Agricultural Techniques and Impacts on Biodiversity

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Abstract

This study aims to objectify the impact of the use of traditional agricultural techniques on biodiversity, in particular on the disappearance of plant and animal species. The data presented here come from a socio-environmental survey conducted in the central Moungo region in 2013-2014 and whose data collection was done through questionnaires, field observations and semi-structured interviews. The analysis of maps of the region at different periods (2001, 2007, and 2013) in order to understand the evolution of the vegetation cover completed our methodology. From the analysis of the data, it appears that the agricultural techniques used (slash-and-burn agriculture, plowing, regular polyculture, excessive use of pesticides) by farmers in Mélong have an impact on biodiversity in that they contribute to the decline of vegetation, soil depletion and the disappearance of certain plant and animal species. In conclusion, we believe that farmers should take their environment into account when developing their farming techniques, and thus practice sustainable agriculture.

Keywords: Agriculture, Biodiversity, Impact

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Introduction

Many countries have agriculture as their base of development. It is the dominant sector of the economy in developing countries. According to the World Bank report (2007), it employs 1.3 billion small farmers and constitutes the main means of subsistence for 86% of rural populations around the world. In addition, it generates on average 30 to 35% of the GDP, thus constituting the main source of income and employment for more than 60% of the active population. However, for several years now, this type of agriculture has been unable to meet the world population's demand for foodstuffs, in particular because of unprecedented demographic growth, the withdrawal of certain States from the agricultural sector. Cameroon is not on the sidelines of this deal and to breathe new life into its agriculture, the country has embarked on a vast program of agricultural revolution which involves the adoption of new farming techniques. But in recent years, the scientific community has drawn attention to the degradation of natural resources due to urbanization, industrialization, and inappropriate agricultural practices. Anthropogenic factors seem decisive in the erosion of biodiversity. According to Leveque (1997), they translate the way in which society “uses and abuses” the environment and the biodiversity that serves it as food resources, living resources for domestic and industrial use and traditional pharmacopoeias. Man struggles to find the right balance between satisfying his needs and preserving the bases of production. Beyond the use of nature by human societies, the erosion of biodiversity attributable to humans is largely caused by the destruction and transformation of habitats and natural environments: (i) deforestation or logging, agricultural clearing and deforestation, particularly in tropical regions; (ii) conversion of forest areas into agricultural, agro-industrial and pastoral areas; (iii) degradation of biotopes and natural environments (drying up of waterways, marshes and wetlands, various types of

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pollution, eutrophication); (iv) intensification of agriculture and soil pollution; urbanization and extension of built-up areas (Chapman, 1992). In Cameroon, the objective of achieving food self-sufficiency resulted in the launch in 1973 of the "green revolution" operation materialized by the creation of agro-industrial companies such as semry, sodecoton, socapalm, sodenkam. However, Cameroon experienced a crisis which reached its climax in 1987 with the entry of the country into a severe economic recession. The Cameroonian countryside is being reconverted with the adoption of food crops (tubers, fruits, vegetables, edible leaves, cereals, legumes, etc.) (Carney, 2011; Murtaza et al., 2021). All in all, agriculture, which is considered the pillar of the Cameroonian economy, is becoming the prerogative of many citizens, both rural and urban (McCann, 1995). All invest in it with various and varied practices and techniques without the necessary consideration of environmental issues. Engaged in the battle for survival, the protection of biodiversity is not the major concern of these farmers. The locality of Mélong which is one of the agricultural granaries of the country, has experienced it. Indeed, by abandoning traditional cash crops (coffee and cocoa) in favor of food crops, do the farmers of Mélong, through the agricultural techniques used, realize the threat they pose to the environment and to the the present case on biodiversity? This study is carried out with the aim of linking agricultural techniques and the degradation of biodiversity in the district of Mélong, in order to contribute to the good management of natural resources in Cameroon through the sustainable development of space. This contribution would like to allow the local authorities of Mélong to identify agricultural techniques that destroy biodiversity and to consider corrective measures for this degradation in order to combine agriculture and ecology for the benefit of the entire population.

