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MODELLING AS A TOOL FOR SPATIAL PLANNING OF COMMODITY PRODUCTION: THE EXAMPLE OF CERTIFIED OIL PALM PLANTATIONS IN CENTRAL AFRICA

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Abstract

The Central African region is targeted by agri-business companies as a suitable place to develop large plantations. Most of the existing assessments of available land are based on an a priori definition of availability and without any operational-level rules of sustainability. We intend to estimate the potential for a sustainable development of oil palm plantations in the Republic of Congo, taking into account spatial constraints linked to RSPO certification standard and ground-checked social realities. The analysis builds on an assessment of current land uses and prospects and on spatial analysis. Spatial constraints are combined so as to circumscribe areas suitable for oil palm, available for development, responding to the sustainability criteria of RSPO and adequate to the technical model proposed. This analysis results in an estimation of 10.7 Million ha theoretically suitable for oil palm. From this, 1.4 Mha should be available but the technical model applied limits this area to 1.1 Mha adequate for industrial plantations, and 0.1 Mha adequate for smallholdings. Explicit spatial modelling of sustainable production is possible at national scale. This tool allows to take into account the certification standards in land use planning and to highlight new possible areas of development outside natural forests.

Key Words:

Development and conservation trade-offs, land use plan, local people livelihoods, Roundtable on Sustainable Palm Oil (RSPO), spatial analysis.

INTRODUCTION

The Central African region is targeted by agri-business companies as a suitable place to develop their activities. Investors expect huge areas of non-cultivated, non-protected and low-population-density land to be available to develop industrial plantations: rubber trees, timber or oil palm. Deininger et al. (2011) estimated that 20% of the land available worldwide outside forests are found in the region. The assessment and location of available land is a major issue for public and private decision-makers across the region. Until today, estimations of non-cultivated, non-protected and low-population-density land have been made mostly through analysis of national statistics and spatial models at global scale. Most of existing assessments are based on an *a priori* definition of available land, mostly from land cover criteria irrespective of land use and traditional rules that govern access, and without any operational-level rules of sustainability (Janssen et al, 2010). Looking more precisely at national cases might change the figures. Some land that might have appeared suitable might not be so, non-cultivated land might include some fallows involved in an agricultural rotation, scattered family farming might not have been seen.

Oil palm is the most extended commodity currently cultivated by industries in the region, with the largest concessions acquired in the agricultural sector, totalizing more than 800 000 ha (Feintrenie 2014), and the biggest plans of expansion totalizing more than 260 000 ha (Feintrenie 2014). This rapid expansion of oil palm plantations answers to the domestic demand (all the countries of the region are net importers of palm oil) and the global demand for edible oil (human and animal), industrial use and indirectly for biofuels.

In this paper we intend to estimate the potential for a sustainable development of oil palm plantations in the Republic of Congo (RC), taking into account spatial constraints linked to RSPO certification standard and ground-checked social realities.

METHOD

BUILDING SCENARIOS OF PRODUCTION

The assessment of the potential for a sustainable development of oil palm plantations in RC is based first on the identification of potential players in the development of these new plantations, and the analysis of their constraints in terms of mobilizing their human, financial, technical and land resources. For this purpose, a field trip was firstly organized to meet key public and private stakeholders in the agricultural and forest sector, at local, regional and national scales, and to take note of agricultural production systems all over the country. After this first phase, technical and spatial scenarios of sustainable production were developed. Each scenario is:

- a type of actor: family farmers or industry;
- a type of production system (technical skills and practices);
- a set of available areas for production (depending on actors);
- the pattern of a typical production unit.

The final potential is the result of a double statistical and spatial generalization of these patterns across the country. Scenarios are led by 2013, in the current conditions of land use, cultivation practices and agronomic knowledge.

The exercise carried out is in an exploratory prospective from the current reality of farming systems. Unlike most existing studies that are part of a normative prospective seeking to develop visions of what would be desirable to achieve a given objective (GHG reduction, a minimum rate of incorporation, etc.), we sought to develop visions of possible "futures" at short-term, given the spatial organization of rural areas, existing players, rules of land use, and respect for principles of sustainable development.

Our general approach can be summarized as follows:

1. Delimiting the land favourable to the cultivation of oil palm;
2. Identifying potential actors of the production, their technical capacity and sustainability standards they can adopt;
3. Defining for each actor their property rights;
4. Delineating for each actor land that is available for their actions (cf definitions below);
5. Defining for each actor an agronomic and spatial patern of sustainable production;
6. Calculating the technical potential of sustainable production by defining the fraction of land available that actors can technically develop according to their agronomic and spatial model.

AVAILABLE LAND

Land available for production are here defined as spaces that i) are suitable to the growth of oil palm ii) could be appropriated by future actors, iii) are not reserved for other uses.

Suitable land is defined as land areas where soil and climatic conditions meet the requirements of oil palm. In this case, the soil and climate criteria are (Jacquemard 2012):

- minimum mean Temperature of the coldest month > 18 ° C;
- maximum mean temperature of the hottest month <34 ° C;
- Mean annual rainfall > 1200 mm.

RC soils belong mainly to the class of lateritic soils, covering about 90% of the country. These soils are suitable for palm oil whatever their texture (clay or sand). However, these lateritic soils combine hydromorphic soils which are temporary or permanently waterlogged. These latter, mainly found in the Congo Basin, in low areas to poor drainage and along rivers and streams, have been excluded from planting areas

Authorized land is designating areas on which future players will have planting rights. These rights depend on identified actors and operational rules that i) are imposed to them or ii) they choose to follow.

In this scenario, we assume that actors - industries and family farmers - choose to plant according to the standards set by the RSPO (2006). Table 1 summarizes all the RSPO principles that may have an impact on authorized land and the guidelines we adopted for this assessment. Thus, are excluded from authorized land for industries: legal reserves and natural parks, existing forests, especially riparian forests, land within 100 m of a river to prevent pollution, poor soils and areas of steep slopes (> 12%) to avoid the risk of erosion.

