



Socioeconomic factors determining ecosystem services local perceptions in two ecological zones in Benin (West Africa)

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ABSTRACT

Forests have been undergoing diverse threats due to human activities and these may affect their role as Ecosystem Services (ES) providers. Therefore, it becomes crucial to undertake some analysis of the current socio-economic context of ES offerings to provide valuable information for the decision-making process and policy regarding sustainable forest management. This study aimed at highlighting the local perception of ES in two contrasting ecological regions. 689 respondents distributed in six districts were interviewed through a semi-structured survey on the various ES and their assessment. The analysis in principal components is used to understand socio-cultural group perception. Then, we used Beta regression to know how socio-economic factors influence the rate of people knowledge of ES. Our results show that provisioning services were more overall perceived, followed by cultural services and regulating services. Youth perceived less regulating and supporting services. Furthermore, cultural services were the most perceived by the seniors. The perception of provisioning and regulating services is influenced respectively by education level and the poverty index. Taking into account the local perception of the different actors and the factors in the decision-making, local development can be improved in compliance with the objectives of biodiversity conservation.

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INTRODUCTION

Forest ecosystems together with human communities living around are facing increasing pressure worldwide (Parrotta et al., 2016). Deforestation, one of the main causes, disrupts its well-functioning through the loss of biodiversity and thus leads to a decline of ES (Kaboré et al., 2015) such as carbon sink (Gouwakinnou et al., 2018; Houghton and Hackler, 2006), soil formation (Sheng et al.,

2015) and food security (Dossou, 2004). Anthropogenic pressures, such as land use, affect biodiversity conservation efforts (Clerici et al., 2007) and the ES (Bidegain et al., 2019; Rodríguez-echeverry et al., 2018; Wilson et al., 2016). Several approaches have been initiated in order to tackle this challenge of loss of biodiversity and ES. One of them highlights the link between biodiversity conservation and ES provision. This approach was the result of the

United Nations Convention on Biodiversity held in 1992, followed by the Millennium Ecosystem Assessments (MEA) in 2005. MEA defines the concept of ES as the benefits that humans enjoy directly or indirectly from the well-functioning of the ecosystem (MEA, 2005). The ratification of this concept has led to its increasing integration into political decision-making relating to the sustainable management and planning of ecosystems (TEEB, 2010). Recently, this provoked an enthusiasm of scientists on the subject to establish the relationship between biodiversity and ecosystem functioning, however with much controversy (Wardle and Zackrisson, 2005). In summing up their studies about the same subject, Costanza et al. (2007) found that a loss of 1% of biodiversity reduces by half the value of the ES provided by a given ecosystem. The goodness of the local and urban population (Naidoo et al., 2011) is therefore indisputable. The local communities that are near to forests ecosystem and tight to use the ecosystem forest' goods and services for their sustenance (Moutouama et al., 2019) are the most vulnerable when these ecosystems are malfunctioning. The economic importance and direct benefit that society enjoy from ecosystems for their well-being have been the subject of recent studies (Angelsen et al., 2014; Belcher et al., 2015; Ahammad et al., 2019).

However, understanding the socio-economic and demographic drivers and the importance of ES are critical (Ouko et al., 2018; Ahammad et al., 2019; Gouwakinnou et al., 2019; Moutouama et al., 2019). Several studies have reported the importance of the social dimension to highlight the value of ES (Scholte et al., 2015; Iniguez-gallardo et al., 2018; Quintas-soriano et al., 2018; Yang et al., 2018). Yet, this social dimension is weakly associated with indirect services though they all contribute to the maintenance of the agricultural system while supporting economic incomes. Similarly, (Cuni-Sanchez et al., 2017) reports that the social science approach in addition to economics and ecology can help to assess ES and to ensure their best estimation. Knowledge, being a factor that influences the aptitudes and the behaviors of people, it helps

to ensure behavioral conformity to management and policies (Ilboudo et al., 2020; Asah et al., 2014) of conservation (Vodouhê et al., 2010). According to Urgenson et al. (2013), understanding the local perception of ES in different contexts is an effective way, to realize the opportunities but also the difficulties that the landscape management is facing. This will help to implement targeted sustainable management strategies to improve the abilities of poor people to help to sustainable conservation to well-enjoy vital ecosystem services (Zhang et al., 2015).

Considering the importance of local perception of ES in ecosystem management, studies in Sub Saharan Africa have more focused on specific habitats including mountain ecosystems (Moutouama et al., 2019), forests reserve (Gouwakinnou et al., 2019; Ouko et al., 2018) though the landscape is in increasing degradation with the different types of land use (Biaou et al., 2019). This difference could affect strategies and policies of management if these do not take into account the different perceptions in the different zones to consider the specifications of each community. This is to implement strategies and policies adopted to their situation and maintain their long-term livelihood.

As in sub-Saharan countries, the forest cover is threatened in the Benin Republic, because the vegetation increasingly undergoing multiple pressures due to agriculture, breeding, logging, urbanization (Hountondji, 2008; Avakoudjo et al., 2014; Biaou et al., 2019; Biga et al., 2020). This study was undertaken to help to implement targeted sustainable management strategies to improve the ability of poor people to obtain vital ecosystem services.

