Mangrove Degradation and Endogenous Strategies for Participatory Restoration and Conservation in Benin

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Abstract

Mangrove ecosystem represents an important coastal resource, which is vital to the livelihood of local communities. Due to the high anthropogenic pressure, mangroves ecosystems are overexploited and degraded. The present investigation was undertaken in three Districts from the coastal area of Benin in order to understand the relationship human-mangrove and to provide baseline information for its sustainable management. Two types of surveys were conducted from November 2011 to February 2012: the survey of the population (180 structured interviews) and of responsible persons in public office (19 semi-structured interviews). The interviewees were randomly selected from three Districts. Mangrove use value was assessed and non parametric test was used to test the statistic difference of the mangrove use value between socio-demographic characteristics. Principal Component Analysis was applied for the analysis of endogenous strategies for mangrove conservation/restoration and helped to describe the relationship between proposed endogenous strategies according to the different socio-demographic traits of informants. The Beninese mangrove supplies fuel and service wood, forage, fishery products, medicinal plant species and cooking salt for local communities. Mangrove areas are also used for agricultural purposes and human settlements. Findings showed significant difference in mangrove use categories between the Districts. Regarding the gender, significant difference was observed for fuelwood, service wood and salt production. Differentiation between ethnic groups for salt production and fishery purpose was observed. Nonetheless, perceived mangrove degradation by local population did not significantly vary from one District to another. Local communities are aware of the necessity for the restoration and sustainable conservation of the mangrove. Various restoration and conservation measures were suggested according to socio-demographic characteristics of informants.

Keywords: Mangrove, degradation, endogenous strategy, gender differentiation, Benin

1. Introduction

Mangroves are ecosystems which represent a high priority of conservation over the world because of their highest production and exceptional flora and fauna (Nagelkerken et al., 2008; Polidoro et al., 2010). Due to the important downfall of leaves, flowers and fruits, mangroves belong to the most productive ecosystem over the world. The total mangrove biomass may reach 700t/ha (Clough, 1992). Ong et al. (2004) and Komiyama et al. (2007) estimated about 460 t/ha per annum the mangrove productivity. According to Twilley et al. (1992), the total global mangrove biomass was estimated to be approximately 8.7 gigatons dry weigh (i.e. 4.0 gigatons of carbon). This important production (organic matter) is decomposed by bacteria and mushroom, and enters therefore in the food chain which plays an important role for biological conservation. According to Kathiresan and Rajendran (2005/2006); Walters et al. (2008); Lucy (2006), and Nfotabong-Atheull et al. 2011), mangroves provide for surrounded populations goods and services, and improve local population livelihood (fishes harvesting, fire wood, salt's production and medicine's uses). Thus the mangroves ecosystems are socioeconomically and ecologically important for local communities. Despite their importance, many works worldwide underlined that mangrove areas are decreasing at an alarming rate even more rapidly than any other type of tropical forests (Ahana et al., 2011).

Like in the tropic countries, mangrove in Benin is facing to the same regressive situation although they pertain to the Ramsar sites 1010 and 1018 in Benin (MEPN/PNUD, 2009). They shelter many species which are not found in any other ecosystems in the country. Mangrove is used by local population for many purposes: fishery, fuel wood, salt's production and medicine's uses. The high demographic

pressure observed at the coastal area lead to a rapid degradation of the mangrove (Bamisso, 2006). Unfortunately, mangrove loss may increase the vulnerability of local population to poverty since most coastal people draw the essential of their needs and income from this ecosystem. In addition, mangrove destruction can release store carbon and aggravate global warming trends (MacDicken, 1997; Fujimoto, 2000). Therefore, mangrove ecosystem needs high priority of conservation due not only to the high anthropogenic pressure that they are facing to but also to their restrict extent and ecological functionalities at the coastal zone. Thus, it appears necessary to define participatory strategies for mangrove rehabilitation by providing baseline information for its sustainable management.

The present study was undertaken in three Districts from the coastal area of Benin and fifteen villages adjacent to the coastal lake. The main goal of this study was to understand the relationship human-mangrove in the study area for setting up participatory sustainable mangrove management in Benin. Specifically, the work aims at: (i) assessing the importance of the mangrove for local communities; (ii) evaluating the vulnerability factors which threat the mangrove ecosystem viability, and (iii) identifying endogenous strategies for mangrove restoration and conservation which will be accepted and adopted by local communities.