Methods

This study takes place in Mélong, which is one of the eleven districts of the department of Moungo, in the Littoral region. Mélong has an area of 400km² and stretches in length between 5°10' and 5°28' North and between 9°45' and 10°7' East. It is bounded to the north by the departments of Menoua and Haut-Nkam, to the east by the department of Nkam, to the south by the district of Baré-Bakem and to the west by the department of Koupé-Manengouba.

Originating in Mount Manengouba, several rivers cross Mélong and flow into the Nkam. On the human level, the district of Mélong is made up of two cantons: the canton Elong made up of nine villages and the canton Mbo made up of twenty-nine villages. In addition, its total population is estimated at 59,378 inhabitants, i.e. approximately 28,970 men and 30,408 women (according to the results of the 3rd general population and housing census of November 2005). The main economic activities are agriculture, livestock and trade. It is an essentially agricultural locality and the peasants constitute more than half of the total population. The data presented here comes from a survey conducted in the locality from July 2013 to February 2014. The district of Mélong being made up of two cantons (the canton Elong with 9 villages and the canton Mbo with 29 villages), the choice of our spatial units and of the peasants was done by sampling, and precisely by a three-stage stratified survey. Initially, we selected villages in which agricultural activity occupies almost all of the inhabitants. Then, based on the discriminating criterion that the farm should cover at least 2 ha, we selected three villages grouping 2992 farmers, namely Mbouassoum (549), Mbouroukou (788) and Nkongsoung (1665). It is ultimately within these three villages that, based on a sampling rate of 10%, we selected 300 farmers to constitute our survey sample, i.e. 55 in Mbouassoum, 80 in Mbouroukou, and 165 in Nkongsoung. The 300 farmers selected were selected by systematic random probability sampling. Two types of surveys were conducted: one of a socio-demographic nature to capture the individual characteristics of the farmers, and the other of an

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environmental nature which aimed to identify agricultural techniques and assess the state of the environment, in particular the plant cover and its content. These surveys were carried out using standardized questionnaires administered to selected farmers, and through an observation grid composed of items such as the density of plant cover, plant species, animal species, etc (Cook & Wheater, 2005). Semi-structured interviews with some city authorities, with heads of CIGs and NGOs and the reading of available documents on the subject completed our fieldwork.

Results and Discussion

Cultivation Techniques and Practices

A permanent production system: The agricultural calendar in Mélong shows a very tight production rhythm. The soils are used continuously throughout the year. The production system can be summed up in 3 main operations: field preparation and sowing, crop maintenance during growth and harvesting (Sokhansanj et al., 2009). Field preparation consists of clearing new plots or simply rearranging the land by forming new ridges on the furrows of the previous campaign (Kangalawe et al., 2008). The maintenance of crops, also called weeding, is done during their period of growth or development and consists of removing weeds likely to shade cultivated species or absorb the nutrients that plants need to grow. Harvesting consists of recovering products that have reached maturity and are likely to be consumed or marketed.

Various Farming Techniques and Practices

Preparing the soil before sowing requires the use of local techniques which boil down to land clearing, bush fires and the use of herbicides. During the dry season, clearing is done using machetes and/or bush fires. In the first case, the uprooted grass is then placed along the old furrows or accumulated in heaps on which a clod of earth from the demolition of old ridges is placed. After the drying, we pass to burning by clearing (act of clearing) or by burning (special form of clearing where the clods of earth and vegetation are turned over and burned to prepare for cultivation). In the second case, that of bush fires, the areas to be cultivated are simply set on fire to burn grass and shrubs and leave the soil bare ready for cultivation. It is a quick and inexpensive process. During the rainy season, when burning and fires become less obvious, farmers use herbicides as a weed control method. Later, the earth is turned over, enclosing the grasses under it. Before and after sowing, the ridges are treated with chemical and organic fertilizers. Aware of the fact that the soils have become depleted over time, farmers use all kinds of fertilizers. Then comes the phytosanitary stage which consists of spreading the pesticides on the crops.

