

Full Length Research Paper

Bumpy road to improved mangrove resilience in the Douala Estuary, Cameroon

Jean-Hude, E. Moudingo^{1,3*}, Gordon, N. Ajonina², Mbarga, A. Bindzi³ and Bertin N. Tchikangwa¹

¹Department of Conservation, BP: 6776 Yaoundé, Centre Region, Cameroon.

²Cameroon Wildlife Conservation Society (CWCS). Coastal Forests and Mangrove Conservation Programme. BP 54 Mouanko, Littoral Region, Cameroon.

³Department of Plant Biology /Forestry Sciences, Faculty of Science, University of Yaoundé I, BP: 812 Yaoundé, Centre Region, Cameroon.

Received 28 November, 2015; Accepted 17 February, 2016

Mangrove stands in the Western and Central African countries especially that of Cameroon are declining due to diverse drivers. Actually, *Rhizophora racemosa* stands in the Cameroon Estuary have been degraded through over-exploitation for fish smoking, pole-wood extraction and fuel wood harvesting by local people in the midst where there is no specific law protecting this ecosystem. Recently, community-based mangrove replanting efforts facilitated by the Cameroon Wildlife Conservation Society in the Douala-Edea Reserve (DER), all dominated by over 80% foreigners was carried for the period of 14 months. These communities out-planted only close to 4 ha (40%) of degraded mangrove compare to the initiate target of 10 ha. In a bid to understand the reason for not meeting the targeted goal, the perceptions of local communities geared towards mangrove restoration were assessed through a questionnaire survey, which was administered to a stratified random sample of 400 people, with 100 individual per village (Mbiako, Youme II, Yoyo I and II). The outcome revealed different levels of perception. Overall, a significant proportion that is, 34.5% ($P<0.005$, $R_s=0.155$) rated mangrove forest as very “little degraded”; 52.5% ($P<0.005$, $R_s = -0.099$) favoured its restoration; while 60.8% ($P<0.005$, $R_s=-0.199$) were not aware that mangrove could be nursed to restore degraded areas. Participation in nursery-out planting activities was significantly varied as 89.8% ($P<0.005$, $R_s=-0.210$) never participated in the process, of which 78.8% ($P<0.05$, $R_s=0.161$) conditioned their participation on some factors which includes greater sensitisation, more training and incentives. Recommendations ranged from putting in place a community day for mangrove, delineation of roles and responsibilities of members in committee, to graduated sanctions for disturbance of restored sites by guided rules.

Key words: Cameroon wildlife conservation society (CWCS), foreign nationals, communities out-plant, mangrove (*Rhizophora racemosa*), Douala-Edea Reserve (DER).

INTRODUCTION

Mangrove forests occupy less than 1% of the world's forested surface (Saenger et al., 1997). The stands which have “salt-tolerant” plants are less diversity compared to terrestrial forested stands and their understory. A recent

study using digital image conducted by Giri et al. (2010) confirmed that mangroves are confined at approximately between 32°N and 38°S with some island extend above this range. With such a geographical range, these

intertidal zones protect the shoreline, serves as breeding ground for fishes and for migratory birds and as carbon sink. They also provide long and short-term socio-economic benefits (Traynor and Trevor, 2008).

Global estimate showed a decline of over 25 % of its original mangrove surface that is from 188, 000 km² in 1980; FAO, 2007) to 137,760 km² in 2000 (Giri et al., 2010). Even with these figures, this milieu is still at the mercy of ever increasing significant threats due to many causes among, which are feeble institutional and capacity of stakeholders, urbanisation, unsustainable extraction of wood, etc. Henceforth, its rapid debility continues (ITTO, 2010). Even though at a sizable declining trend, mangroves are and still one of the most productive ecosystems (Kathiresan and Bingham, 2001) in terms of goods and services (for example, cultural, provisioning, regulating and supporting) (Millennium Ecosystem Assessment, 2005). As a carbon sink, mangroves, including associated soils, could sequester approximately 22.8 million metric tons of carbon each year (Giri et al., 2010).

In Africa, the Western-Central countries with mangrove represent 6.3%, of which Cameroon mangrove occupies over 2000 km² compare to Nigeria with 7386 km² [8]. Throughout the Cameroon coast, extensive natural monoculture stands of *Rhizophora* species (*Rhizophora mangle*, *Rhizophora harrisonii* and *Rhizophora racemosa*), *Avicennia germinans*, *Conocarpus erectus* and *Laguncularia racemosa* occur (UNEP, 2007; Ajonina et al., 2008; Letouzey, 1968) alongside *Nypa fruticans*. Douala-Edea Reserve (DER) gazetted in 1932 covers part of the inshore Cameroon Estuary and have a surface area of 1600 km² (Ajonina, 2001) with more than 10% occupied by mangrove forest.