MATERIALS AND METHODS

Study area

The study took place in Benin Republic in the administrative villages of the Sudanian zone (9 ° 45 N and 12 ° 25 N, rainfall varies from 900 to 1100 mm / year) and the Sudano-Guinean zone (7 ° 30 ' N and 9 ° 45 ' N, rainfall varies from 900 mm to 1110 mm / year) (Figure 1). The Sudano-Guinean zone is dominated by

mosaics open forests, likely with dense dry forests, dotted with trees and shrub savannas, and crossed by forest galleries (White, 1983). On the other hand, climatic vegetation of which shrubby savannas and mosaics of farm and fallow and some islets of open forests and wooded savannas (White, 1983) dominate the Sudanian zone. The major trends observed in terms of population growth in some localities in these areas could be the result of an important internal migration (INSAE, 2016). To this is added slash-and-burn farming almost exclusively rain-fed, transhumance, and the exploitation of timber. These activities encroach on the national forest cover from year to year. It gives birth to anthropized ecosystems going from wooded parks to fallows and impacts biodiversity (Sambiéni et al., 2015; Vodouhê et al., 2010) (Figure 1). These areas show a diversity of ethnic groups with different cultural practices.

Site selection and sampling

The study was conducted in two ecological zones. In each zone, three districts were randomly chosen. Six districts namely, Matéri, Toucountouna and Ségbana in Sudanese zone; Parakou Ouaké, and Dassa in Soudano-Guinean zone (Table 2) were considered. Thus 25% of the administrative villages of each district were chosen based on their closeness to forest reserves (Table 1). To define the representative size of the population to be interviewed, the proportion of individuals in each district that benefit from ES and belonging to the primary sector (farming, fishing, hunting, breeding, logging) (Table 1) was noted in the document from INSAE (2016). The size of the sample of people to be interviewed in each village was estimated using the formula proposed by Dagnelie (1998):

$$N = U_{1-\alpha/2}^2 \frac{Pi(1 - Pi)}{\delta^2}$$

Pi: proportion of individuals belonging to the primary sector of each district and who benefit from ecosystems. $U_{1-\alpha/2} = 1.96$, the value of the normal random variable for a risk α equal to 0.05. The expected margin of error δ is 7%. Thus, the number of respondents

estimated by district is distributed proportionally in the villages. To ensure the proper distribution of the number of respondents per village, the size has been increased in certain villages. 689 individuals were considered and distributed in 66 villages. In each village, the individuals interviewed were chosen randomly and ranked according to their activities and their membership of a socio-cultural group. The sample consists only of 18 and over old people. (Table 2). Table 2 shows the demographic characteristics of the individuals sampled in this study.

Data collection

The interviews were carried out from 20 February to 8 April 2019. This study was based on primary data from surveys and data from secondary sources. The secondary data related to socio-economic factors, also including the poverty index. They were collected from official documents published online (*Cahier des villages et quartier de Ville du Bénin*). The primary data collection through a semi-structured questionnaire was used for data collection related to socio-demographic characteristics (age, gender, ethnicity) and socio-economic (education level, main activity) as well as the possession or not of a private plantation (Yes / No). Qualitative data about the perception of ES are also taken into account. After mentioning the services provided by forest ecosystems, each respondent expressed the importance (1 = Not important, 2 = Important and 3 = very important), the satisfaction level (0 = Not satisfied, 1 = Not very satisfied, 2 = Very satisfied) as well as the trend of service provision over the past 10 years (1 = Low, 2 = Intact, 3 = Improvement). The surveys were carried out in the local language when needed. Local field workers were trained on the concept of ecosystem services to limit the ES misinterpretation mentioned by the respondents. The ES mentioned were associated with the list of MEA services listed by Swinton and Zhang (2005) and used by Gouwakinnou et al. (2019). The services listed by Zhang are 29 grouped into three categories adapted from the MEA categories (Table 3).

Open question options were intentionally included to get the services not mentioned by Swinton and Zhang (2005).

Data analysis

The collected data were processed through a descriptive analysis that consisted of determining the frequency of the citation of the ES, the importance, the trend, and the level of satisfaction by climate zones. The perception rate for each category of ES was estimated. The relationship between the number of services cited and the area, on the one hand, and the sex or gender on the other were assessed by the Chi-2 independence test. A Principal Component Analysis was carried out to assess

the correlation between the perception of social sciences and the socio-cultural category. Also, to assess the factors influencing local perception, beta regression was used (Cribari-Neto and Zeileis, 2010). The poverty index, gender, age category (young people (<30 years), adults (30 ≤ age ≤ 60) and the elderly (age > 60)) (Mensah et al., 2017), education level and the possession or not of a private plantation were considered as explanatory variables. The identification rate for each service category was considered as the response variable. Statistical analyses were performed using R software version 3.5.0. (R Core Team, 2018).

