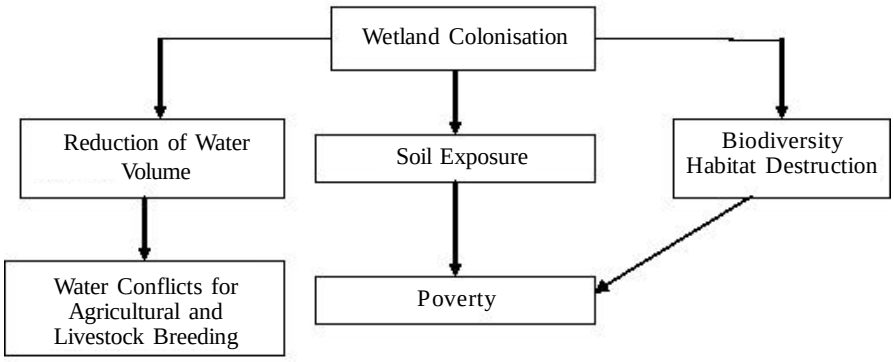

Fig. 2. Implications of wetland colonization on the environment
Source: Kometa, 2011

About 80% of the cultivators experience dry season water scarcity. To adapt to this problem of water scarcity,

As to what solution or adaptation they put in place to resolve the problem of water scarcity, they indicated that quite apart from depending on normal or sporadic rainfall, and moisture from the soil, they also introduce strategies like the use of canals and embankments which channel scarce water from nearby streams to the cultivated areas. Wetlands are used for food production in many parts of this region. In the Ndop plain, rice is grown in the rich fertile flood plains. Careful management would therefore ensure sustainable wetland use in order to receive long term social and economic benefits from them. Many communities are directly dependent on wetland ecosystem for food, medicine, fibre, fuelwood and timber. There is therefore a widespread public constituency to support wetland conservation and management.

Wetlands are the major source of streams in these highland areas and their degradation is affecting the regular flow of streams. Most of the birds in the grassland areas depend on these wetlands to nest, feed, rest and raise their young. Some of these birds are disappearing and this can also be attributed to the destruction of these wetlands. The increasing seasonality of stream flow in this part of Cameroon could equally be attributed to the encroachment of human activities on the wetlands (Lambi 2001). The degradation of wetlands has, therefore, undermined their role as water sponges in absorbing excess water and consequently reducing the risk of flooding during periods of excess rainfall and releasing water during periods of dryness and consequently reducing the severity of drought. A degraded wetland ecosystems normally suffer from biological stress. A stressed ecosystem exhibits reduced resistance and resilience to climate change. The restoration of degraded wetlands will therefore enhance resistance and resilience to future change.

CONCLUSION

From the above analysis, it can be concluded that farmers make an average of about $500 US Dollars (250000 FCFA) from market gardening each month for those involved in the cultivation of vegetables. Economically, it is good for the farmer. However, when we compare the hydrological consequences based on the water needs of these vegetables, it is clear that with the present use of these wetlands, the hydrological situation of this region will continue to deteriorate. In their natural state, these wetlands regulate stream flow and precipitation. Equally, they contain some valuable plants and animal species which are used or needed particularly for medicinal purposes. In their natural state, they can serve the population for a long time. But with their present economic uses, they may last only for a few centuries if a sustainable exploitation scheme is not put into place.

Attitudes are slowly changing and wetlands are increasingly valued. Within this area, there is over exploitation of these wetlands which goes contrary to the Ramsar Convention which calls for the protection of these ecosystems The Government of Cameroon should get involved in the protection of the wetlands. The government should acquire these wetlands for parks, sanctuaries and reserves. Wetlands can also be protected by regional regulations and municipal zoning and through compensation, tax concessions and other incentives to farmers and other property owners. To ease the pressure to drain and develop wetlands, we must promote the wiser use of land for agriculture and other purposes.

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