Usually, wood from this mangrove forest is usually referred locally as 'tanda' (sing.) or 'matanda' (pl.) in the Duala language-Cameroon, or either as 'egba' or 'odo nowe' in the Nigerian language (Letouzey, 1968; Vivien and Faure, 1985). Due to lack of proper protection, the reserve was encroached by local and foreign fishermen alongside their families. Presently, over 6000 individuals inhabits in hamlets and villages, which straddles across the mangrove zone. Over 80% of the total population are foreign nationals, from neighbouring Benin, Ghana, Nigeria, etc. Primarily livelihood activities, which are gender sensitive, include fishing, fish smoking and mangrove fuel wood harvesting. Fishing is primarily conducted by men and the youth, fish smoking mainly by women [10] and wood harvesting by men and women. Fish related processing accounts for over 40% mangrove stand loss in Cameroon (Millennium Ecosystem Assessment, 2005). UNEP (2007) has estimated up to

30% annual loss (3000 ha per year) of Cameroon mangrove forests from 1986 to 2006. Coupled with these induced factors such as "no specific law" enacted for the Cameroon threatened mangrove (FAO, 2007) and the ill-equipped conservation office, mangroves degradation and deforestation in the DER at a rate of roughly 42 ha/year (Ajonina et al., 2005) with over 84% due to wood harvesting destined for fish smoking. Very few fish smokers in the DER have adopted the "improved oven" introduced in 2003 by a national NGO, namely Cameroon Wildlife Conservation Society (CWCS), to minimize the quantity of mangrove wood used for fish smoking. Traditional oven takes up average time of 21 h as opposed to the "improved oven" that takes up lesser time of 5 to 8 h conserving 40 to 50% wood used (Feka et al., 2009). The common fish smoked is ethmalose (*Ethmalose frimbriate*) or 'bonga'. Actually, there has been an increase in the number of "traditional ovens", from 340 to over 850 between 1997 and 2008, as opposed to some 50 "improved ovens" in the DER.

In order to reverse the trend in mangrove stand degradation in the reserve, CWCS and its partners used a Participatory Wetland Appraisal (PWA) to involve coastal communities in mangrove restoration (replanting) activities as a win-win option between October, 2007 and January, 2009. The PWA gave locals the opportunity to practice the approach "learning by doing" so as to arrest and reverse mangrove deforestation and degradation. Actually, local community participation has yielded somewhat desirable results in nursery and outplanting activities. Despite, the creation of an entity called 'Village Mangrove Restoration Steering Committee (COPVAM-French acronym) to assist CWCS (Ajonina et al., 2009; Moudingo et al., 2015), the targeted goal for restoration which was not met. Hence, of the initial target of 10 ha to restore, communities participated in restoring only 4 ha (40%) (Moudingo et al., 2015). However, little or no study has been done in DER, in understanding the dynamics of community participation in *in situ* mangrove restoration efforts through indirect seeding. This study was therefore conducted as part of an effort to do so.

MATERIALS AND METHODS

Study area

The study area has been described in Ajonina and Usongo [10]. The reserve takes its name "Douala-Edea" from the Douala (Wouri) and Edea (Sanaga-maritime) Divisions tributaries. It is located within the Douala-Edea basin of the coastal Atlantic Ocean. The dense hydrological network naturally defines the boundaries of the reserve. The reserve is limited in the North by R.Wouri estuary, East by R. Sanaga, Dipombé and Kwakwa, South by R. Nyong, and