2. Investigation Area

The investigation area includes three Districts from the coastal area of Benin. There are the Districts of Sèmè, Ouidah and Grand Popo (Fig. 1). The coastal area of Benin is situated at the Gulf of Guinea, alongside the Atlantic Ocean in West Africa and extends between 1°35´ and 7°30´ eastern longitude from Togo in the west to Nigeria in the east and between 6°20´ and 7°30´ northern latitude. It covers an area of approximately12,000 square kilometres corresponding to 10.5% of the national surface. This area is characterized by a coastal lagoon with ancient and recent lagoons extending more than 30 km into the littoral zone. Blind drainage areas with flat depressions can be found throughout the area. According to the Troll's classification (Troll, 1965), the littoral is situated in the sub-humid tropical climate zone (V2). It is characterized by two rainy seasons from April to July and October to November, and two dry seasons, from August to September and December to March (Adam and Boko, 1993). The annual precipitation ranges from 820 mm to 1300 mm and the annual average temperature is about 33°C, with weak daily thermal amplitudes of approximately 3°C (Afouda and Houanye, 2004). The most significant soil types are sandy soils, hydromorphic soils, and ferralitic soils (Adam and Boko, 1993). The native vegetation is essentially composed of a semi-deciduous forest which has been transformed in a mosaic of traditional agroforestry systems (fallows, fields and plantation) and human settlements (Adomou, 2006). The mangrove is located along the coastal lagoon and is exploited by local population for various uses. Currently, the number of inhabitants of the investigation area is estimated to be roughly 60,000 inhabitants (INSAE, 2003). This area represents the most densely populated zone in Benin. The littoral is mainly populated by Fôn, Mina, Houeda and Xlâ as well as the related ethnic groups who have traditionally been the owners and users of the land. The main activities of this population are agriculture, fishery, cattle-breeding, salt production, processing of agricultural products, small commerce, marine sand exploitation, and hunting.

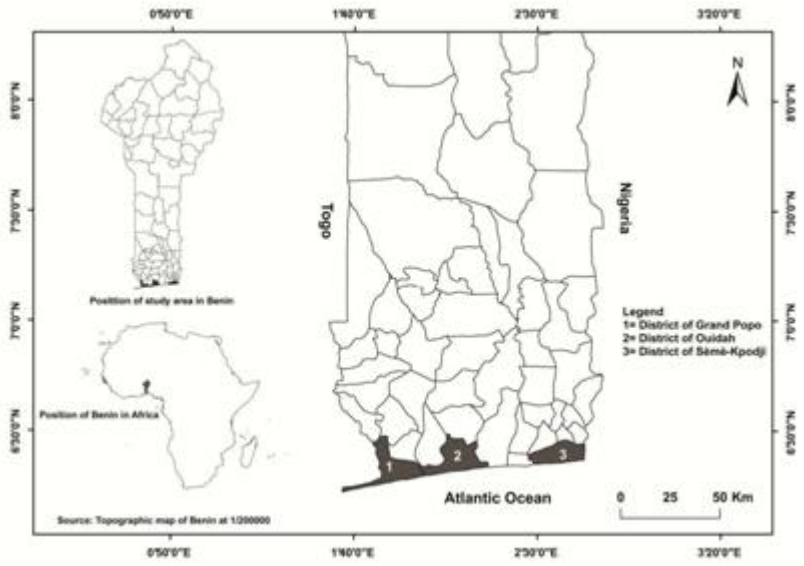

Figure 1: Investigation area

3. Methodology

3.1 Data Collection

Basically, two types of surveys were conducted: (i) the structured interviews with 180 informants and (ii) semi-structured interviews with 19 responsible persons in public office as well as local authorities. These surveys were conducted from November 2011 to February 2012. The interviewers were randomly selected from 15 villages of the three investigated districts. Altogether, 77 women and 103 men from four ethnic groups were interviewed. The questions were related to: (i)-mangrove use by local population (use categories). In addition informants were asked to give a score to each use category. The scores scale vary from 1 to 3 (1 = low importance of the use, 2 = average importance of the use and 3 = high importance of the use), (ii)-the trend of mangrove area (regression, progression and stability), (iii)- threats to mangrove ecosystems conservation, (iv)- endogenous strategies currently use for mangrove restoration and conservation by local communities, (v)- the effectiveness of these endogenous strategies and the way to improve them.