Moreover, according to the principle 7.5 of RSPO, industries must also comply with current traditional activities on land in particular hunting, gathering firewood and slash and burn.

To comply with these uses, available land for industries is restricted to authorized land located above a 5 km distance from a residential area. Our fieldwork showed that this threshold is a minimum to avoid major land conflicts and to reconcile all uses.

RSPO principles and criteria	**Guidelines for national assessment**
Principle 1: Commitment to transparency (Not relevant for potential assessment)	
Principle 2: Compliance with applicable laws and regulations	
Criterion 2.1 There is compliance with all applicable local, national and ratified international laws and regulations.	All relevant legislation has been identified No plantings on officially declared as protected areas
Criterion 2.2 The right to use the land can be demonstrated, and is not legitimately contested by local communities with demonstrable rights.	Customary land use rights or disputes have been analyzed and mapped
Criterion 2.3 Use of the land for oil palm does not diminish the legal rights, or customary rights, of other users, without their free, prior and informed consent.	No plantings in a 5km radius around each village, to meet the current traditional activities on land in particular hunting, gathering firewood and family farming.
Principle 3: Commitment to long-term economic and financial viability	
Criterion 3.1 There is an implemented management plan that aims to achieve long-term economic and financial viability.	A techno-economic study was conducted using data collected from local industries and from other industrial plantations in Central Africa. This study concludes with an economic viability for industrial plantation size greater than 15,000 ha. These 15,000 ha will be concentrated in a radius of 30km around a potential processing unit
Principle 4: Use of appropriate best practices by growers and millers	
Criterion 4.3 Practices minimize and control erosion and degradation of soils.	No plantings in areas of steep slopes (> 12%) No plantings within 100 m of a river, to protect riparian areas
Criterion 4.4 Practices maintain the quality and availability of surface and ground water.	No irrigation. Plantation are only hold in suitable areas No plantings within 100 m of a river, to protect riparian areas

Principle 5: Environmental responsibility and conservation of natural resources and biodiversity	
Criterion 5.2 The status of rare, threatened or endangered species and high conservation value habitats, if any, that exist in the plantation or that could be affected by plantation or mill management, shall be identified and their conservation taken into account in management plans and operations.	It does not exist in RC any national document outlining biological corridors. Only the boundaries of protected areas was considered plantations No plantings on officially declared as protected areas
Principle 6: Responsible consideration of employees and of individuals and communities affected by growers and mills (Not relevant for potential assessment)	
Principle 7: Responsible development of new plantings	
Criterion 7.2 Soil surveys and topographic information are used for site planning in the establishment of new plantings, and the results are incorporated into plans and operations.	No plantings on hydromorphic soils
Criterion 7.3 New plantings have not replaced primary forest or any area containing one or more High Conservation Values.	No plantings on forests as defined by the Ministry of Water and Forest of RC
Criterion 7.4 Extensive planting on steep terrain, and/or on marginal and fragile soils, is avoided.	No plantings in areas of steep slopes (> 12%)
Criterion 7.5 No new plantings are established on local peoples' land without their free, prior and informed consent	No plantings in a 5km radius around each village, to meet the current traditional activities on land in particular hunting, gathering firewood and family farming

Table 1: RSPO principles and criterions (RSPO 2006) and spatial constraints induced

MATERIAL AND ASSESSMENT METHOD

Data used for available land location and assessment are summarized in the table 2.

Data	**Source**	**Shape**
Land Use, including forest area	Interactive forest atlas project (WRI, 2013)	Polygons
Soil	Soil Map of Congo - ORSTOM	Scanned map
Climate	WorldClim 1950-2005	Raster (1 km)
Relief	Shuttle radar topography model (DEM90) of the National Geospatial Intelligence Agency (Farr et al., 2007)	Raster (90m)
Protected areas	UNEP-WCMC World Database on Protected Areas (2012)	Polygons
Forest Concessions	Interactive forest atlas project (WRI, 2013)	Polygons
Rivers, road	Interactive forest atlas project (WRI, 2013)	Lines
Villages	Interactive forest atlas project (WRI, 2013)	Points

Table 2: summary of the data used in the modeling exercise

The assessment method for this scenario follows a hierarchical construction of potential. At first, the theoretical potential of palm oil is mapped. It is all suitable land as defined above. This potential is estimated, in a GIS software, by overlaying rainfall, temperature and soil layers.

In a second step, the available potential is mapped. It corresponds to the maximum share of theoretical potential that future stakeholders could develop within the limits of available and authorized land. This potential is estimated by subtracting the theoretical potential geographically all unauthorized planting zones: steep slopes areas, forest areas, 100m buffer areas on either side of the rivers, 5 km buffer areas around villages, protected areas.

In a third step, the technical potential of sustainable production is mapped. It corresponds to the fraction of the available potential that future stakeholders could technically operate according to the sustainable production model defined above.

The identification of land consistent with the sustainable production model is a result of spatial generalization in a GIS. These steps are detailed in the results section.

RESULTS

NATIONAL CONTEXT

The Republic of Congo ranks third on the acreage of natural forest on the African continent, after Democratic Republic of Congo (DRC) and Gabon. RC natural forest is estimated above 21 Mha (De Wasseige et al. 2012). This forest holds a rich biodiversity including more than 300 registered timber species. 70% of the forest massif is considered of interest for timber commercial exploitation. Savannahs cover about 35% of the country, dispatched between the Niari peneplain, the Bateke highlands and the Cuvette.

The national economy relies on oil and other hydrocarbons exploitation which represents 88% of national exports (Le Roy 2011). The second post of exports is held by timber, but only ranked at 3% of exports in 2010 (Le Roy 2011). RC has a debit balance regarding food products; 20% of national imports consist of meat, fish-meat and manufactured food products.