*Corresponding author. E-mail: m_ekindi@yahoo.fr

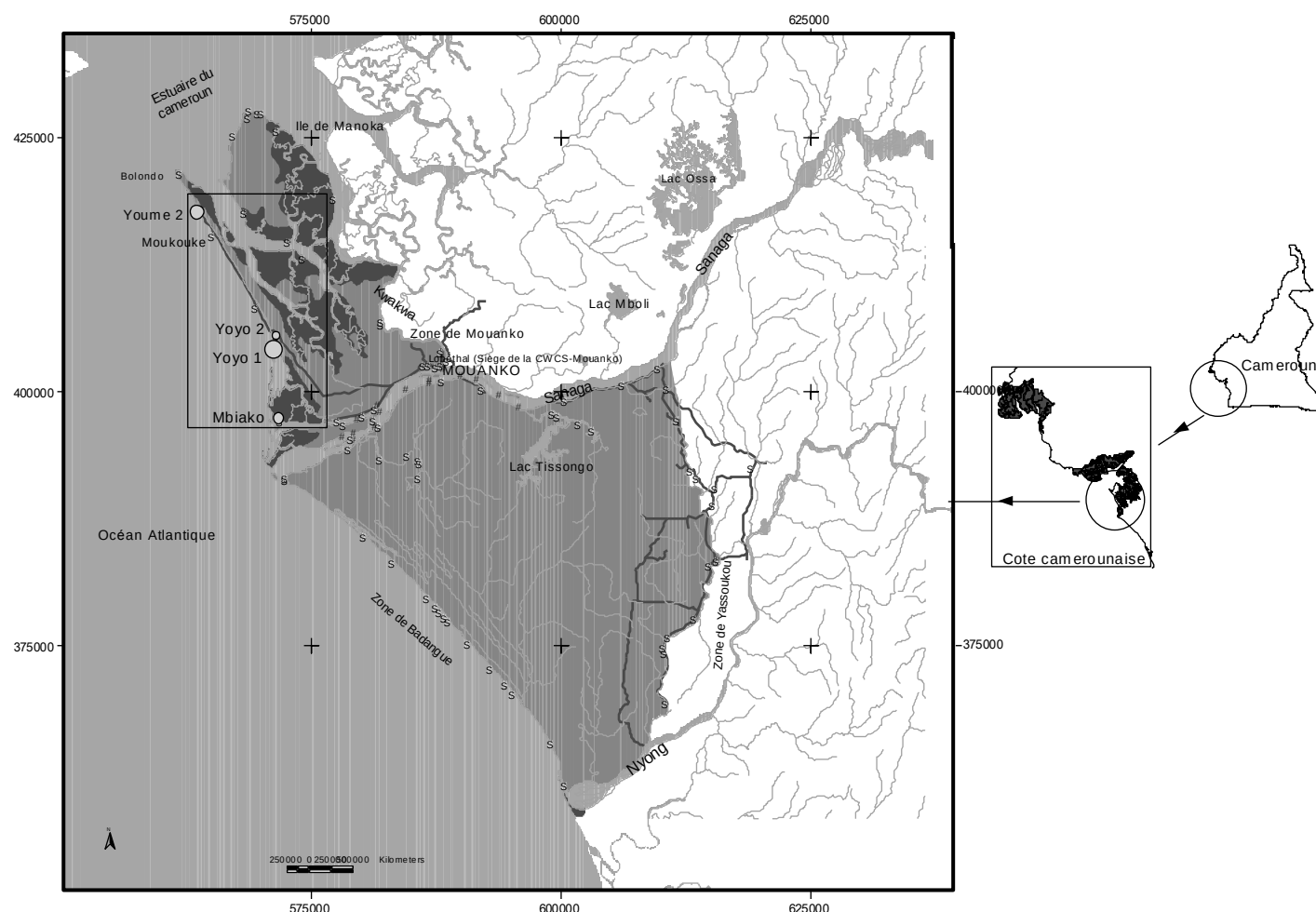


Figure 1. Map showing the distribution of mangrove, study villages in the DER.

West by the Atlantic Ocean covering about 100 km (52 nautical miles) coastline from R. Nyong to the Wouri estuary. The reserve is within the Littoral Region administratively, and sandwiched by the Edea (Yassoukou village) and Mouanko sub divisions (Figure 1). This study overlaps on four mangrove forest villages (Mbiako, Yoyo I, Yoyo II and Youme II) covering over 80% of Douala-Edea mangrove forests estimated at more than 16,000 ha where CWCS has been working for over 13 years. These villages are located between Latitude 3°35' to 3°48' N and Longitude 9°38' to 9°48' E. In the area, there are more than sixty villages and fishing hamlets in the mangrove zone, mostly (80%) inhabited by foreign nationals from Benin, Ghana, Nigeria, etc. Fishing, fish smoking, mangrove fuel wood harvesting, trading and poaching is their main livelihood activities.

The climate is under the influence of the proximity of the Ocean. Annual rainfall varies between 3000 to 4000 mm, with the month of September registering the heaviest rainfall and the month of December the least. Average yearly temperatures range between 24 to 29°C. The soil varies from very sandy to very high clayey, while that in the mangroves is firm in some places, muddy and slushy in other places, so that walking is practically difficult, if not impossible. The salinity presents a very high spatial-temporal variation. Excess water during the rainy season frequently reduces salinity. Salt measurements during the months of August and February revealed 1.5 g/l and 12 g/l respectively (Mbog, 1999).

METHODOLOGY

Relevant data on community perception in efforts was obtained using semi-structured questionnaires that was aligned to the three WPA stages. Four types of questions structure were addressed in the DER, Cameroon. It consisted of open-ended, closed-ended questions with either ordered, and/or unordered response categories and partially close-ended where many possible responses are addressed. The interviews were conducted for 3 months (between October to December 2009) and administered to a systematically sampled people of 400 (Yoyo I and II, Youme II, and Mbiako had 100 individual each) in 45 households facilitated by the linear settlement pattern. Stratified random sampling method was used to select people of various age groups, profession and sexes to provide a balanced picture of their roles in the different stages of mangrove restoration activities (Figure 2). The interviews were conducted during the day on foot (from 7:30 am to 5 pm), with a break of few minutes. French and 'broken English' (commonly used) languages were used in the interview, and were later translated into English language during analysis.

The survey ended when the quorum of the first hundredth person in each village was reached, giving a total sampling intensity of 16.1% of the selected four villages. Hence, to achieve the stated objectives, the question exploited the sensitization, community organization to nursery-outplanting steps geared toward *in situ*