3.2 Data Analysis

Appropriate identification of research participants is critical to the science and practice of psychology, particularly for generalizing the findings, making comparisons across replications, and using the evidence in research syntheses and secondary data analyses. If humans participated in the study, report the eligibility and exclusion criteria, including any restrictions based on demographic characteristics.

The use value of the mangrove ecosystem was determined per ethnic group; age category and gender by assessing the scores give by the informants for the different use value of the mangrove. The use value was computed per use category of the mangrove following Phillips and Gentry (1993) by:

$$UVp = \frac{1}{n_c} \sum^{n_c} Si$$

1

Where Si represent the score give by the informant for a given use category (p) of mangrove, nc is the number of informant interviewed in each ethnic group, age category and gender type.

The overall use value (OUV) of the mangrove was computed as:

$$OUV = \sum_{1}^{j} UVp$$

Where j represented the number of use category for the mangrove.

Since the use value data do not meet the assumption of normality we used a non parametric test (Man Whitney and Kruskal-Wallis) to test whether there was statistic difference in the use value of the mangrove for the different category regarding the ethnic group, age category and gender. For the analysis of endogenous strategies for mangrove conservation/restoration, informants were distinguished according to ethnicity, gender, age as well as their location. The members of each ethnic were grouped according to sex, men (Mi) and women (Fi) as well as age like Teka and Vogt (2010): (1) young adults ($i \leq 30$ years old); (2) adults ($30 < i \leq 60$ years old) and (3) elderly persons ($i \geq 60$ years old). In each ethnic group, six subgroups were defined: young men (M1), adult men (M2), old men (M3), young women (F1), adult women (F2) and old women (F3). Thus, 24 subgroups were derived from the four ethnic groups. The relative frequency citations of proposed endogenous strategies for mangrove restoration were determined for every subgroup within the 24 subgroups. The relative frequency is defined as the proportion of interviewees belonging to the subgroup who identify the different the proposed endogenous strategies.

Data matrix comprising the different relative frequencies of the endogenous strategies type according the 24 subgroups were then submitted to the Principal Component Analysis (PCA) using SASv9 software. This statistical method based on relative frequencies also allows minimizing the effect of the difference of the number among the different subgroups. PCA was applied in order to describe the relationship between proposed endogenous strategies according to the different socio-demographic traits of informants. For graphic purposes, the subgroups are labelled by preceding the ethnic group prefix with the label of one of the six groups defined above. For example, a young man from the ethnic group of Fôn is labelled FonM1, whereas an old woman from the same ethnic group is labelled FonF3.

4. Results

4.1Importance of the Mangrove for Local Communities

Our results revealed that mangrove is used by the local population for 6 main use categories namely fuelwood, service wood, forage, salt production, medicinal uses, fishery (Fig 2). Apart from these use categories the Beninese mangrove areas are also used for agriculture and human settlements.