The agricultural sector is dominated by family farming. Most of the farms focused on subsistence production, mainly covered by cassava with a few vegetables and fruits. This agriculture is based on a nearly complete absence of manufactured inputs, and material reduced to machetes and hoes. Family farms are spread over the country, with a concentration on the vicinity of rivers and main roads. Cash crops like coffee, cocoa and rubber were developed in family plantations in the 1970s, but have been abandoned since 1990. During this year, national agricultural offices that were in charge of the collect and sale of agricultural commodities were dismantled, as an answer to the National Adjustment Plan fixed by the International Monetary Fund (IMF). The collects stopped and farmers were left with completely disorganized market chains. As a consequence, cash crops are presently limited to :(i) sugar cane production by the company SARIS (Société Industrielle et Agricole du Niari - Industrial and agricultural company of Niari) owned by SOMDIAA, a filial of the group Vilgrain et Castel, and (ii) two palm oil societies not yet in production, Atama which was attributed a large-scale concession in the northern part

of the country (in the departments Cuvette and Sangha) in 2010, and Eco-Oil Energy which bought the former public enterprises Sangha Palm and *Régie Nationale des Palmeraies du Congo* (RNPC) in November 2013.

In 2011 the government launched a national program of afforestation and replanting (Programme National d'Afforestation et de Reboisement, ProNAR). This program aims at planting 1 Mha before 2021 (MEFDD 2012) for multiple uses: timber, Carbon stock, agricultural commodities and others. Plantations are to be developed in savannahs or in degraded forest as part of a restoration plan. About half of the objective should be covered by plantings in the central region of RC, mainly in the department Pool (objective: 200 000 ha) and Plateaux (250 000 ha planned). The ProNAR should help the country answering the domestic demand for food, feed, fiber and fuel (charcoal, fuel-wood and biofuel), participating to the mitigation of climate change through Carbon storage, and diversifying exports. This program is aligned with the national objective of development within a green economy framework.

OIL PALM IN THE RC

Oil palm is endemic to the Congo Basin. As such, it can be found in wild groves and has been exploited since immemorial times by local people. It can be found in family gardens nearby houses as well as scattered amidst food-crops, where it is often saved during the plot preparation (slash and burn of the previous vegetation, being forest or savannah). Fruits are freed from the Fresh Fruit Bunches (FFB), and then Crude Palm Oil (CPO) – or red palm oil – is extracted using a manual or motorized press. The artisanal production of palm oil is well developed in Cameroon (Nkongho et al 2013, Iyabano 2013) and DRC, with commercialization of red oil to feed urban areas. In RC the sector is less developed, motorized presses are scarce and the production is nearly limited to family consumption. Nonetheless, a few medium-scale plantations with small mills equipped in motorized presses are owned by national elites, such as the company Sadec with a 300 ha plantation near Oyo.

The company Atama acquired in 2010 a plantation permit for 180 000 ha of oil palm on an agro-industrial site covering 470 000 ha, under a lease for 25 years renewable. This agro-industrial site will include two mills and 5 life-camps. The 5 life-camps should evolve in villages with schools, health centres, stores and other facilities. Part of the concession covered by the lease will not be developed for various reasons

including conservation value either environmental or cultural, technical constraints, unsuitability for oil palm, presence of a village and food crops. The company followed the legal process to acquire the lease and plantation permit, which include conducting an Environmental and Social Impact Assessment (ESIA) and writing an Environmental and Social Management Plan (ESMP). These documents were submitted to the relevant authorities in Brazzaville and in the province (Feintrenie 2014), but are still to be validated. Social programs are put in place by Atama, and every village impacted by the activities of the company has been consulted previously to the beginning of Atama's activities in its surroundings. Agreements have been signed between the provinces' authorities and Atama on books of requirements in which Atama engaged itself to carry out various social programs to the benefit of the villagers. Atama is not a member of RSPO, and didn't express any plan to become one. The policy of social and environmental responsibility of Atama might nonetheless limit negative impacts of the plantations to the consequences of deforestation and of the increase of human pressure on natural resources.

The company plans to employ about 27 000 people once in full activity, it is to say around 2060. This means the density of population should increase from less than 2 inhabitants/km^2 in 2012 to about 18 inhabitants/km^2 (Feintrenie 2014). The pressure on wildlife for bush meat and on land for food-crops will increase proportionally. Besides, the low density of local population at present implies a need for migrant labour force. Migrants might come from other regions of RC, but more probably will come from the bordering countries or from western Africa. A melting-pot of ethnic groups will result from this dynamic, with a rising risk of social conflicts (Feintrenie 2014).

Eco-Oil Energy plans to replant 4 oil palm plantations dating from the 1960s in (i) Owando (Cuvette), (ii) Etoumbi (Cuvette Ouest), (iii) Kandeko, and (iv) Mokeko (Sangha). Until 2013 these public plantations had been abandoned for more than 20 years and anarchically exploited by the local population.

These two companies plan to develop industrial oil palm plantations, and eventually support some smallholdings in their surroundings. At present no formal partnership has been proposed to the villagers around the estates however. A model of industry-smallholder partnership needs to be developed, adapted to the Congolese context.

INDUSTRY-SMALLHOLDERS PARTNERSHIP

The technical model was built on examples of industrial plantations existing en the Central African region, mainly the companies Atama in the RC and Olam in Gabon.

Industrial oil palm plantations range from several hundred hectares to more than 150 000 ha. Plantations are broken in sub-units to adapt to the physical constraints (topography, hydrography) and to conservation constraints. These sub-units are of a minimum size of 100 ha, and must be at reachable distance to the processing mill. Oil must be extracted from FFB within 48h from the harvest to ensure a good quality.

Estates are attached to a mill whose capacity may vary between 25 t FFB/hour to 60 t FFB/hour. The most common mills have a capacity of 40 t FFB/hour, which is sufficient to transform the production of a 15 000 ha plantation. Such a mill requires less than 100 employees thanks to the high level of automatism in the extraction process. More labor is required to manage the plantation, for example Atama plans 5500 employees per 36 000 ha block. The same rate of about 1.5 people per 10 ha is planned by Olam-Gabon.