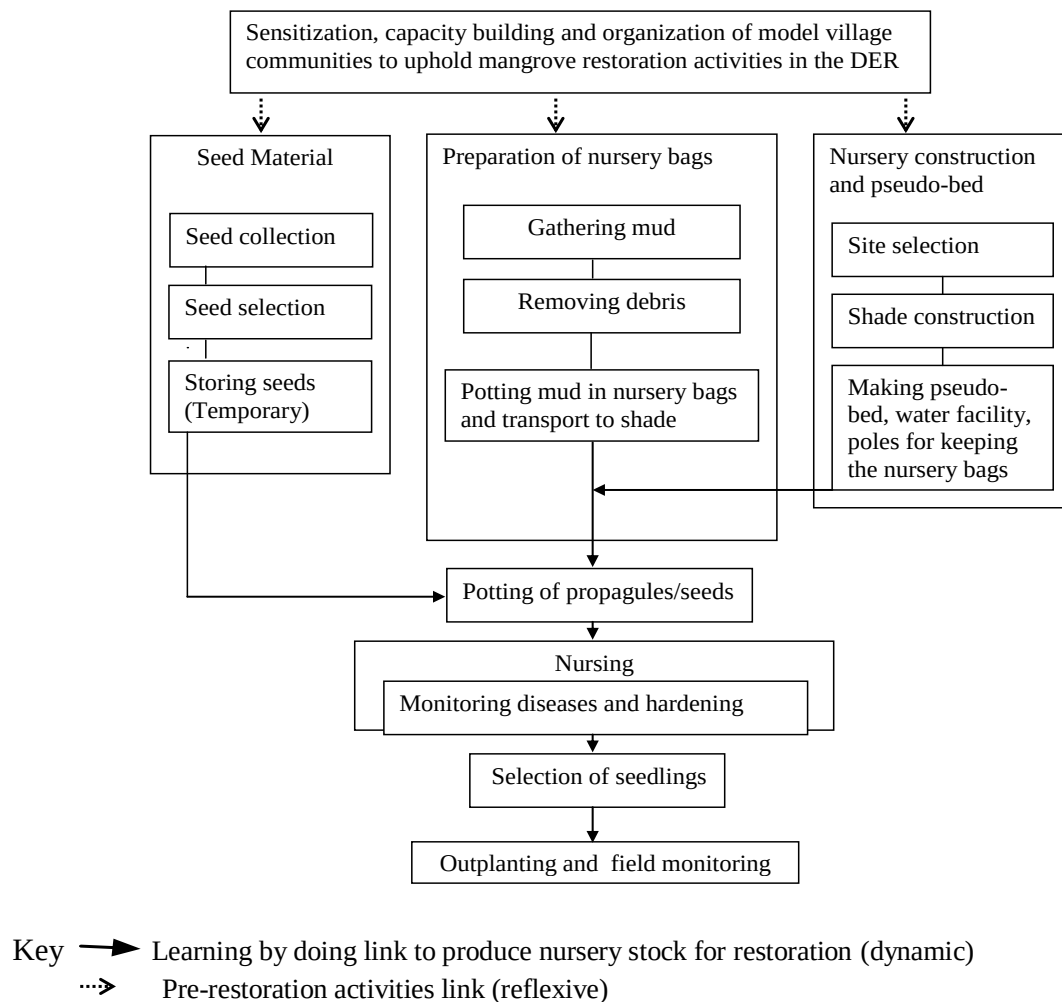


Figure 2. Chart of stages towards mangrove restoration using nursery seedlings in the DER.

indirect seeding (replanting) using *R. racemosa*, to assess community participation. The site was accessible and had a suitable and regular tidal dynamic. Soil was muddy with little or no standing tree. Salinity for ranged from mesohaline to polyhaline. The data were analysed using simple descriptive statistics especially frequency counts and percentages. The user-friendly statistic software packages (Microsoft Office Excels and the Statistics Package for Social Sciences, SPSS) provided many opportunities to analyse participatory data matrix (PDM). The PDM consisted of response variables as column and explanatory variables as rows. The response variables consisted of community characteristics (site, gender, nationality, occupation, and origin and education level, longevity in site, marital status and age group) and participation indicators while the explanatory variables consisted of subjects (individuals). PDM analysis involved interpretation and categorisation of responses. Pearson's chi-square (χ^2) test (95 and 99.5% respectively) and Spearman's correlation (R_s) (Agresti and Finlay, 2009) were used to test the significance of responses, especially the observed community participation as revealed by PDM and the expected community involvement as predicted by the counts. Spearman's correlation coefficient (R_s), was used to test the direction and strength of the relationship between two variables with participation variables.

RESULTS

Community characteristics

The socio-economic characteristics of the 400 respondents distributed in the four villages are presented in Figure 3. Of a sample of 400 people interviewed, over 40% were between 30 to 39 years, more or less equal representation of men and women who were mostly married (above 50%) with first school or no formal education.

Analysis of community perception and participation

Community perception in rating mangrove forest status

Overall, of the 400 interviewed, a significant ($P < 0.005$; $\chi^2 = 170.671$, d.f= 12; $R_s = 0.155$) proportion 138 (34.5%)