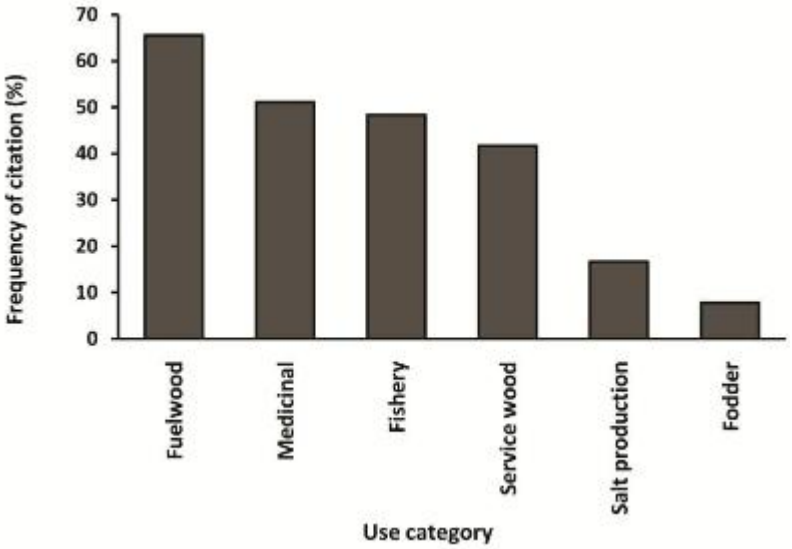

Figure 2: Mangrove use category in the coastal area of Benin

Roughly investigation showed significant difference in mangrove use categories between the districts (Chi-Sq = 22.3; P = 0.014). Whereas the District of Ouidah is characterized by a strong exploitation of the mangrove as fuelwood (70%), service wood (46.6%) and salt production (40%), the District of Grand-Popo is characterized by the use of the mangrove for medicinal purpose (53%), fishery (55%) and fodder (13.3%). In the District of Sèmè, the mangrove is characterized mainly by its use as fuelwood (66%), medicinal purpose (50%) and weakly as fodder (3%) and salt production (3%). This spatial differentiation of the mangrove use categories among surveyed Districts was also observed for the other uses. Indeed, the settlement of the mangrove is largely observed in Grand Popo and Sèmè while its use for agricultural purpose is highly observed at Ouidah and Grand-Popo.

4.2 Use Differentiation between Gender, Age Classes and Ethnic Group for Mangrove Use

With respect to gender, significant difference was observed for fuel-wood, service wood and salt production showing that man and woman use differently the mangrove resource for wood and salt production purpose (Table 1). In fact, salt production was highly practiced by women specifically in the District of Ouidah. Fuel-wood were principally collected by women for cooking while service wood was harvested by men for building or handicraft. We also observed that the different ethnic groups use differently the mangrove resource for salt production and fishery purpose (Table 1). Houédah and Fôn accorded high importance to the mangrove use for salt production as for fishery. For the age category, significant difference was observed for mangrove use in traditional medicine, fishery and fuel-wood. While the elderly people used the mangrove for medicinal purpose, young people accorded less importance for such use in all the investigation districts.

Table 1: Mangrove use value according to gender, ethnic group and age category

	Gender				Ethnic group						Age				
	Women	Men	U	P	Fon	Houédah	Mina	Xwla	H	P	Young	Adult	Elder	H	P
Fuelwood	2	0.97	1624	0.000***	1.78	1.44	1.06	1.67	3.55	0.314	1.71	1.80	0.96	6.67	0.036*
Service wood	0.25	1.47	909	0.000***	1.00	0.67	0.67	1.11	3.51	0.319	0.83	1.04	0.71	1.25	0.535
Fodder	0.17	0.19	1296	0.767	0.28	0.17	0.00	0.28	6.2	0.102	0.17	0.17	0.21	0.19	0.912
Salt production	0.58	0.08	1450	0.022*	0.56	0.67	0.00	0.11	8.86	0.031*	0.33	0.42	0.25	0.24	0.888
Fishery	0.94	0.94	1312	0.986	1.00	1.33	0.39	1.05	11.09	0.011*	1.16	1.17	0.50	9.68	0.008**
Medicinal	1.33	1.28	1327	0.882	1.39	1.28	0.94	1.61	2.6	0.458	0.375	1.88	1.67	16.56	0.000***
OUV	5.28	4.94			6.00	5.55	3.05	5.83			4.58	6.45	4.29		

OUV= Overall use value, U = Man-Whitney Statistics, H = Kruskal-Wallis statistics, P = Level of significance;

** $P < 0.01$, *** $P < 0.001$

4.3 Local Assessment of Mangrove Dynamic

In general, local population observed mangrove degradation in the three districts (Figure 2). The majority of the informants declared the mangrove regression (Grand-Popo: 66.2%; Ouidah: 68%; Sèmè-Kpodji: 62.5%). Only little proportion of informants opined for the mangrove progression (Grand-Popo: 9.5%; Ouidah: 10.7%; Sèmè-Kpodji: 11.1%). Nonetheless, the perception of mangrove degradation by local population did not significantly vary from one district to another (Chi-Sq = 0.676, P = 0.954).