Atama and Olam-Gabon both plan to try some smallholdings development program, based on the model of partnership used in Indonesia and Malaysia (Feintrenie et al. 2010). This type of partnership includes the organization of smallholders into cooperatives. The cooperative and each of its members sign a contract with the industry in which all the production from smallholdings have to be sold to the industrial mill against the engagement of the industry to provide technical assistance and access to inputs (quality seedlings, chemicals, fertilizers). The cooperative manage the smallholdings following the technical calendar and advices of the industry. Smallholders may or may not work in their plantations. If they don't work, the cooperative employ laborers. All the production costs (inputs, labor, and maintenance of buildings and roads) are to be paid by the smallholders. Every month or twice a month, the cooperative pays the members applying a direct withdrawal of the costs on the payment of FFB.

Usually smallholdings are planted by the industry under a credit arrangement involving a bank and the State. The State participates in providing land titles to smallholders, which serve as guarantees to individual bank loans. The reimbursement is managed by the partner-industry and directly deduced from the monthly sales of FFB (Feintrenie et al. 2010). This model is known as Nucleus Estate and Smallholders (NES).

NES type of industry-smallholders partnerships have been tried in Central Africa. In Cameroon a program of development of village plantations was conducted in the late 1970s. The program was supported by the World Bank through the National Fund for Agriculture and Rural Development (Fonader). 35 000 ha of oil palm smallholdings have been planted in this program (Carrere 2010) in 1990. Unfortunately the program didn't last longer. The Fonader bankrupted for a number of reasons (see Nkongho et al. 2014 for details). The direct competition between industrial mills engaged in the program and artisanal presses in buying FFB from the farmers participated in the ending of the program (Nkongho et al. 2014).

The presence of an artisanal palm oil sector is a major difference between the Southeast Asian context and the Central African one. In Indonesia and Malaysia farmers have no traditional knowledge of palm oil production; oil palm growers are dependent on industries to buy and process their production (Feintrenie 2012). The type of partnership between industries and oil palm growers must be reconsidered to be adapted to the Congolese context. For instance, some flexibility could be included in the contract, allowing a certain proportion of the smallholders' production to be transformed by them and not sold to the mill.

POTENTIAL FOR CERTIFIED OIL PALM PLANTATIONS IN RC

THE TECHNICAL AND SPATIAL MODELS OF SUSTAINABLE PRODUCTION

The sustainable production model is based on industrial production and processing units involving a minimum of 15 000 ha of plantations concentrated in a radius of 30 km. The area of 15 000 ha can be broken into lots of 100 ha minimum. In each plot of 100 ha, 5% of unavailable land (due to the various constraints) is tolerated.

This model of industrial plantation is associated with family plantations. These will be developed near the industrial concession as it is the case in OLAM Gabon business plan. The proposed scenario suggests 5 000 ha family plantation for each concession Family plantings are grouped in production plots of 20 ha, facilitating a possible collection by the manufacturer (table 3).

Oil palm plantations do not require a lot of labor. One couple of adults can manage about 6 ha of a mature plantation. During the two first years however, more labor is needed to maintain the nursery and protect the young seedlings from pests. Thus a couple of adults can only manage 2.5 ha during this period, if not employing external laborers (Feintrenie et al. 2010).

	Estate	**Smallholdings**
Production standard	RSPO	RSPO
Surface of the concession	30 000 ha	
Surface planted	15 000 ha	5 000 ha, 2 000 smallholdings, 2.5 ha/family
Oil palm density	160 trees/ha	160 trees/ha
Planting program	2 000 ha/year	100 smallholdings/year
Labor force	2 200 employees (1.5 people/10 ha)	Familial
FFB yield	20 t FFB/ha once mature	15 t FFB/ha once mature
Mill capacity	40 t FFB/hour	
Oil extraction rate	25 % once mature	25 % once mature

Table 3: Technical characteristics of the model

These small family plots should also be within a 30km radius of a processing unit (figure 1).

The generalization of this production model at the national level is made with GIS, by seeking adequate areas in the available land. To this objective, the available land is divided into cells of 90mx90m. Each available cell is assigned the value 1. Available cells that can satisfy an industrial plantation is identified by the Focalsum function[1] in a square window of 100 ha (or 110x110 cells). If the result is greater than 95, then the cell is considered adequate to participate in the production model because in its neighbourhood there is sufficient land available (more than 95 %). The same operation is then performed in a window of 20ha, (16x16 cells) to identify cells according to the model of family production.

Finally, a new focal analysis is applied to the cells retained previously to measure density. Using the Focalsum function, we identified all cells recognizing at least 15 000 ha of industrial plantations in a circular window of 30km radius. The overall results cells represent the adequate settlement area of the future processing units and is then applied as a spatial filter to exclude available cells but considered too remote and / or too fragmented for industrial needs.

[1] Focalsum is an operation that calculates the sum of the values for each cell location on an input raster within a specified window and sends it to the corresponding cell location on the output raster (ESRI ArcGIS © documentation library)