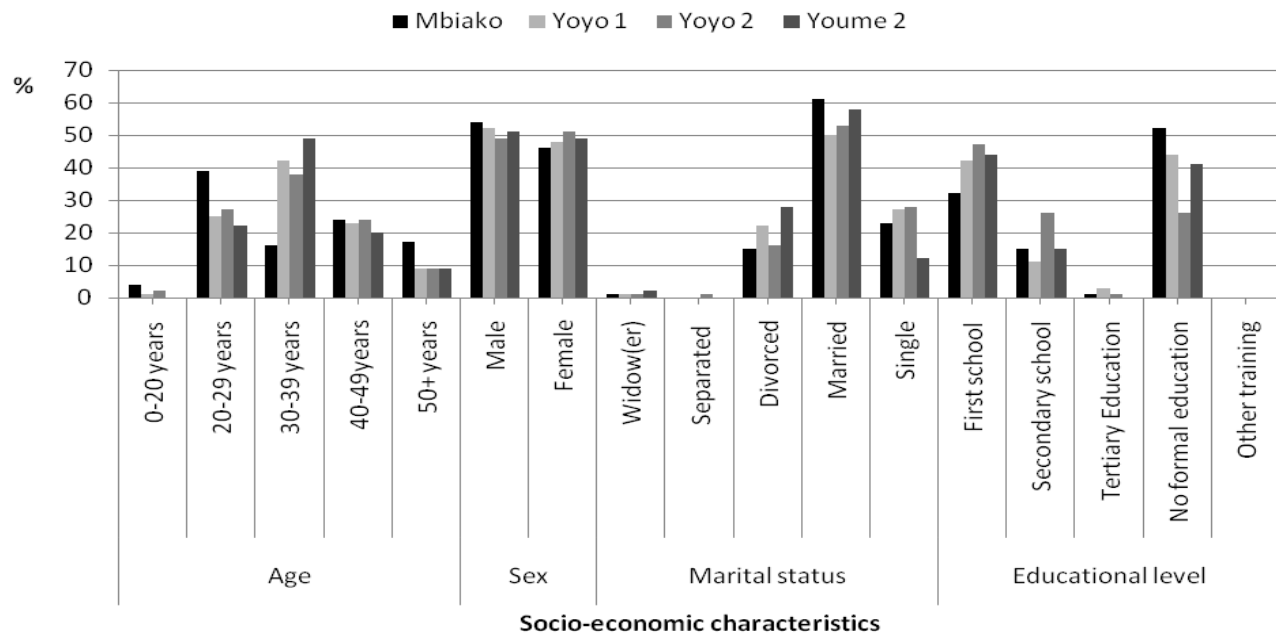


Figure 3. Socioeconomic characteristics of the respondents in DER, Cameroon.

said that the mangrove forest was very little degraded with *R. racemosa* present in near to pristine condition (Tables 1 and 2). Of these 138, the majority supported the responses within and across community characteristics. Of these 138, over 60 persons were from Youme II. In addition, no significant difference was found within and across some community characteristics (longevity in site, marital status and age group). R_s revealed that all the association had weak correlations. Actually, the mangrove areas in the selected communities have decreased noticeably. Results revealed that communities were aware that mangrove are degraded, especially those from Yoyo II. The reason for this acknowledgement stemmed from the fact that this population carry out activities such as fish smoking, and cooking which require a good quantity of mangrove wood and its harvest is on-going to meet subsistence requirements. Presently, this population now go longer distances to fetch mangrove wood for these activities.

At village level, there were significant differences and weak correlations (Table 2). Of the 100 individuals interviewed, a large proportion had no significant difference within and across community characteristics in Mbiako and Yoyo II. The results at this level also showed that more of those interviewed in Mbiako said that mangrove was very little degraded. While, in Yoyo II a significantly larger number within communities said that mangrove was considerably degraded. Besides, in Youme II a significant proportion said that mangrove was very little degraded. A significant difference was observed with some community characteristics such as occupation ($P>0.05$; $\chi^2=18.343$, d.f=9, $R_s=-0.093$) and education

level ($P>0.05$; $\chi^2=15.939$, d.f= 6; $R_s=-0.132$) among those who said the mangrove was very little degraded.

On the other hand, in Yoyo I a significant number of individuals interviewed, 21 ($P<0.05$; $\chi^2=21.021$, d.f= 8; $R_s=-0.384$) Nigerians, 15 ($P<0.05$; $\chi^2= 21.021$, d.f= 12; $R_s=0.21$) fishermen, 31 ($P>0.05$; $\chi^2= 10.906$, d.f= 4; $R_s=-0.187$) non-indigene and 15 ($P<0.005$; $\chi^2=31.403$, d.f=12; $R_s=0.227$) non-scholars said that their mangrove was not at all degraded.

Community awareness on mangrove out planting

Tables 2 and 3 (Question 3) show that of the 400 interviewed, 210 (52.5%) ($P<0.005$, $\chi^2= 48.312$, d.f= 3; $R_s=-0.099$) answered 'yes' to the question "should we grow mangrove?" (*R. racemosa*). Of these 210, most were from Yoyo II, 81 (20.3%). Whereas a significant proportion, 190 (47.5%) answered "no" on planting mangrove. Representative community characteristics of those who said "no" on planting mangrove include 122 (30.5%) ($P<0.005$; $\chi^2= 41.009$, d.f= 3; $R_s= 0.319$) Nigerians; 184 (46.5 %) ($P<0.005$; $\chi^2=13.279$, d.f= 1; $R_s= 0.182$) non-indigenes and 89 (22.3%) ($P<0.005$; $\chi^2= 13.317$, d.f= 3; $R_s= -0.161$) without formal education. No significant difference was observed for some community characteristics. R_s showed that all correlations were weak (Table 2). Actually, overall analyses prove that selected community members in all sites will participate in *R. racemosa* out planting. At village level, the results showed discrepancies amongst and within community characteristics (Table 2). Of the 100 individuals

Table 1. Contd

99.5%	28.30	34.27	34.27	34.27
Significant	**	ns	ns	ns

*Significant at $\alpha=95\%$, **Significant at $\alpha=99.5\%$, ns for (Not Significant for given degree of freedom).