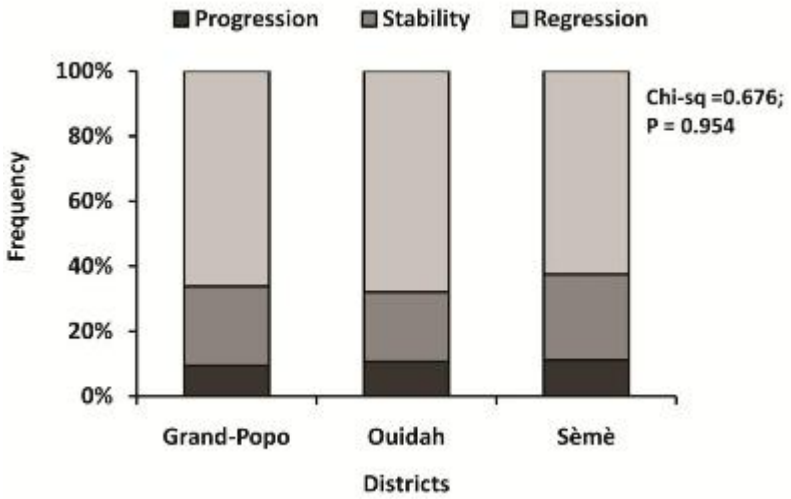

Figure 3: Perceived trend of mangrove cover in the coastal area of Benin

4.4 Vulnerability Factors of Mangrove

The figure 4 displays the vulnerability factors of mangrove according to local population. The wood harvesting (54.4%), the urbanization and anarchic settlement (40%), and the disrespect of traditional rule (30%) represented the main factors of mangrove vulnerability in the coastal area in Benin. The fishery, salt production, fodder and vegetation fire were less mentioned as vulnerability factors of mangrove. Apart from this general trend, we observed a specificity of the vulnerability factors according to the investigated district. For the population of Sèmè, the urbanization remains the principal factor for mangrove vulnerability while the climate change through marine intrusion was the most mentioned by coastal inhabitant of Grand-Popo. At the same time population in Ouidah mostly declared the wood harvesting as the major threat for mangrove conservation. Socio-demographic traits like ethnicity, age and gender do not affect the opinion of local communities regarding the vulnerability factors of mangrove. However, the religion affiliation seems to play a relevant role. Indeed the traditional religions adherent stated mostly the disrespected of the traditional rule while Christian and Muslims declared respectively, the wood harvesting, the urbanization, the climate change and the vegetation fire as main factors which threat mangrove viability. The salt production and fodder were less expressed by Christian and Muslims.

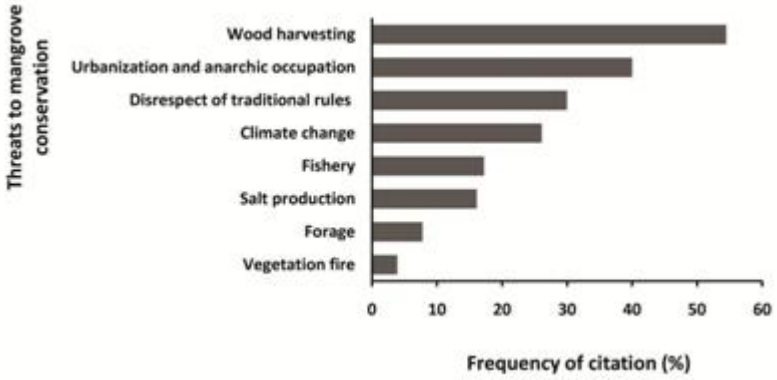

Figure 4: Threats to mangrove conservation in the coastal area of Benin

4.5 Restoration Strategies and Sustainable Conservation of Mangrove

The investigated populations from the three districts are aware of the necessity for the restoration (82.2%) and sustainable conservation (68.3%) of the mangrove. For the restoration, population agrees that one may plant the mangrove trees (*Rhizophora racemosa* and *Avicennia germinans*). At the same time they insist on the new alternative for service and firewood supply.