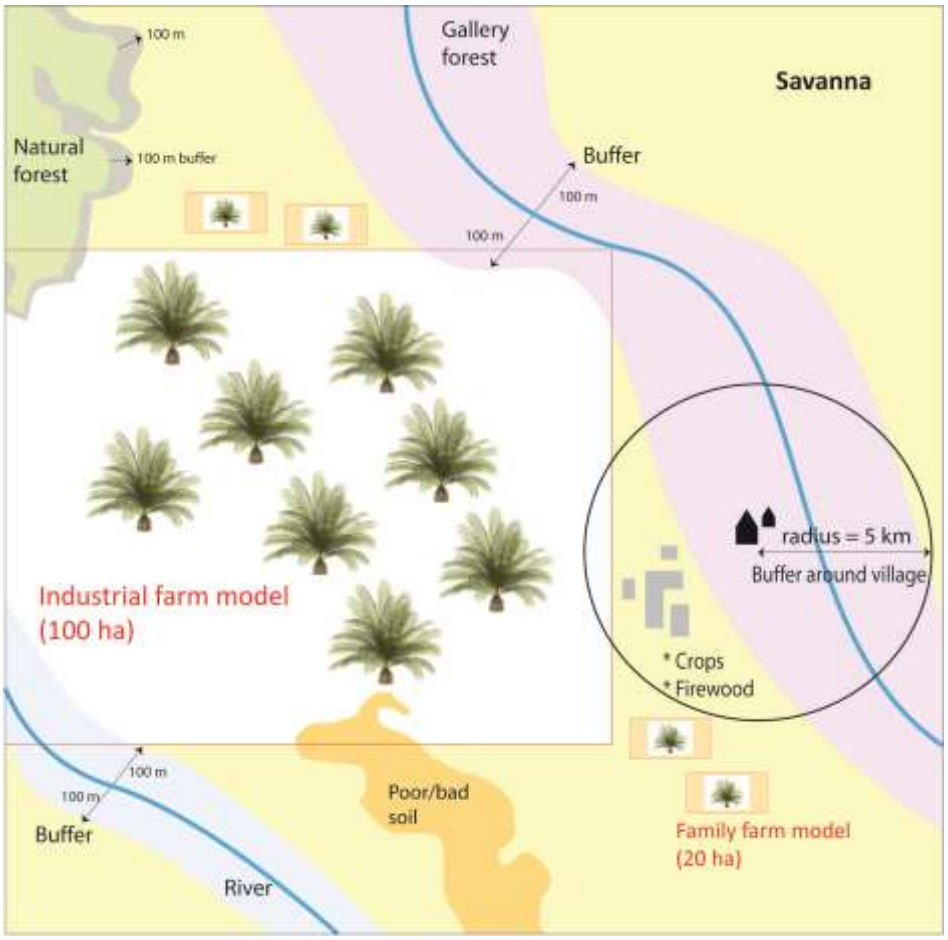

Figure 1: Scheme of the spatial organization of the technical model

SPATIAL DISTRIBUTION OF THE POTENTIAL FOR SUSTAINABLE OIL PALM PLANTATIONS

In RC, the theoretical potential for oil palm is 10.7 Mha (figure 2). The available potential is 1.4 Mha (figure 3), or 13% of the theoretical potential. Finally, the technical potential of sustainable production totalled 1.28 Mha or 91% of the available potential (Figure 4). This surface area is shared between 1.15 Mha for industrial plantations and 0.13 Mha for family plantations (table 4). Reducing distances from smallholdings to mills to a radius of 15 km, this technical potential is limited to 1.0 Mha.

	Surface (Mha)
Total surface area of the Republic of Congo	34.1 Mha
Theoretical potential	10.7 Mha
Available potential Outside natural forests, protected areas, villages, rivers and buffers zones	1.4 Mha
Technical potential of sustainable plantations:	1.28 Mha
- Industrial plantations (15 000 ha broken into 100 ha units)	1.15 Mha
- Additional land for smallholdings (20 ha blocks)	0.13 Mha

Table 4: summary of the results

This oil palm plantation model, based on a partnership between industries and farmers and following RSPO certification rules, seems socially acceptable (based on the field surveys and discussions with local and national experts). Some past experiences have shown the difficulties to maintain good relationships between industries and villagers when land is at stake. This is the case of Eucalyptus plantations near Pointe-Noire where urban expansion has driven an increase demand for charcoal, fuel-wood and food-crops and increase land prices. As a result claims on land, even on savannahs, have multiplied and the timber industrial plantations have been called into question by the local population.

The spatial distribution of potential sustainable oil palm plantations (figure 4) is located at a distance from the main cities which could prevent the risk of urban pressure on land. But land tenure will be one of the main questions to be discussed before any industrial plantations select a location for implanting its activities. This discussion will be necessary not only with the central government, but also with customary authorities in the targeted area.

It appears possible to develop agro-industrial oil palm plantations outside the forested areas, and eligible for RSPO certification (respecting buffer zones along rivers, High Conservation Value areas and planned-expansion of villages and food crops). This estimation needs to be taken with care since all land uses (such as an exploitation forest unit outside natural forests, extractive mining permits) have not been taken into account in the spatial modelling. This spatial distribution of technical potential for sustainable oil palm plantations is only an indication of potential areas to be explored, but not a land use plan.