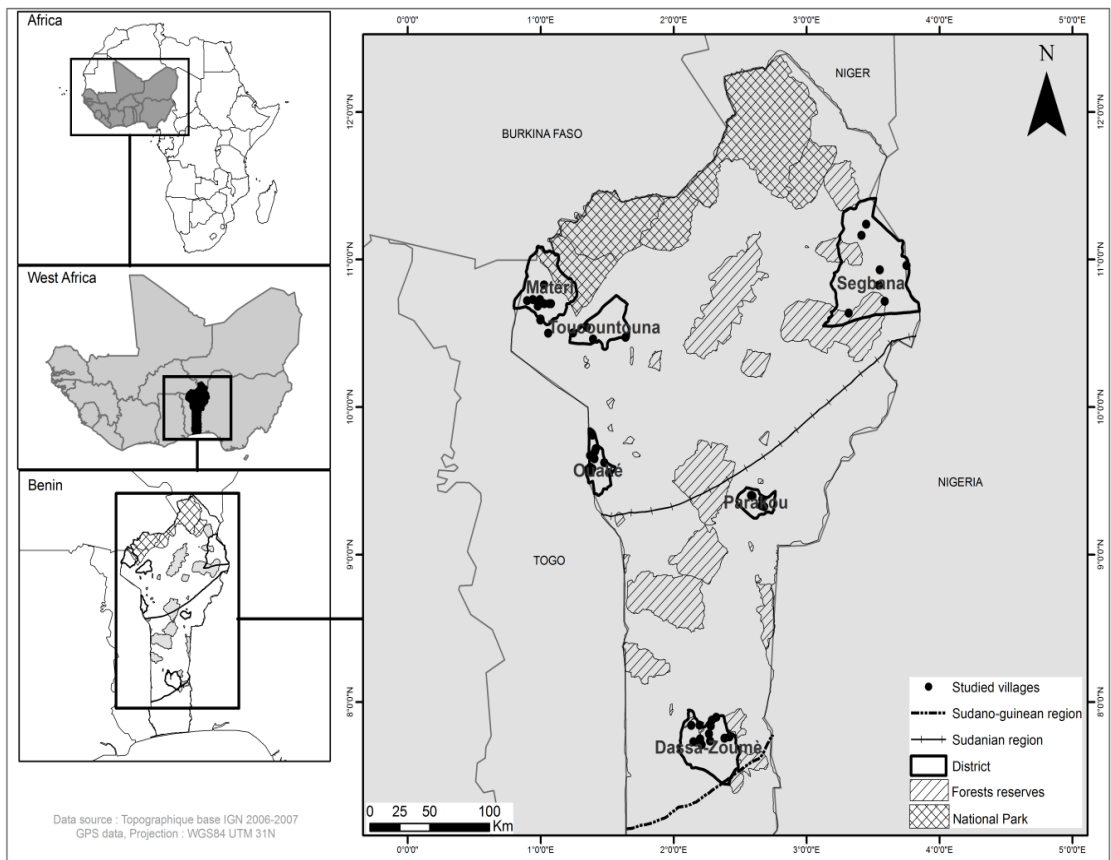


Figure 1: Location of the study zone and districts sampled.

Table 1: Characteristics of the survey sampling.

Districts	Pi (%)	Total number of villages	Number of villages	Number of investigated people
Ouaké	67.8	44	11	176
Matéri	88.4	56	14	98
Dassa	63.5	69	17	174
Parakou	11.8	42	11	88
Toucountouna	86.9	22	6	90
Ségbana	92	29	7	63
Total		262	66	689

(n = 689)

Table 2: Demographic characteristic of respondents according to the ecological region.

Categories		Sudanian	Sudanese-Guinean
Socio-cultural groups	Other	25	17
	Bariba	1	51
	Biali	64	8
	Boo	33	0
	Ditamari	15	1
	Fon	0	60
	Foudou	0	15
	Idaatcha	0	118
	Kabiè	0	15
	Lokpa	0	138
	Nateni	17	0
	Natimba	27	0
	Peulh	21	10
Waama	35	0	
Gender	Women	68	150
	Men	170	283
Age category	Adult	85	146
	Young	129	228
	older	24	59
Socio-professional groups	Farmer	212	401
	Breeder	16	26
	Other	10	6

(n = 689)

Table 3 : Ecosystem services according to MA and repertory by Swinton and Zhang (2005).

Provisioning	Regulating and Supporting	Cultural
• Livestock Feed	• Pollination	• Education and knowledge systems
• Livestock	• Regulation of air quality	• Aesthetic values
• Building	• Erosion regulation	• Spiritual values
• Crops	• Climate regulation	• Cultural practices
• Fuel	• Water purification	• Recreation
• Wild foods (plants et animal)	• Waste treatment	• Cultural heritage
• Ornamental resources	• Natural hazard regulation	• Sense of place
• Plant-derived medicines	• Nutrient cycling	• Ecotourism
• Fresh water	• Noise buffering	
• Aqua-cultural fish	• Soil formation	

RESULTS

Local perception of ecosystem services provided by forest ecosystems

The results showed that the number of ES mentioned is not significantly linked to gender ($\chi^2 = 3.1607$, $\text{dof} = 2$, $p = 0.2059$), but is linked to the climate zone ($\chi^2 = 10.679$, $\text{dof} = 2$, $p = 0.0048$). In general, provisioning services were the most recognized by the local community (81.8%) followed by cultural services (62.5%), regulating, and supporting services (36.36%). Respondents in the Sudanese zone recognized few services than those respondents in the Sudanese-Guinean zone (Figure 2d). The provisioning services well-known in the two zones relate to the supply of wild foods (96% in the Sudano-Guinean zone and 85% in the Sudanian zone), wood-fuels or 95% in the Sudano-Guinean zone and 65% in the Sudanian zone and medicinal plants at 82.8% and 60% respectively in the Sudano-Guinean zone and the Sudanian zone (Figure 2a). The supply of ornamental resources (85% against 32%) and lumber (84% against 25%) were the most mentioned in the Sudano-Guinean zone, unlike the Sudanian zone. The offer of these services meet very little the community' expectation.