The PCA performed on the frequencies citation of the proposed strategies of mangrove conservation by the subgroups showed that the two first axes explained 72% (axis1 = 48% and axis 2 = 24%) of the total variation. Therefore, only these axes were used to describe the relationship between the socio-demographic subgroups and the mangrove conservation strategies. Table 2 presents the correlation of initial variables and the two principal axes (eigenvalue). The axis 1 is positively correlated with restoration of traditional rules, avoiding of anarchic settlement, mangrove tree planting, and negatively correlated with solar salt production and reconversion of mangrove users. At the same time, the axis 2 is positively correlated with alternative fuel wood planting and mangrove tree planting, and negatively correlated with solar salt production.

Table 2: Correlation between proposed mangrove restoration/conservation strategies and PCA axes

Variables	Axis 1	Axis 2
Restoration of traditional roles	0.83	-0.22
Avoiding of anarchic settlement	0.64	0.19
Mangrove tree planting	0.52	0.77
Alternative fuel wood planting	0.13	0.80
Solar salt production	-0.56	-0.41
Reconversion of mangrove users	-0.67	-0.21

The figure 5 displays the projection of the different subgroups into the system axes 1 and 2.

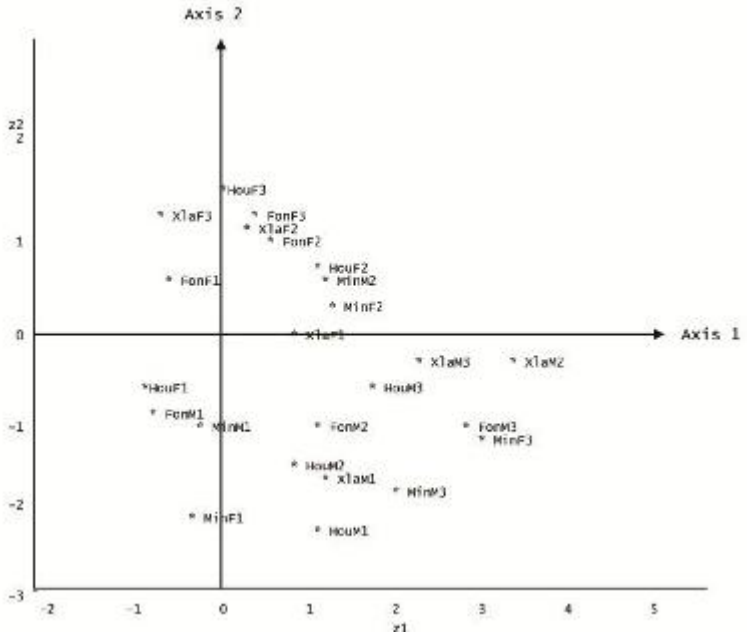

Fig. 5: Relationship between socio-demographic traits and proposed mangrove restoration/conservation strategies

Through the figure, it appears that the various subgroups proposed different strategies for the mangrove conservation. In general, the subgroups of young people are located in the negative part of axes 1 and 2, while the subgroups of elderly people are located in the positive part of axis 1. Moreover, one can remark that the subgroups of elderly people are discriminated into male and female. In fact, as the male elderly are mostly in the negative part of axis2 the female elderly are located in the positive part of the same axis. Therefore we deduced that: (i)- young people are more inclined to the reconversion of mangrove users and solar salt production as strategy for mangrove conservation while the elderly are more included to restoration of traditional role as well as the avoiding of anarchic settlement and (ii)- Women suggested mostly alternatives fuel-wood and mangrove tree planting.

Whatever the age, gender and ethnicity, the informants' proposed alternative tree planting as possible new strategies to save mangrove ecosystem from their degradation in the southern Benin. In addition, it is remarkable to note that, the different ethnic groups are dispersed on the chart suggesting that ethnicity did not play a meaningful role in the proposed strategy for mangrove conservation. In conclusion, we can assume that proposed strategies for mangrove conservation depend on the age and gender of the informants, and are people oriented measures. This may be taken into account in the participatory mangrove restoration.