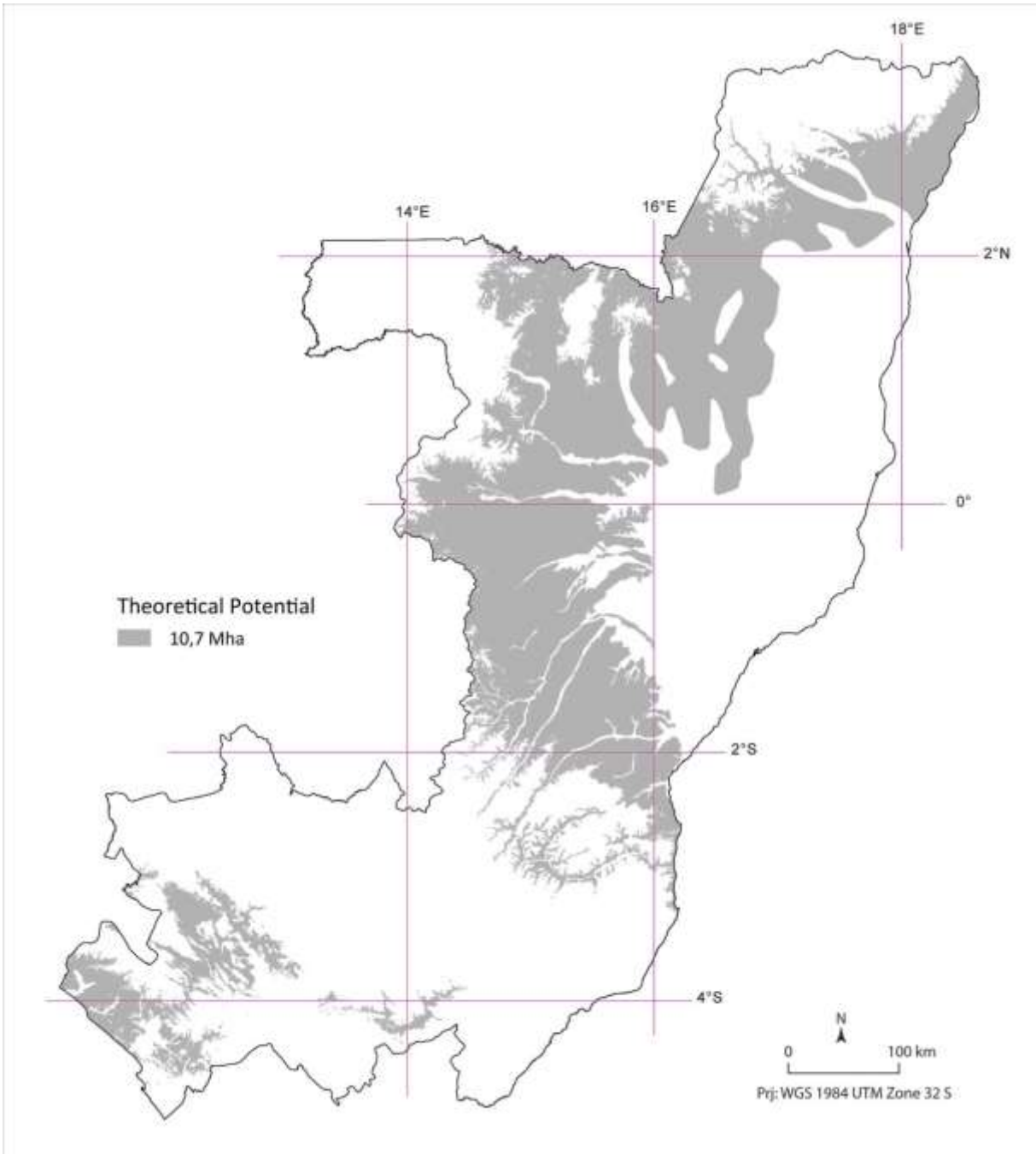

Figure 2: Spatial distribution of the theoretical potential for oil palm plantations

Feintrenie L, Nkoua M, Saidi S, Gazull L. 2014. *Modelling as a tool for spatial planning of commodity production: the example of certified oil palm plantations in Central Africa.* Annual World Bank conference on land and poverty, Washington DC: March 24-27.

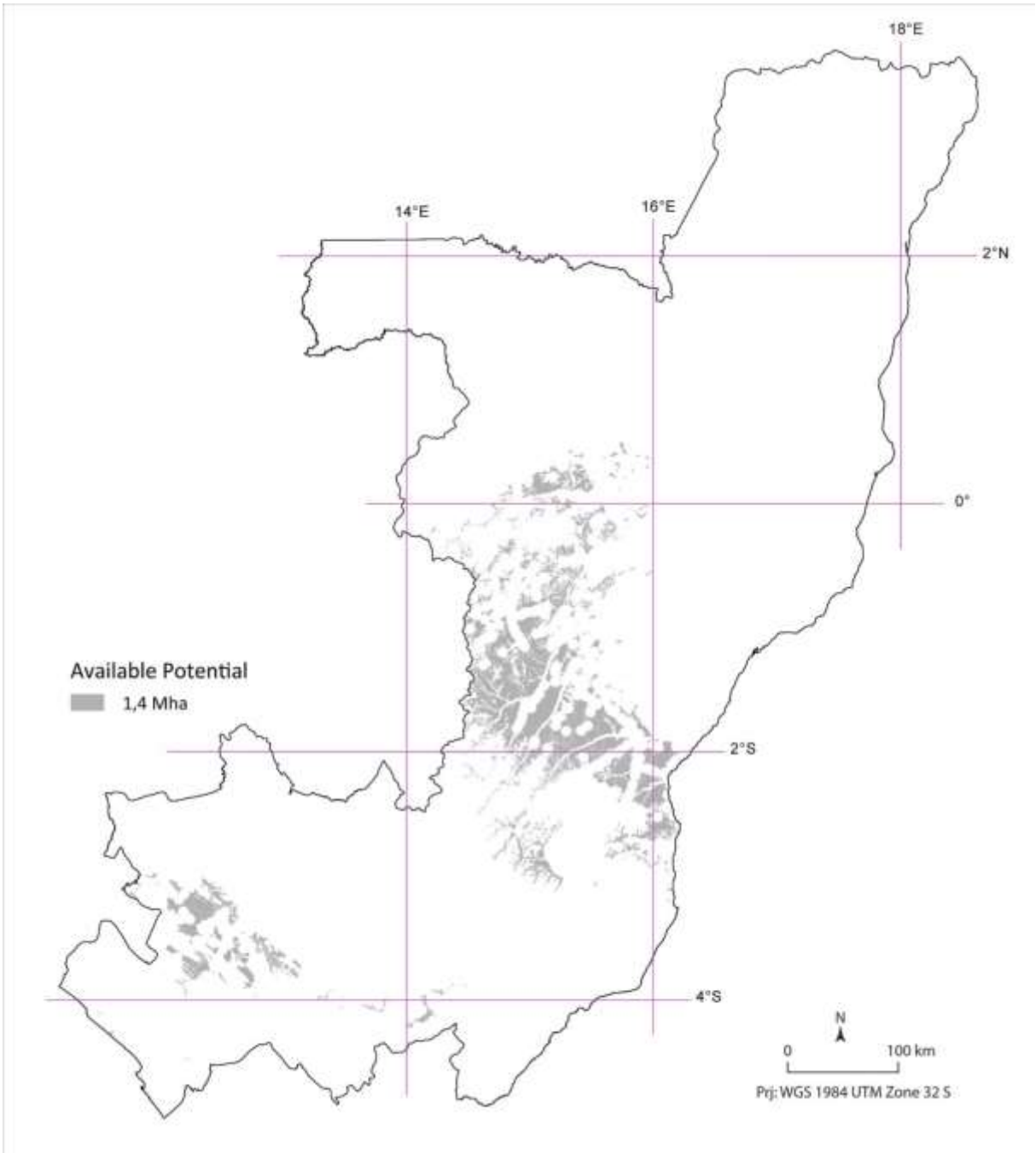

Figure 3: Spatial distribution of the available potential for oil palm plantations