Clearing and Felling of Trees

Clearing is done after choosing the plot to cultivate, which is either old fallow or primary or secondary forest. First, cut grasses and shrubs to ground level. Then, we gather the cut herbs with a pitchfork. The felling of trees is one of the most exhausting stages, the peasant uses the ax or the motor saw to cut down medium-sized trees in order to aerate the field. In some cases, chainsaws are used to fell large trees. Once the trees have been felled, the trunks and branches are cut into easily transportable pieces. Then the field is left to dry for at least a week.

Bush and forest fires are among the techniques used especially in the dry season. Indeed, three to four weeks after the felling of the trees, the farmer sets fire to the branches and tree trunks when they are dry. Generally, when the clearing and the felling of trees have gone well, the field burns well so that only pieces of tree trunks remain, in which case, days of systematic

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cleaning of the field are organized which consists of clearing the earth of the remains of branches. After this phase, the farmer cleans the ground and rids it of tree trunks that have resisted the fire by placing them at the edge of the field. Thus, the land is bare, ready to receive the seedlings. However, when the field is left to rest because it no longer produces, it will no longer be cleared, but simply burned by fire (Photo 1). These clearing fires and cultural fires are used to clear pieces of forest, gallery forests and fallow land and establish or expand crops.

The Use of Herbicides and No Tillage

In the rainy season, with burning and bush fires becoming less evident, some farmers use herbicides as a weed control method; which makes it easier for the farmer who saves the physical strength of manual weeding (Photo 2). These herbicides are available in fungicides and in insecticides and nematicides. This simplification of tillage operations continues, in particular with the elimination of plowing. The no-till farming technique consists of not turning the soil using a hoe. It is therefore opposed to conventional plowing (turning the soil up to 20 or 30 cm deep). Here, plowing is reduced in the sense that tillage is superficial with direct seeding under plant cover.

Plowing and Sowing

Plowing is done only for certain plants while sowing is practiced for all plants. Plowing is done with a hoe and a pickaxe. For food crops such as maize, farmers scrape the soil to form ridges or mounds about 8 cm thick. It is usually the hoe that is used in this kind of work . In some areas with the presence of weeds here called sissongo or eupathlorium, we use the pickaxe to clear them. The mounds are arranged in no precise order and on these mounds, we proceed to sowing on the fly by pockets or by ordered dissemination. In the case of banana-plantain trees, we proceed by hole-making (digging holes 10 to 15cm deep into which the offshoots are introduced).

In the dry season, the cleared grasses are piled up horizontally and vertically on the plot to be ploughed, burned and are covered at the top by a few clods of earth: this is burning. On the other hand, ridging consists in bringing the earth towards the foot of the plant and thus forming a small mound 10 to 15 centimeters high all around. To mound the earth, we use the hoe. Mound cultivation is therefore a method of cultivation in which the plants are planted in raised strips of land: the rooting of the plants is therefore deep. Ridging is a method of preparing fields for ploughing. The cleared grasses are piled up parallel and then covered with soil using the hoe to serve as organic manures. The result is a landscape resembling corrugated iron (Dongmo, 1981), because the ridges are the protruding parts and the furrows the hollow parts (photo 3). Their orientation depends on the steepness of the slope: on slopes of less than 8%, the ridges are made parallel to the level curves, while on moderately steep or steep slopes, the ridges are arranged obliquely at slope.