interviewed, a large number of responses show no significant differences across the community characteristics in Yoyo II and Youme II. In Yoyo II, 44 ($P>0.05$; $\chi^2=1.881$, d.f= 1; Rs=0.137) females, 45 ($P>0.05$; $\chi^2= 7.43$, d.f= 3; Rs=0.189) Cameroonians, 36 ($P>0.05$; $\chi^2= 0.767$, d.f=3; Rs=0.072) people of others occupation, 65 ($P>0.05$; $\chi^2= 2.29$, d.f= 1; Rs=0.151) non-indigenes and 35 ($P>0.05$; $\chi^2=2.699$, d.f= 3; Rs=-0.044) primary school leavers, answered that mangrove should be planted. Whereas in Youme II, 29 ($P>0.05$; $\chi^2=0.623$, d.f= 1; Rs=0.079) males, 36 ($P>0.05$; $\chi^2=4.033$, d.f=3; Rs=0.13) Nigerians, 19 ($P>0.05$; $\chi^2= 5.894$, d.f= 3; Rs=-0.08) fish smokers, 53 non-indigenes with no statistics due to their limited presence and 23 ($P>0.05$; $\chi^2= .0.499$, d.f= 2; Rs=-0.06) non-scholars were against mangrove planting. Moreover, analysis within and across community characteristics revealed that Yoyo II and Youme II had no significant differences compared to Yoyo I and Mbiako for respondents who said *R. racemosa* should not be planted. In Mbiako results show that, 33 ($P<0.05$; $\chi^2= 3.904$, d.f=1; Rs=0.18) males, 31 ($P<0.05$; $\chi^2=10.881$, d.f=3; Rs=0.27) Nigerians, 25 ($P<0.05$; $\chi^2= 9.762$, d.f= 3; Rs=-0.23) fishermen and 31 ($P<0.05$; $\chi^2= 11.536$, d.f= 3; Rs=-0.29) married, and in Yoyo I, 38 ($P<0.05$; $\chi^2= 7.131$, d.f=1; Rs=-0.267) females, 26 ($P<0.05$; $\chi^2= 11.459$, d.f=3; Rs=-0.258) fish smokers and 48 ($P<0.05$; $\chi^2= 4.963$, d.f=1; Rs=0.22) non-indigenes answered that mangrove should not be planted.

Furthermore, of the 400 interviewed,

respondents gave reasons for “why mangrove should or should not be planted”. The clustered rank showed that 93 (23.3%) answered that mangrove regeneration was natural (Figure 4). Many held the view that natural regeneration of mangrove was satisfactory whereas others, 87 (21.8%), believed that the replenishment of mangrove forest was done by divine hands as their responses were that ‘God’ plants mangrove. Figure 4 shows that across villages, communities perceived the importance of mangrove from different points of view.

Community awareness on the role of nursery in mangrove restoration

Of the 400 interviewed, in site and across community characteristics of a significant ($P<0.005$; $\chi^2= 23.098$, d.f= 3; Rs=-0.199) large proportion, 243 (60.8%), demonstrated that they were not aware that mangrove was nursed for outplanting (Question 4: Tables 2 and 4). They did not seem to know the importance of why *R. racemosa* should be nursed. Of these 243, most were from Yoyo I, 76 (19%). Conversely, 157 (39.7 %) agreed that mangrove can be nursed and saw the importance of doing so. Majority, 53 (13.30%) of those who agreed were from Youme II. During the interview, all respondents provided reasons as to why they did not know the importance of nursing *R. racemosa*. The reasons provided were arranged and clustered to give the percentages presented in (Figure 4). Overall, the

attribute that received a strong response support, was 268 (67%) for a ‘no answer’ or ‘no idea’. Of this 67 %, Yoyo I (21%) and Mbiako (18.5 %) had outstanding percentages for those who had ‘no idea’.

According to Figure 5, only respondents in Youme II knew more about the positive role of nursery in *R. racemosa* restoration. These results showed that only a few communities were aware of the role of nursery in restoration of mangrove, while many saw that the activities were not of prime concern to them. Rs coefficient showed that all correlations were weak. Community awareness for *R. racemosa* nursing issues in the DER, Cameroon was poor.

Discrepancies were found among and within the four villages (Figure 5). However, 15.6% acknowledged the positive role of the NGO (CWCS) working in the mangrove conservation through restoration. Moreover, of the 100 interviewed in each selected villages (Mbiako, Yoyo I and Yoyo II) significant proportions were not aware that mangrove could be nursed for restoration. Of these, in Mbiako, the study had 44 ($P<0.005$; $\chi^2= 9.805$, d.f= 1; Rs=0.31) males, 33 ($P<0.05$; $\chi^2= 9.647$, d.f= 3; Rs=0.21) Nigerians, 29 ($P<0.005$; $\chi^2= 23.22$, d.f= 3; Rs=0.189) fishermen, 33 ($P<0.005$; $\chi^2= 16.993$, d.f= .4; Rs=-0.27) of those who have been in site for less than ten years and 31 ($P<0.05$; $\chi^2=12.729$, d.f= 4; Rs=-0.30) of those aged 20 to 29. Moreover, many in Mbiako, 74 (18.5 %) did not know the importance of nursery (Figure 4). In Yoyo I we had 41 ($P<0.05$; $\chi^2= 4.488$, d.f= 1; Rs=-0.21) females, 47

Table 2. Spearman correlation matrix for all the four villages in the Douala-Edea, Cameroon.