Over 50% of respondents have claimed the offer of these ES does not meet their satisfaction. Despite the importance of these ES for social well-being, more than 80% of those surveyed acknowledged their decline over the past five years (Table 4).

The regulation and support services were very little perceived in the Sudanian zone (Figure 2b) except climate regulation (20.28%). On the other hand, services related to climate regulation (85%), air quality regulation (62%), and natural hazard regulation (45%) have been widely known in the Sudano-Guinean zone (Figure 2b). The importance of soil formation has been widely recognized (more than 50%) by the respondents who mentioning it (Figure 2b). The level of satisfaction depended on the type of ES (Table 4). The regulation of natural hazards and the climate does not at all satisfy more than 40% of the respondents, unlike soil formation (55.47%). Although these regulating and supporting services do not satisfy the local community, the improvement in the supply of services over the past five years has been widely reported (over 50%) (Table 4).

Regarding cultural services, the local community in the Sudanian zone (10%) and in

the Sudano-Guinean zone (48%) perceived the spiritual value. Besides, services such as cultural value (15%), recreation (49%), and aesthetic value (15%) were perceived in the Sudano-Guinean zone (Figure 2c). These services are very important for more than 50% of the respondents, but their supply is not very satisfactory (Table 4). These cultural services are in decline according to more than 80% of the local community except for the spiritual value (92.04%) which does not change (Table 4).

Local perception according to socio-cultural group of ecosystem services

The results of the PCA (Figures 3, 4, and 5) showed that the two axes respectively explained the total variances in the frequencies of the rate of provisioning services (60.90%), regulating services, supporting (90.04%) and cultural services (76.32%). Regarding provisioning services, the first axis (37.13%) relates that the supply of wood fuel ($r = 0.85$), the crops ($r = 0.84$), medicinal plants ($r = 0.93$), are the most mentioned by the Natimba, the Bariba, the Kabiè, the Waama and the Ditamari social-cultural group. On the other hand, the supply of fodder ($r = -0.34$) and freshwater ($r = -0.27$) are more perceived by the Biali and the Lokpa social-cultural group (Figure 1a). The second axis (23.77%), shows that the provision of ornamental resources ($r = 0.89$) is more perceived by the Lokpa, Ditamari, Kabiè, Nateni and Boo ethnic groups while for the Foudou, Natimba and Peulh communities, it is the supply of fodder ($r = 0.47$).

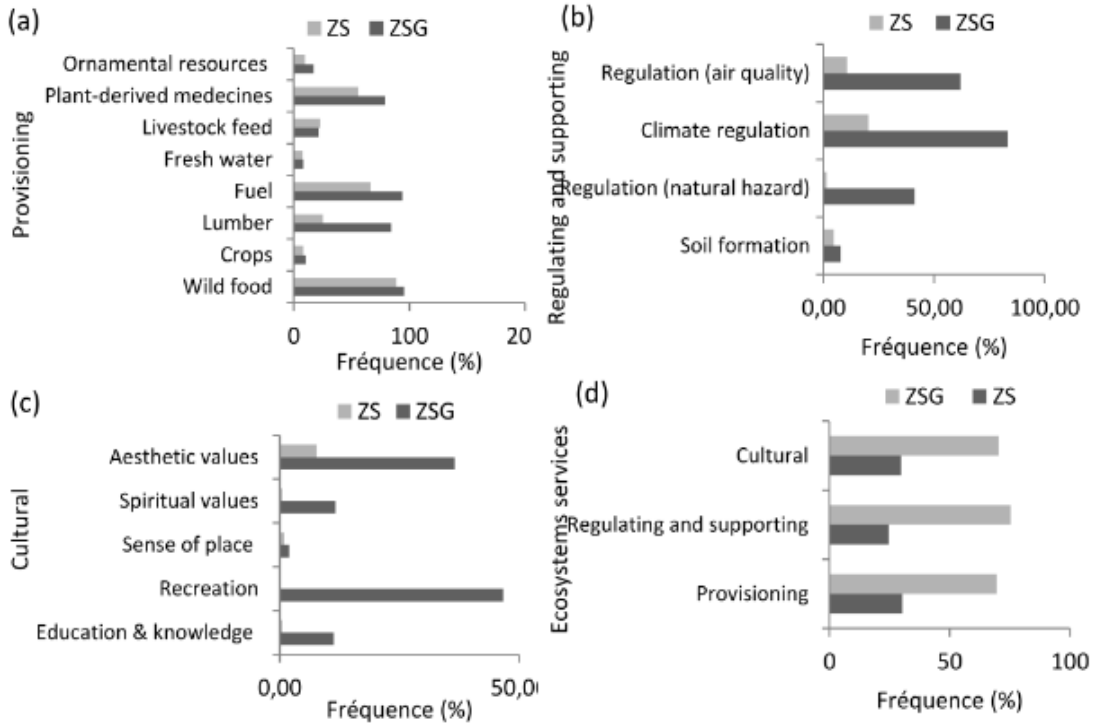
For regulation and support services, the first axis (56.3%) is significantly and positively correlated with the natural hazard regulation ($r = 0.88$), the regulation of air quality ($r = 0.97$), and climate regulation ($r = 0.90$). These services are the most cited by the Bariba and the Idaatcha social-cultural group. The second axis (23.3%) is significantly and positively

correlated with soil formation ($r = -0.96$). Natimba and the other social-cultural groups (Figure 4) perceived this service.