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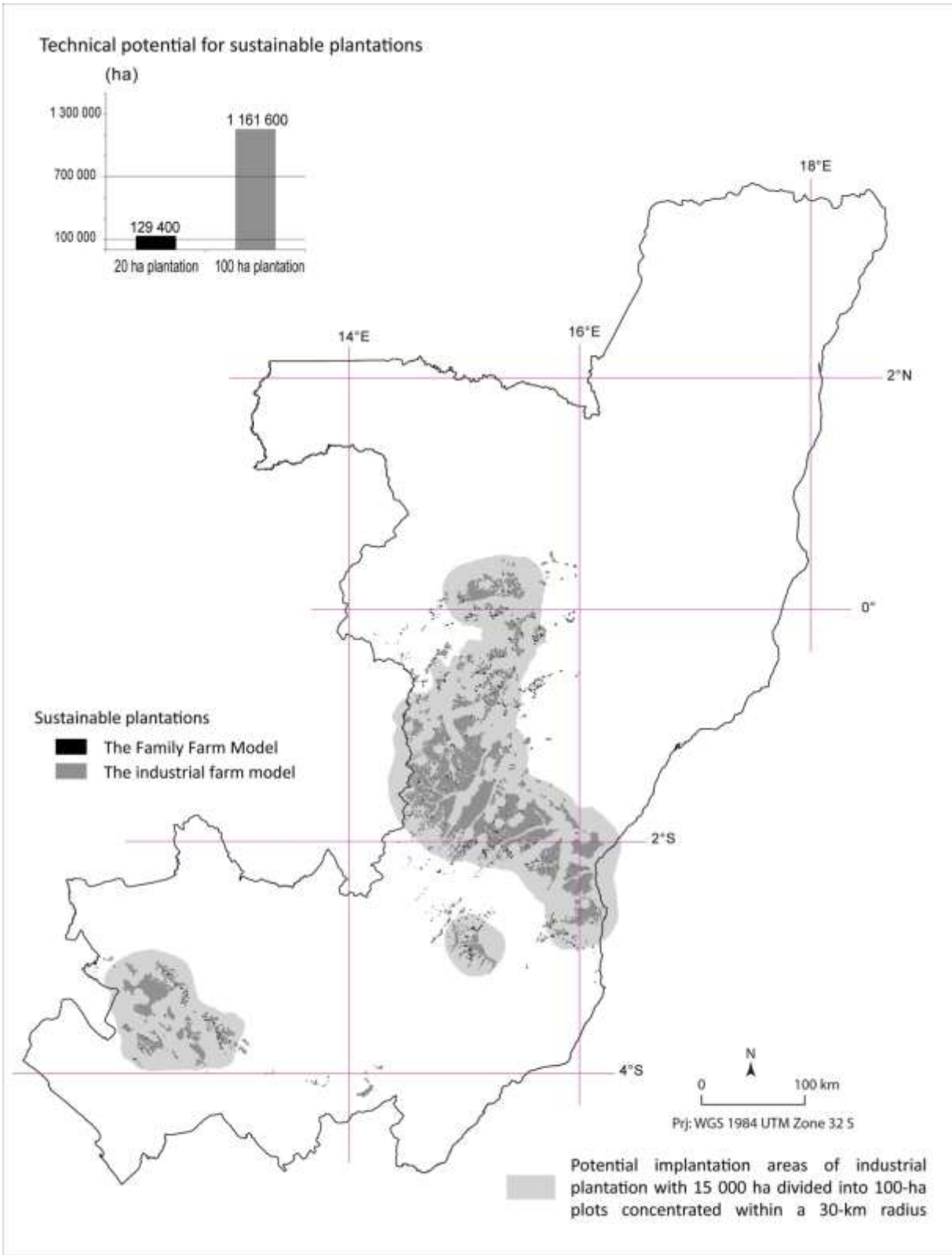

Figure 4: Spatial distribution of the technical potential for sustainable oil palm plantations

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DISCUSSION

OIL PALM IN CENTRAL AFRICA

Even though oil palm plantations have been extending in Central Africa since 2000, the trend will probably change. Potential yields are lower in the region than in Southeast Asia due to the climatic conditions marked by a dry season in most of the savannah areas and a lack of sunlight in the forested areas.

In 2013, the industries investing in oil palm plantations in the region mainly targeted the domestic and regional markets. Consumers from the area do not ask for certified products. Thus certification is not needed to answer the market demand; it is seen by industries either as an answer to the pressure of international NGOs, a communication tool, or a management tool. Indeed certification principles and criterions provide guidelines for best practices which might lead to a more efficient production, and external audits might help by providing experts' judgement on the process and practices of the industry.

Agro-industries of the oil palm sector put in place two types of certification: RSPO and ISO (9001 or 14001). ISO standards are not specific to any commodity, whereas RSPO is the only certification specific to palm oil production and market chain. RSPO certification requires a national interpretation of its Principles and Criterions (P&C) before any official certification. No national interpretation has been validated so far in Central Africa. The most advanced country in this process is Gabon, where WWF is coordinating the process of interpretation, with working groups involving private stakeholders, representatives of the civil society and of the public services. SIAT and Olam-Gabon, the two agro-industries with oil palm plantations in the country, are willingly and actively engaged in the working groups. The main challenge in this country is to deal with trade-offs between development of the agricultural sector and conservation of the biodiversity-rich forests that cover most of the country.

In Cameroon RSPO national interpretation of P&C hasn't begun yet, but NGOs are promoting the label through communication, trainings of the actors (on the concepts used in RSPO and on RSPO itself) and advocacy to the private and public sectors. A national strategy for sustainable development of oil palm in Cameroon is being designed by the Ministry of Agriculture and Rural Development (Minader) with the support of working groups including representatives of all the categories of actors: agro-industries, smallholders, civil society, humanitarian and environmental NGOs, research institutes, and all the

ministries with stake on land, agriculture or environment. This strategy will clearly address objectives of sustainability in the sector, helping industries on the first steps toward certification of sustainable practices. One result of the multi-stakeholders discussions on the strategy is the decision of the Minader to promote smallholdings in the oil palm sector, and limit new industrial plantations to 20 000 ha (communication by Minader within a working group on the strategy). A national land use plan is under discussion in the government that should be considered in the decisions to come on land attribution for oil palm plantations. The method of spatial planning developed on the case of RC could be very useful in supporting this exercise.