Intensive Polyculture

The polycultural system is practiced in Mélong and consists of sowing two or more plant species on the same plot "so that there is temporal and spatial overlap in the growth and development of some or all of these plant species. Depending on their distribution in space, we can distinguish, especially in the rainy season, varieties such as vegetables, tomatoes that grow on the ridges made in ecobuage almost everywhere on the slopes. The basic crops being made up of maize, beans, macabo, cassava, potato, taro, potato are grown everywhere in the fields, whether they have high yields or not because they easily fit into the food habits of the populations. Unlike plants with a long vegetative cycle (3 to 5 years) such as macabo, taro,

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banana-plantain, plants with a short vegetative cycle (corn, beans, market gardening, potatoes) are most often subject to of two agricultural campaigns. These plants with a short vegetative cycle, using intensive methods (chemical fertilizer, animal manure, kitchen waste and selected seeds), can be grown on the same plot two to three times during the year.

Widespread Use of Organic and Chemical Fertilizers

Due to the strong human pressure on the already poor soils, farmers, under the guidance of agricultural monitors/technicians/delegates as well as agricultural engineers, are turning to the use of chemical and organic fertilizers to fertilize their soil. This technique began with the introduction of coffee growing when chemical inputs were subsidized by the state (GRET, 1998). But following the disengagement of the State, the peasants according to their means use different fertilizers, namely organic fertilizers (chicken droppings, compost and animal manure). Chemical fertilizers are in the NPK form (N=nitrogen, P=potash, K=phosphate) which depend on the variation in the degree of concentration of the elements, for example 12-6-20, 20- 10-10. In addition to KNP, Urea or 46%N, NH3 and foliar fertilizers are all types of fertilizers used.

Agricultural Techniques and Practices Degrading the Environment and Biodiversity

The agricultural techniques and practices employed by the farmers of Mélong fall within their level of technological development (low) and aim to improve or even increase production. However, they contribute on the one hand to air pollution, waterways and soil degradation, and on the other hand to the decline of the land ecosystem followed by the reduction of biodiversity.

Air Pollution, Waterways and Soil Degradation

Slash-and-burn agriculture is a pollution factor. In fact, already loaded with carbon dioxide, the air is contaminated by the harmful molecules contained in the smoke and the gases that emanate from the fires that are put on the grass in order to have ashes to fertilize the soil. Even more, if we agree that one of the roles of the forest is to regulate the ecosystem processes such as climate and soil (Bardgett & Wardle, 2010), then burning leads to the disruption of these main services, leading to warming of the micro-climate in the Mélong district. By estimating that one million trees absorb nearly 250 million carbon, the important role that trees play in reducing greenhouse gases (Andrews, 2008). Thus, deforestation due to clearing by bush fires in Mélong leads to the reduction of carbon sinks, hence the change in temperatures observed in the region. Indeed, nearly 80% of farmers believe that temperatures have increased considerably in their locality. They observe that there is a temperature difference between the clearings and the still wooded areas, that is to say that the climate would be warmer in the clearings.

In addition, during applications, the drift of pesticide droplets means that products can end up outside the farm. The phenomenon of drift is influenced, among other things, by the size of the droplets sprayed, the wind speed, the type of equipment used and the height of the spray (. In this way, pesticides can end up in the air in the form of vapours. This phenomenon is called volatilization. As described by Environment Canada, after the application of certain pesticides, these are released in the form of gas and adhere to particles such as dust. Subsequently, these pesticide residues in gaseous form can be removed from the atmosphere by condensation and return to the water or on the ground by the effect of precipitation or by the deposition of fine solid particles charged with chemical molecules. The increased use of fertilizers in Mélong is suspected in water and air pollution. Indeed, 73.5% of the farmers surveyed use chemicals to maximize production and fight against plant diseases. During the rains, these chemicals are

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washed away, resulting in the dissemination of nitrates and phosphates in aquatic environments (rivers) where the phenomenon of eutrophication, proliferation of algae and depletion of dissolved oxygen occurs.