It appears from the projection of cultural services that axis 1 (49.68%) shows, that the Kabiè, Waama and Peulh conceive that the education and knowledge system ($r = 0.71$), recreation ($r = 0.87$) and the aesthetic value ($r = 0.83$) are forest cultural service. On-axis 2 (26.65%), we found that for the Bariba the Nateni and the others, the forest has a particular and supernatural meaning. For the Kabiè, Waama, and Peulh ethnic groups, forests are more perceived as sites of education and knowledge of aesthetic value.

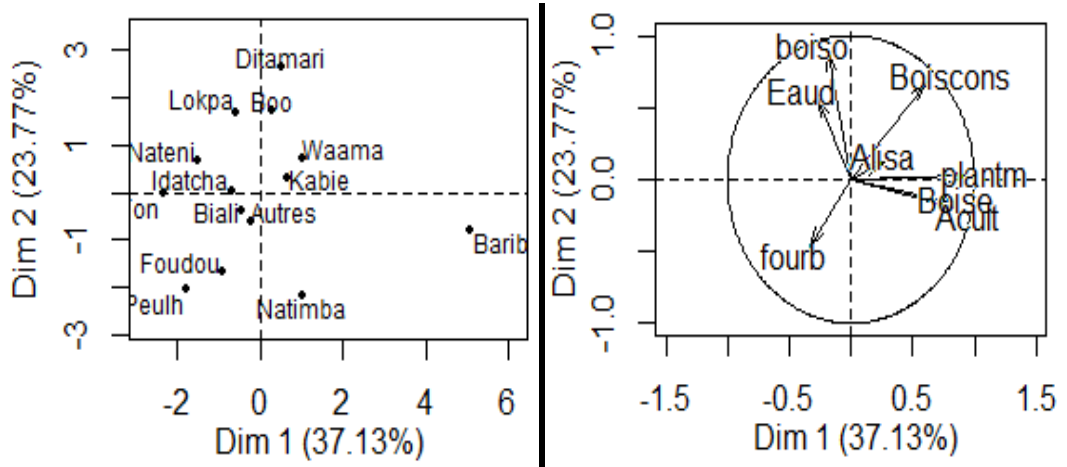
Factors determining the perception of ecosystem services

It appears that several socio-demographic and socio-economic factors influence the perception of the local community of each category of ES. The poverty index is significantly and negatively determinants in the perception of provisioning services and regulating and supporting services ($p < 0.05$, Table 5). The level of education was also a significant determinant in the perception of provisioning services, regulating and supporting services ($p < 0.05$, Table 5). People from and above primary school perceived the provisioning, regulating and supporting services more significantly, unlike those with no education. Also, young people significantly less perceived regulating and supporting services compared to adults and the seniors ($p < 0.05$, Table 5). Furthermore, cultural services were the most significantly cited than adults and young people ($p < 0.05$, Table 5). People who own tree plantations were more significantly aware of provisioning, regulating and supporting services than those without plantation ($p < 0.05$, Table 5). Let's note that gender did not influence the perception of the three categories of ES ($p > 0.05$, Table 5).



ZS= Sudanian Zone; ZSG= Sudanese-Guinean Zone

Figure 2: Identification rate of each Ecosystem Services groups according to ecological zone.



Eaud=Fresh water; boiso=Ornamental resources; Boiscons=Lumber; Alisa=wild food; fourb=Food

Figure 3: Projection of provisioning ecosystem services perception and sociocultural group in the principal space of PCA.

Table 4: Importance, satisfaction and trend of ecosystem services provided by the forest ecosystem.