In DRC most of the agro-industries have decided not to plant on forest (Nocafex, Socfin, GBE, with the exception of PHC), but rather replant old plantations. The country used to host numerous agricultural societies with plantations or crops on 100 to 15 000 ha plots. These societies have been abandoned during several decades (Feintrenie 2014), the presently represent a huge potential for the re-launch of the agricultural sector in the country, without impacting conservation areas or natural forests. It is worth noting an on-going experiment by Socfin in its plantation Brabanta, to develop oil palm plantations on savannahs. This experiment, so far producing good results, support the results of the spatial modelling of technical potential for sustainable oil palm plantations in RC. The method could here again be used to better target the most adequate areas in DRC for sustainable oil palm plantations. In 2013 the Ministry of Agriculture and Rural Development (Minagrider) published a National plan of investment in agriculture which runs from 2013 to 2020 (Minagrider 2013). This plan includes the creation of hubs of agricultural enterprises located in agri-business parks and areas of planned agricultural settlement (‘*Zones d’Aménagement Agricole Planifiés*’, ZAAP). Each of these areas will target a few agricultural commodities, and will trigger their development in its surroundings. The spatial modelling of sustainable production of the agricultural commodities of interest for the country could help selecting the adequate target for each ZAAP.

In RC recent land attributions for industrial oil palm plantations have targeted forested areas in the Northern part of the country. The maps published in this article show that another strategy is possible regarding oil palm development, which would be in better coherence with the national engagement toward a green economy. This methodology gives the opportunity to promote a sustainable development approach through supported public decisions in accordance with the interests of all the categories of stakeholders (State, local populations, broader civil society, NGOs, investors).

PROSPECTIVE USING SUSTAINABLY EXPLICIT – SPATIAL MODELS: A POWERFUL TOOL FOR LAND-USE PLANNING

During the last 5 years, demand for large scale farmland in Central Africa has been enormous. This growing demand occurs in a world with shrinking water and land resources, increasing soil degradation and rising temperatures all impacting on land productivity (Ritter, 2008). Many reports have raised serious concerns about environmental and social risks associated with those forms of agricultural land expansion. Concerns include benefits for local population, competition for land with smallholders, environmental impact of land use change, etc. For all those reasons the sustainability of large scale production systems is a major issue and a condition to their development. Potential for cultivation expansion in Central Africa is theoretically huge, as we showed it here with the case of the RC. But most of existing potential assessment studies do not take into account sustainability, or do not explicit clearly sustainability principles and criteria they use in their calculations. As we showed here, sustainable production standards have a direct impact on available land – defined as the land that could be appropriated by future actors and is not reserved for other uses.

In this context, sustainably explicit spatial models can support the development of locally adapted sustainable schemes (as has tried to do the COMPETE initiative in Africa) that could be introduced in land planning operations.

In one hand, spatial modeling can simulate different kind of sustainable production schemes, from family farmers production systems to large-scale industrial systems. Thus, it allows to explore different kind of sustainable solution and to improve it, if necessary.

In the other hand, spatial modeling produces maps where available land is clearly defined (through explicit multi-criteria analysis, as described in RC case) and located. Resulting areas are not only suitable areas for cultivation but also potential areas where land conflicts should be alleviated, where transaction costs should be low and where production should be more efficient. Such maps are very powerful tools for state agencies for land use planning, or for investors who want to develop sustainable assets.

In RC, main concerns are about deforestation and respect of economic and social rights of local people. Our spatial modeling, showed that it’s possible to expand agriculture areas, in a sustainable way, without forest clearing, and using production systems models that associate smallholders and oil palm industries.

But above all, it shows that it’s possible to integrate sustainable rules at the beginning of a land planning process, and not at the end, as it is usually done, once theoretically suitable areas for investors are

delineating. This method is transposable to other agricultural commodities and to other geographical contexts to support decision making for rural development

CONCLUSION

The spatial modeling exercise conducted on the case of oil palm plantations in the Republic of Congo concluded that sustainable oil palm plantations following RSPO principles and criterions could be developed in the central region of the country, mainly in the districts Pool and Plateaux. This region is covered by savannahs with forests restricted to corridors along riversides, and the density of the population is very low. The spatial distribution of the technical potential for sustainable oil palm plantations should be used as an indication to target areas where oil palm could be developed. However specific locations will need additional analysis before any project is implemented. A complete process of discussion with local populations and customary land owners will be key to the success of any plantation project. If local peoples are not included properly in the discussions from the beginning, especially to define the precise limits of an industrial plantation, social conflicts might rise and the project be put into question. The conditions of the deal must be fully agreed by the villagers impacted on short or long term by the project prior to the signature of the authorization of plantation by the government.

Oil palm is one of the two commodities with the largest surface areas under planting or replanting in Central Africa since 2000 (rubber being the second). The spatial modeling of potential for sustainable plantations of oil palm could support public authorities in the decision making of land attribution to industrial projects and help investors have a better analysis of local conditions prior to investment.. In the countries where land use planning is under discussion, this method could be applied to any agricultural commodity of interest for the country, to feed the discussions on priority areas of development.

The quality of the maps produced by this method depends on the quality of the data used in the modeling. The most critical information is current land occupation. It is very difficult to get proper and complete information on land uses in countries with incomplete cadastre. When and where this data is available, the maps produced by the spatial modelling not only show land suitability to a specific agricultural commodity, but take into account land availability, and areas where transaction costs should reduce and production more efficient. Such maps are very powerful tools for state agencies for land planning, and can be applied in any geographical context, to any agricultural or forestry commodity.

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