S/N	Question	Village/sites	Community							
			Gender	Nationality	Occupation	Origin	Education	Longevity	Marital status	Age
2	Can you rate the degradation of the area(s) where mangrove is being harvested?	0.155	-0.013	-0.231	0.058	-0.152	0.017	0.017	0.021	0.106
3	According to you should we plant mangrove?	-0.099	0.042	0.319	-0.167	0.182	-0.161	0.018	-0.068	-0.144
4	Are you aware that matanda can be nursed?	-0.199	0.111	0.066	-0.021	-0.006	-0.033	-0.154	-0.031	-0.148
5	Have you ever taking part in mangrove nursery work?	-0.21	-0.015	0.075	-0.019	0.074	-0.083	-0.044	0.044	-0.026
8	How can you rate your participation?	0.182	-0.067	0.031	-0.047	0.018	0.001	0.198	-0.064	0.152
9	Do you need incentives for taking part in mangrove restoration?	0.161	-0.046	-0.062	0.045	0.049	0.111	-0.14	0.072	0.05
2	Can you rate the degradation of the area(s) where mangrove is being harvested?	Mbiako	-0.093	-0.053	-0.11	0.022	0.033	0.229	0.107	0.211
3	According to you should we plant mangrove?		0.198	0.276	-0.232	0.138	-0.102	-0.103	-0.296	-0.275
4	Are you aware that matanda can be nursed?		0.313	0.218	-0.028	0.011	0.032	-0.273	-0.254	-0.307
5	Have you ever taken part in mangrove nursery work?		-0.212	0.313	-0.054	0.339	-0.322	0.114	0.121	0.028
8	How can you rate your participation?		-0.048	0.031	-0.035	0.02	-0.129	0.397	0.137	0.416
9	Do you need incentives for taking part in mangrove restoration?		-0.18	-0.108	0.117	0.051	0.182	-0.097	0.229	0.098
2	Can you rate the degradation of the area(s) where mangrove is being harvested?	Yoyo 1	0.076	-0.384	0.208	-0.187	0.227	-0.116	0.086	0.155
3	According to you should we plant mangrove?		-0.267	0.483	-0.258	0.223	-0.231	0.216	0.025	-0.142
4	Are you aware that matanda can be nursed?		-0.212	0.339	-0.519	0.193	-0.329	0.139	0.136	-0.03
5	Have you ever taken part in mangrove nursery work?		-0.107	0.248	-0.226	0.297	-0.21	0.091	0.207	0.01
8	How can you rate your participation?		0.007	-0.223	0.26	-0.132	0.122	0.041	-0.149	0.054
9	Do you need incentives for taking part in mangrove restoration?		0.115	-0.103	0.169	-0.018	0.087	-0.072	0.024	0.154
2	Can you rate the degradation of the area(s) where mangrove is being harvested?	Yoyo 2	0.037	-0.288	0.07	-0.227	0.159	-0.012	-0.108	0.133

Table 2. Contd.

3	According to you should we plant mangrove?	0.137	0.189	0.072	0.151	-0.044	-0.082	-0.086	-0.144
4	Are you aware that matanda can be nursed?	0.101	-0.1	0.157	-0.115	-0.019	-0.081	-0.003	0.026
5	Have you ever taken part in mangrove nursery work?	-0.208	0.102	-0.104	0.043	-0.205	-0.009	-0.023	-0.07
8	How can you rate your participation?	0.005	0.136	-0.145	0.122	0.107	-0.056	-0.137	-0.056
9	Do you need incentives for taking part in mangrove restoration?	-0.058	0.078	-0.111	0.077	0.084	-0.2	0.062	-0.061
2	Can you rate the degradation of the area(s) where mangrove is being harvested?	0.067	0.025	-0.093	u	0.132	-0.09	-0.012	-0.056
3	According to you should we plant mangrove?	0.079	0.133	-0.082	u	-0.062	-0.039	-0.009	-0.018
4	Are you aware that matanda can be nursed?	0.202	-0.297	0.322	u	0.267	-0.36	0.12	-0.251
5	Have you ever taken part in mangrove nursery work?	0.219	-0.153	0.147	u	0.121	-0.181	0.105	-0.049
8	How can you rate your participation?	-0.218	0.279	-0.284	u	-0.182	0.356	-0.168	0.135
9	Do you need incentives for taking part in mangrove restoration?	-0.057	-0.067	-0.015	u	0.047	-0.183	-0.063	0.008

u - no statistical analysis (area inclusively habited by non-nationals).

Table 3. Overall analysis of community perception of mangrove planting in the Douala-Edea, Cameroon.