The soils are increasingly degraded in the region. This degradation is observed at two levels: quantitative and qualitative. The quantitative loss of soil, called regression, is essentially due to erosion. It corresponds to a phenomenon of soil rejuvenation (return to the state opposite to the climax stage). Thus, any slight modification is quickly corrected and the balance restored. In reality, soils are reshaped or disturbed by many "disturbing factors" that occur occasionally. In the event of significant destruction of the soil or vegetation (fires, bush fires, deforestation, ploughing), the disturbance suffered by the ecosystem may not allow the resilience of the system, i.e. the soil may "to die". There is then "involution" or "regression" of the ground. Clearing of sloping soil followed by heavy rains can lead to complete destruction of the soil. Like what, some farming techniques such as the felling of trees and the deforestation that follows lead to erosion. The most common technique in Mélong, plowing, especially when done in the direction of the slope, favors the rapid formation of gullies and the transport of large quantities of land by torrential waters towards the valleys where the drainage becomes more and more frequent. worse. With the ridges, farmers temporarily improve infiltration, but reduce the cohesion of the material and therefore increase the risks of erosion and landslides, expose the deep horizons with less humus to the beating of the rains; accelerate dry creeping by moving the clods with the tools.

Qualitatively, we see loss of quality soils. Most of the soils here show signs of biological and physico-chemical degradation, limiting their productivity. This qualitative degradation is linked to the agricultural techniques used. We can cite among others: (i) the replacement of diversified primitive vegetation (known as climax) by secondary vegetation (polyculture) which modifies the humus, the formation of the soil and the reduction in the rate of organic matter induced by overexploitation of the floor ; (ii) the destruction of humus and insoluble clay-humic complexes by plowing which buries and destroys the upper living layers of the soil, or by excessive tillage (too intensive or too frequent) of the soil; (iii) Pollution by heavy metals or biocidal substances (pesticides or other pollutants) which would kill organisms essential for maintaining soil cohesion and capillarity (fungi, earthworms), compaction (soil compaction) and their asphyxiation. The compaction that we have observed here induces a sharp drop in the natural porosity of the soil and is the most serious and common form of qualitative soil degradation. Thus, although originally very fertile, the soils in Mélong suffer from continuous and rapid impoverishment, the main causes of which are the excessive use of fertilizers and other chemical products, slash-and-burn agriculture which exposes the soil to harsh climatic conditions. harsh conditions such as intense solar radiation and heavy precipitation which disrupt the nutrient cycle, the abandonment of fallow land and rotation in favor of regular polyculture where the soil is constantly cultivated throughout the year and successively over several years. With regard to the agricultural calendar (Table 5), the soils are constantly disturbed and exposed at least 2 to 3 times a year for market gardening and 4 times a year for food crops. This overexploitation of the agrarian space associated with the climatic aggressions of the periods with great morphogenic manifestations contribute appreciably to the weakening of the structural stability of the soils. Moreover, the exiguity of the finage causes at least the shortening of fallow times, if not its abandonment. All factors that make the risk of soil depletion inevitable.

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Conclusion

The main purpose of this study was to present the different agricultural techniques used in the district of Mélong and to describe them with a view to highlighting their impact on biodiversity in Mélong. It appears that farmers in Mélong use a wide range of agricultural techniques and practices. To the predominance of slash-and-burn agriculture is added the use of rudimentary tools, the increasingly widespread use of agricultural inputs such as chemical fertilizers and herbicides. Agriculture being the main activity of the populations of the district of Mélong because practiced by almost all of the population, our results show that the agricultural techniques used are the cause of soil degradation (increasingly poor), the decline of the forest ecosystem, and the threat to flora and fauna ecosystem biodiversity. We realize that the development of human societies necessarily poses problems of degradation of natural resources and therefore of biodiversity. To meet this challenge, the main actors, in this case the farmers, have developed traditional strategies for managing this biodiversity in balance with the physical and socio-economic environment. Too often ignored, even despised by other actors, these methods are not popularized. It would be useful to study their functioning and their dynamism because they can serve as a starting point for dialogue for a sustainable improvement of the environment. Since the farmer is the main user of the various agricultural techniques, all measures for the protection of biodiversity and the sustainable management of this biodiversity can only be possible if decision-makers take into account farmers' knowledge.

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