Perception	Importance (%)			Satisfaction (%)			Trend (%)		
	None	Important	Very Important	Not satisfied	Very satisfied	Not very satisfied	Intact	Low	Improvement
Provisioning services									
Livestock feed	0.65	33.50	65.86	29.06	9.58	61.36	2.91	83.98	13.11
Lumber	0.86	40.54	58.60	29.38	5.21	65.41	1.01	88.79	10.20
Wild food	1.72	32.50	65.77	30.19	5.77	64.04	1.92	88.89	9.20
Fresh water	1.96	47.06	50.98	27.45	0.00	72.55	2.00	96.00	2.00
Feed	0.00	30.00	70.00	30.00	11.67	58.33	5.17	84.48	10.34
Crops	0.68	36.05	63.27	25.17	4.08	70.75	2.68	87.92	9.40
Plant-derived medicines	0.46	27.19	72.35	28.87	6.47	64.67	2.75	90.83	6.19
Ornamental resources	0.00	35.80	64.20	28.75	5.00	66.25	3.75	91.25	5.00
Regulating and supporting services									
Soil formation	1.56	25.00	73.44	33.59	10.94	55.47	11.90	9.52	78.57
Air quality regulation	0.98	45.59	53.43	14.87	6.15	78.97	1.82	8.48	89.70
Natural hazard regulation	0.00	24.35	75.65	56.25	2.68	41.07	1.85	97.22	0.93
Climate regulation	0.32	34.42	65.26	49.16	3.03	47.81	1.02	95.59	3.39
Cultural services									
Aesthetic value	11.90	23.81	64.29	16.67	2.78	80.56	5.26	94.74	000
Knowledge system	0.00	29.03	70.97	13.33	6.67	80.00	7.41	88.89	3.70
Recreation	0.00	34.17	65.83	1.72	2.59	95.69	2.80	90.65	6.54
Sens of place	0.00	25.00	75.00	25.00	12.50	62.50	12.50	87.50	0.00
Spiritual value	3.88	28.68	67.44	33.33	3.70	62.97	92.04	0.88	6.72

(n = 689)

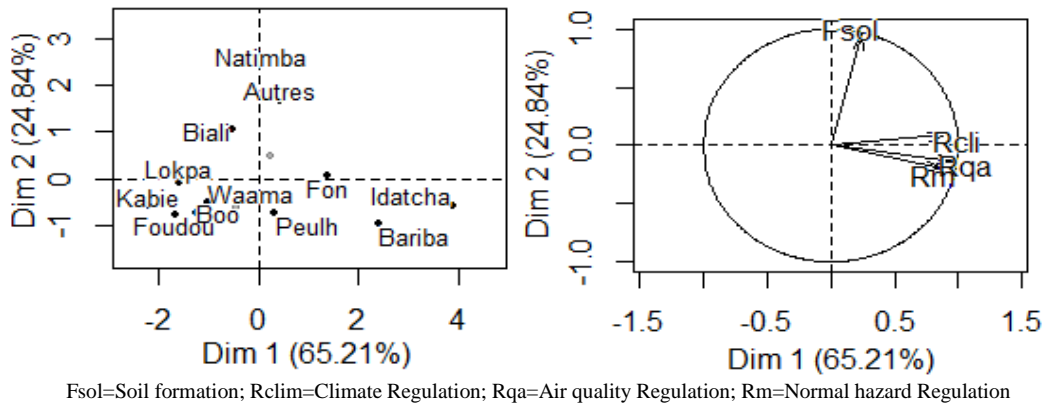


Figure 4: Projection of regulating, supporting ecosystem services perception and sociocultural group in the principal space of PCA.

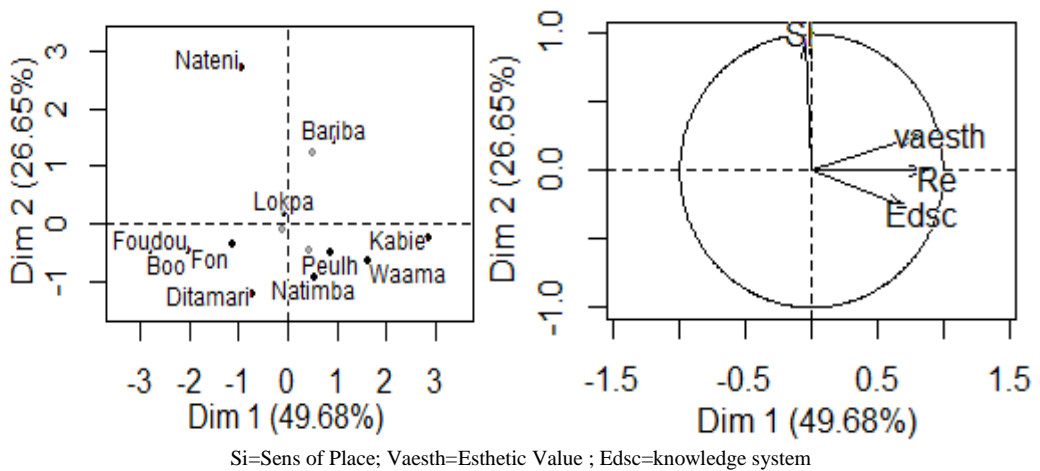


Figure 5: Projection of cultural ecosystem services perception and sociocultural group in the principal space of PCA.

Table 5: Determinants in the perception of Ecosystem Services of the Sudanese and Sudanese-Guinean zones.