5. Discussion

5.1 Mangrove and its Services

In tropical and subtropical zones, mangrove resources play an important socio-economic role for the local population livelihood (Walters et al., 2008; Nfotabong-Atheull et al., 2011). Mangrove resources are very diversely used and especially by local population who developed high attachment of this ecosystem. Like the worldwide coastal areas, the coastal zone of Benin which shelters the mangrove, suffers from the process of coastalisation that leads to a high concentration of human population as well as of various socio-economic activities (OECD, 1993; Cicin-Sain and Knecht, 1998). Coastal areas represent in the subtropical and tropical zones the most densely regions, and therefore require high demand in natural resources such those from mangroves (Ciccin-Sain and Knecht, 1998; Glaeser et al.,

2005; Vogt et al., 2010). From our results, it appears a differential uses of mangrove resources according to the age groups, the ethnic groups and gender. Thus, taking into account all socio-demographic categories, the mangrove ecosystem is exploited in Benin for the fuel- and service wood, the salt production, the continental fishery, the medicinal uses, etc. The fuelwood from the Beninese mangrove is strongly exploited because local populations until now do not have other fuelwood alternatives for their domestic uses and easily accessible with lower costs. The salt production remains an out off season activity which is practiced by mangrove surrounding populations. This activity occupies almost all rural households in the region, and the locally produced salt covers approximately 100% of the surrounding populations needs, and approximately 60% of the national requirement of cooking salt (TBS/INSAE, 2006). Practiced only during the dry season where rain-fed agriculture activities are not possible, the salt production provide to women a consistent income enabling them to face their essential needs for this period. Service wood extraction which is a primarily male activity occurs since the local inhabitants have constant increasing requirements of wood for construction/service that nowadays are – due to the high population growth- difficult to be fulfilled. The same situation was observed for the continental fishery practiced on the coastal lagoon which shelters the Beninese mangrove. In addition, we found that the mangrove is also exploited by the traditional healers use the plant and animal organs drawn from the mangrove ecosystem for the treatment of current diseases (dermatosis, malaria, etc.). But the process of ethnitisation (Fôn and Houedah mainly in continental fishery) and gender differentiation (women primarily in salt production and men in the wood seeking) lead to a differential importance perceived of resources with respect to time. In this way, the restoration and the participatory conservation of the mangrove ecosystem require the involving of all the socio-professional groups, ethnic and age groups (Kairo, 2001). In addition to the above mentioned goods and services provided for inhabitants of the coastal area of Benin, mangroves as particular ecosystems take part in the conservation of biological diversity, function with priceless value. Mangroves also supply rich and various habitats for wildlife. All of the natural ecosystem goods and services drawn from the mangroves will improve access to food resources and increased income for the coastal communities estimated about of 1,000.000 (INSAE, 2003) through sustainable livelihood initiatives.

5.2 Threats and Mangrove Degradation

The mangrove ecosystems are facing to a progressive degradation due to the abusive deforestation and the uncontrolled settlements and occupations of the coastal area (Teka et al., 2012). Findings revealed that the level of the various threats on the mangrove varies according to the investigated Districts. The abusive deforestation and overfishing lead to the retreat of the mangrove forest cover and decreasing of fishery output. From our results, it appears that the inhabitants of the surrounding areas of the mangrove are quite aware of the degradation. Furthermore, they assess the possible effects on their livelihood. Indeed, the supplying of fire and service wood will be disturbed. The fish stock after the degradation of spawning zones already is dropping. Local populations cannot fish during the whole year like in the past time. Due to the loss of biological diversity, it is not possible for traditional healers to find all the plant species they used for the traditional medicine. In fact, the various mangrove plants species according to their characteristics react differently to the ecological conditions shift (sunning, temperature, immersion time, salinity, penetration of the solar). For example, Conocarpus erectus supports low water height with an average salinity of 5‰; Avicennia resists to the water salinity (maximum 60 - 65 ‰) and as a long immersion time (Diallo et al., 2007). The only requirement of this plant species is that its pneumatophorous remains in air contact, so that its seedlings develop at the sunny areas. This could be explained by the fact that the decreasing of the rainfall and the rise in the water temperature lead to an intensification of evaporation, an increase in salinity and in the concentration of water vapour in the atmosphere. This phenomenon will drive a modification of the fauna and flora composition and therefore drop of the biological productivity. Local populations aware of this situation are right now ready for a change of mangrove resources valorisation/exploitation patterns. This awareness represents a significant asset for the acceptance of a participatory sustainable management of mangrove ecosystem (Borrini-Feyerabend et al., 2000).