Services	Provisioning		Regulating and Supporting		Cultural	
	$\beta \pm SE$	P	$\beta \pm SE$	P	$\beta \pm SE$	P
Constant	1.46±0.21	<0.001***	1.37±0.40	<0.001***	-2.02±0.37	<0.001***
Poverty	-0.04±0.00	<0.001***	-0.06±0.1	<0.001***	0.00±0.01	0.94
Young people	-0.06±0.06	0.33	-0.23±0.11	0.039*	0.09±0.10	0.41
Old	0.03±0.08	0.7	0.08±0.15	0.57	0.63±0.14	<0.001***
Elementary school	0.13±0.06	0.037*	0.25±0.12	0.037*	-0.05±0.11	0.64
Secondary school	0.35±0.07	<0.001***	0.29±0.13	0.031*	-0.04±0.12	0.74
University	0.90±0.22	<0.001***	1.42±0.43	<0.001***	-0.04±0.38	0.92
Gender	-0.04±0.06	0.53	-0.01±0.11	0.93699	0.10±0.10	0.34
Sudano-guinean	-0.32±0.08	<0.001***	-0.51±0.16	<0.01**	0.13±0.14	0.36
Private Plantation [Yes]	0.19±0.05	<0.001***	0.25±0.10	0.012*	-0.01±0.09	0.9

$\beta \pm SE$: Estimate \pm Standard Error

DISCUSSION

Local perception of ecosystem services

The local perception of ES varies within the local community. This suggests the complexity of the relationship between local perceptions and ES (Boafo et al., 2014). Provisioning services were more widely perceived, followed by cultural services, regulating, and supporting services. This result is explained by the tangible nature of provisioning services, unlike regulating and supporting services and cultural services (Lamarque et al., 2014; Martin-Lopez et al., 2012). Besides, provisioning services are directly involved in community well-being. This result corroborates those of Rodríguez et al. (2006), Muhamad et al. (2014), Ouko et al. (2018), Ahammad et al. (2019) and Gouwakinnou et al. (2019) and suggests that tangible services directly affect the community, unlike indirect services (Fisher et al., 2011; Ouko et al., 2018). It appears that the ES as a whole were more perceived in the Sudano-Guinean zone of Benin Republic. This result could be explained by the degraded state of forest ecosystems in the Sudanese domain as reported by several authors (Mama et al., 2013; Oussen et al., 2016; Biaou et al., 2019). The poor knowledge of the ES by the local community in Sudanese zone is also explained by the differential level of development between the two ecological zones considered because in the Sudan-Guinean zone there are more developed localities than in the Sudanian zone. The most cited provisioning services in the Sudano-Guinean and Sudanian areas being the supply of wild food, wood energy, the supply of ornamental resources and medicinal plants, this result shows the dependence of the local community to close-ecosystem which provide services for their well-being, because they are important to them and satisfy the majority of the population. This supports the findings the rural community prioritizes substantial ecosystem benefits (Martín-López et al., 2012) whereas the urban community values only the more abstract services (Kroll et al., 2012). For example, collecting wild food

can be an essential alternative source to enable people to maintain their livelihoods during lean periods (Ahammad et al., 2019). This is also the case with the supply of medicinal plants that help to cure illnesses (Gouwakinnou et al., 2011). Despite the tangible nature of these ES, their identification rate distinguishes socio-cultural groups. This various use of forest ecosystems by socio-cultural groups suggests that the local community has a good knowledge of the material goods provided by close-ecosystems and according to socio-cultural practices.

On the one hand, regulating and supporting services are lowly mentioned in the Sudanian zone except for climate regulation, though they are the main basis for the production of provisioning services. On the other hand, in addition to climate the community of the Sudano-Guinean zone mainly cited regulation, services related to air quality and the regulation of natural risks. This can be justified by the high concentration of environmental projects in the Sudano-Guinean zone than the Sudanian zone. This result corroborates those of Gouwakinnou et al. (2019) who showed the critical role of environmental education sessions and the intervention of projects within the local community. For Zhang et al. (2015), an environmental awareness can be explained by reforestation activities. Thus, this would explain the high number of mention of air quality service by the local community in the Sudano-Guinean area. Only a few socio-cultural groups in the two climate zones also perceived the regulating and supporting services. Therefore, out of a dozen socio-cultural groups, only four were able to cite regulating and supporting services. Services such as soil formation have not been known by the community, although soil quality is the most important element in most ES and forms the basis of primary production (TEEB, 2011). The poor mention of forest involvement in soil formation constitutes the reasons for land use without any sustainable land management initiative. This is worrying for sustainable land

management because the population of the two climatic zones is mainly constituted of farmers. This result shows the importance of integrating a policy to sensitize people to strengthen the local perception of ES. This also confirms the relationship between the development level and the perception of indirect services. The under-developed localities, is concerned more with the improvement of its livelihood rather than with the factors of which depend on this livelihood. The low level of satisfaction with these services also shows the decline in forests, which modifies the ecological function of forest ecosystems. The actions of the population are more oriented towards activities that improve their income, for example, the establishment of private plantations dominated by *Anacardium Occidental*, *Tectona grandis*, and *Gmelina arborea*.

Cultural services, though intangible, contribute to the protection of biodiversity and therefore to the maintaining of ES. The services cited by the community related to the improvement of education and knowledge systems, spiritual value, and sense of the place. The perception of these services depended on socio-cultural groups. This suggests an intercultural difference in the services provided to each community (Vodouhê et al., 2009; Houehanou et al., 2011). The difference in citing cultural services within socio-cultural groups could be due to the influence of traditional knowledge regarding the forests and trees.

The local community also expressed the importance of cultural services. This result also shows the community's link to their forest. This cultural importance of forests should reflect the positive attitudes of the community towards the conservation of the natural forests of each region. The study by Fritz-Vietta, (2016) in Madagascar is a case where populations protect some of forests and trees for spiritual beliefs aimed at increasing well-being. Nowadays, we notice in the two study areas an uncontrolled exploitation of ecosystems as well as community forests dedicated to conservation. The regressive trend

of these cultural services suggests the forests are losing their sacred aspect (Ryan et al., 2016) what impact conservation practices. According to Mama et al. (2013), the socioeconomic changes of human societies through the non-respect of ancestral nature conservation practices based on the development of myths and fear by the younger generation is the cause of the regression of forest ecosystems and therefore cultural services. Also, the change in religious beliefs and the decline of the influence of traditional chiefs don't facilitate to realize the importance of what is sacred (Byers et al., 2001; Sheridan, 2009) and ease the regression of spiritual and cultural values of forests not perceptible.

Taking into account the diversity of advantages offered by forest ecosystems and participatory decision-making can facilitate integrated forest management in types of land use (Ahammad et al., 2019). One of the objectives of Benin's forest policy is to improve forest cover without the necessary consideration of the socio-economic aspects that would contribute to the well-being of the population. This encourages managers to plant exotic species that are not very useful for the community. This approach to planting exotic species without taking into account the needful species for the community proves to be irrelevant because it does not contribute to biodiversity conservation and sustainability in supplying ES. Forest policy, focus on increasing of number of forest species, should take into account the aspirations and satisfaction of ES to increase the interest of populations in adapting to land use planning.

Socio-economic drivers of ecosystem services

We found that the poverty index is negatively correlated with the perception of provisioning services and regulating and supporting services. This seems surprising for provisioning services, because poor people are more interest in provisioning services that step in its livelihood. This suggests that apart from the living standard of the population, other

factors must be taken into account. However, income can be decisive, because as shown by (Ahammad et al., 2019), the middle-income and wealthiest, are given the importance of provisioning services to improve their income. Regarding the correlation of regulating and supporting services with people on a low income could be explained by the non-tangible nature of this service, because very few socio-cultural groups were able to cite these services. Also, its understanding requires mastery of ecological processes (Zhiyum et al., 2011).

Besides, people with at least a primary level of education perceived in a significant and positive way the provisioning, regulating and supporting services unlike the uneducated. This suggests that education has a positive effect on knowledge of regulating and supporting services and provisioning services. These results corroborate those of Martín-López et al. (2012), Mensah et al. (2017), Ahammad et al. (2019), Gouwakinnou et al. (2019) and Moutouama et al. (2019) respectively in Bangladesh, Spain and South Africa and Benin which demonstrate that education could induce the attitude of people to support conservation policies and improve the attitude towards natural resources. Also, people age significantly influences the perception of the various ecosystem services except the supply service. Younger people less identified regulating and supporting services compared to adults and seniors. This result confirms (Moutouama et al., 2019) which explains the situation by the probable low experience of young people of disturbances and changes in agriculture. Young people with less experience of their environment probably do not have a reference base for perceiving the contribution of ecosystems to maintaining global balance. For Mensah et al., (2017), this is due to the accumulation of knowledge by older people over time. The seniors prefer cultural services linked to nature experiences while the young in urban areas tend to socialize (Riechers et al., 2018). Furthermore, cultural services were more widely known by the seniors than adults and young people. This shows the cultural

conservationist behavior of elderly people, while the youth who is more attached to modern things. This confirms that the lack of information and experience can affect people perception of cultural services and also on the value they attribute to these (Mensah et al., 2017).

Gender shows no effect on people perception of ES. This seems surprising, because in Africa women are mostly involved in the ES collection (Mensah et al., 2017; Moutouama et al., 2019) respectively in South Africa and mountainous ecosystems in Benin. The crucial role of women in the household (Martin-Lopez et al., 2012) promotes awareness of the benefits and importance of direct environmental services (Allendorf and Yang, 2013). However, it seems obvious that ES that forest ecosystems provide today are all involved in the collection and exploitation of the different resources of the forest. Regarding regulating and supporting services, the issue of climate change, impacts, for example, all the ES that the community can benefit from forest ecosystems.

Conclusion

This study provides information for designing strategies and programs for better planning of local development linking with the objectives of biodiversity conservation. It shows how local perception, appreciation (importance, level of satisfaction, and tendencies of ES varied within the local communities. Provisioning services were ES category well perceived by local people even if their expectations are no longer meet due to a decline in supplying these services. The well knowledge of supply services unlike indirect services (regulating, supporting, and cultural) should incite to design an environmental education plan to improve knowledge of indirect services. Also, factors such as levels of education, age, socio-cultural group, and levels of prosperity highly influence the local perception of the various services. The integration of these factors would be a crucial point for policy and decision-making to

process for ecosystem restoration as a source of the well-being of the population. The poverty index is a main factor in the perception of ES, it is appropriate to set up programs to improve livelihoods. Promoting income-generating activities around forest ecosystems could improve the living conditions of the local population. This would reduce the pressures on forest ecosystems.

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AUTHORS' CONTRIBUTIONS

FCA, GNG and SSHB conceived the idea for the research project. FCA and SB collected and analyzed the data. FCA write the initial manuscript with contributions from GNG, SB and RCS All authors contributed critically to the discussion and edited the manuscript before submission.

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