From the above discussion, it appears that the mangrove is a very sensitive ecosystem to external disturbances and especially to human disturbances. The pressure on the Beninese mangrove is quite high explaining its advanced degradation state so that this ecosystem requires nowadays a participatory sustainable management which will only be efficient by involving all the surrounding inhabitants who draw their livelihood from this natural resource as well as the stakeholders of natural resources management of the investigation area.

5.3. Participatory Mangrove Restoration and Conservation: The Reality of Benin

Participatory natural resource management raises the vital question of whether the patterns of explanation and solution of the participating groups differ significantly. Therefore, the human dimensions of mangrove use cannot be ignored, as participatory management is about directing human behaviour. Given that natural resources management has so far been considered an exclusively sovereign governmental task, the issue of whether the persons responsible in governmental functions will come to different assessments and consequently favour different actions than the affected population must be examined. It is therefore very important to involve local communities as well as all stakeholders. In this way, to gain acceptance for participatory mangrove restoration and conservation, effective communication and stakeholder participation strategies are important. Mangrove planners and managers should work closely with stakeholders to consider the different perspectives of individuals and local groups. The importance of mangroves was recognized by all interviewed persons in the coastal area of Benin. This is an important step in favour of the acceptance of participatory management process. The mangrove provides many benefits to coastal populations in terms of economic goods and ecological services, such as, fisheries production, medicinal use, provision of building materials, eco-tourism value, etc. This mangrove represents valuable ecosystem which is currently extremely overexploited and requires long-term protection and conservation. This need was also expressed by all the interviewees. The majority of interviewees advocated the restoration (82.3%) and conservation (68.3%). For the restoration/conservation of the mangrove ecosystem, various categories people opined different strategies. Thus, as women suggested alternative fuel wood planting, men generally opined for the restoration of traditional role. Young people are mostly for the reconversion of salt producers into new activities which do not depend on the mangrove. This will allow identifying the livelihood and income generation options which has implication on mangrove conservation rather its degradation. Possible income generation strategies are for instance the vegetable gardens, the establishment of commercial plant nursery. It appears then clearly that proposed strategies by local population are based on the satisfaction of their livelihood needs without overexploiting the mangrove. For instance the alternative fuel wood planting suggested by women will help to develop new fuel and timber lots in the surrounding villages of the mangrove in order to reduce pressure on mangrove wood utilization. Thus, we conclude that a successful participation of local communities to mangrove restoration and conservation requires people oriented process and approaches as well as enabling policy and institutional and legal frameworks.

Conclusion

This work evaluated the various uses of the Beninese mangrove, the pressures to which the ecosystem is currently facing and the way local population perceived the evolution of this ecosystem. The mangrove affects directly and indirectly local communities. The socio-economic impacts of the mangrove include effects on income, livelihood opportunities and on ecosystem services. Sustainable and participatory mangrove restoration and conservation can offer important benefits, both to the environment and to the local communities. Aware of the mangrove degradation and the possible negative effects on their livelihood, surrounding inhabitants of investigation areas proposed endogenous strategies for mangrove restoration and conservation. Due to the fact that the use patterns of the mangrove vary according to socio-demographic characteristics' of local populations, different people oriented restoration and conservation measures were suggested. However, the majority of informants recommended in order ensuring the participation of local population, to look for other alternatives which will allow local population ensuring their livelihood. Some of them, recommended in

order decreasing the high pressure of mangrove wood extraction the necessity to find other sources of fire wood and service wood. Other recommendations relied on the reconversion of the salt producers in other income generating activities such as the breeding of small game animals. Otherwise if nothing is done, the destruction of the mangrove will continue with negative consequences on fauna and flora habitats/diversity, and the disturbance of the socio-economic activities of inhabitants.

Acknowledgements

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