			Community characteristics																																	
			Sites								Gender				Nationality						Occupation						Origin									
S/N	Question	Response	Mbiako	%	Yoyo 1	%	Yoyo 2	%	Yome 2	%	Total	%	Male	%	Female	%	Cameroonians	%	Nigerians	%	Ghanaians	%	Others	%	Fishing	%	Fish smoking	%	Wood cutting	%	Other	%	Indigene	%	None-indigene	%
3	According to you should we plant mangrove?	Yes	48	12	34	8.5	81	20.3	47	11.8	210	52.5	106	26.5	104	26	102	25.5	96	24	11	2.8	1	0.3	40	10	72	18	13	3.3	85	21.3	28	7.0	182	45.5
		No	52	13	66	16.5	19	4.8	47	13.3	190	47.5	88	22	102	25.5	37	9.3	122	30.5	28	7.0	3	0.8	64	16	66	16.5	1	0.3	59	14.8	6	1.5	184	46
		χ ² -Statistics							48.321							0.691							41.009							19.829					13.279	
		P							0.00							0.406							0.00							0.00					0.00	
		df							3							1							3							3					1	
		χ ² -Tabulated							7.81							3.84							7.81							7.81					3.84	
		95%							12.84							7.88							12.84							12.84					7.88	
		99.5%							12.84							7.88							12.84							12.84					7.88	
Significant							**							ns							**							**					**			

Table 3. Contd.

		Community characteristics																																						
S/N	Question	Response	Education level								Longevity in site (years)								Marital status								Age group (years)													
			None	%	Primary	%	Secondary	%	Higher learning	%	<10	%	10-20	%	20-30	%	30-40	%	40>	%	Single	%	Married	%	Seperated	%	Divorced	%	Widow(er)	%	<20	%	20-29	%	30-39	%	40-49	%	50>	%
3	According to you should we plant mangrove?	Yes	74	18.5	85	21.3	48	12	3	0.8	96	24	44	11	37	9.3	16	4.0	17	4.3	43	10.8	116	29	47	11.8	1	0.3	3	0.8	2	0.5	48	12	80	20	52	13	28	7.0
		No	89	22.3	80	20	19	4.8	2	0.5	81	20.3	41	10.3	42	10.5	17	4.3	9	2.3	47	11.8	106	26.5	34	8.5	0	0.0	3	0.8	5	1.3	65	16.3	65	16.3	39	9.8	16	4.0
		χ ² -Statistics				13.317									3.193											2.721							9.549							
		p				0.004									0.526											0.605							0.049							
		df				3									4											4							4							
		χ ² -Tabulated95%				7.81									9.49											9.49							9.49							
		99.5%				12.84									14.86											14.86							14.86							
		Significant				**									ns											ns							*							

*Significant at $\alpha=95\%$, **Significant at $\alpha=99.5\%$, ns for (Not Significant).

($P<0.005$; $\chi^2= 14.65$, d.f= 2; $R_s=0.33$) Nigerians, 29 ($P<0.005$; $\chi^2= 31.676$, d.f=3; $R_s=-0.519$) fish smokers, and 37 ($P<0.005$; $\chi^2= 27.571$, d.f=3; $R_s=-0.329$) non-scholars, who did not know the role of nursery in mangrove restoration. Finally, in Yoyo II the study had 30 ($P<0.05$; $\chi^2= 7.81$, d.f=3; $R_s=0.157$) with other occupations who answered that they were not aware that mangrove can be nursed and planted.

On the other hand, Youme II respondents showed a significant difference with respect to within and across community characteristics in that they were aware the mangrove could be propagated by seedlings from nursery. Of the 100 interviewed in Youme II, 31 ($P<0.05$; $\chi^2=4.064$, d.f=1; $R_s=0.20$) females, 47 ($P<0.005$; $\chi^2= 22.806$, d.f=3; $R_s=-0.297$) Nigerians, 29 ($P<0.005$; $\chi^2= .27$; 991, d.f= 3; $R_s=0.32$) fish smokers, 53 non-indigenes, 28 ($P<0.05$; $\chi^2=7.184$, d.f=2; $R_s=0.267$) non-scholars and 44 ($P<0.005$; $\chi^2= 30.601$, d.f=3; $R_s=0.12$) married agreed that

R. racemosa can be nursed for restoration. Of those who were aware, 71 (17.75%) knew the importance of nursery.

Community participation in mangrove nursery-outplanting activities

Overall, of the 400 individuals interviewed, a significant ($P<0.005$, $\chi^2= 32.04$, d.f =3; $R_s=-0.21$) large proportion, 359 (89.8%), answered that they did not participate in nursery and outplanting activities (Question 5: Tables 2 and 5). Of these 359, most were from Yoyo II, 96 (24%). Whereas a few, 41 (10.3%), said that they took part in nursery and outplanting, of which most were from Youme II, 25 (6.3%). R_s showed that all correlations were weak (Table 2). The level at which the people of the four selected communities participated proved to be inconsistent and dismal across in general. Also, sub-statement No. 5.1

shows that most, 364 (91%), inhabitants interviewed did not participate in nursery and outplanting activities geared towards mangrove restoration inside the DER (Figure 6).

At village level (Question 5: Table 2), of the 100 interviewed the results showed a significant difference with respect to within and across community characteristics. Most community characteristics in selected villages revealed that a significant number had not participated in mangrove nursery and outplanting activities (Figure 6). Youme II inhabitants participated more than those in Mbiako, Yoyo I and Yoyo II in nursery and outplanting activities in the DER. For instance within and across community characteristics in Mbiako, significant differences were observed. 49 ($P<0.05$; $\chi^2=4.483$, d.f= 1; $R_s=-0.219$) males, 54 ($P<0.005$; $\chi^2= 12.886$, d.f= 3; $R_s=0.075$) Nigerians, 37 ($P<0.05$; $\chi^2= .10.908$, d.f= 3; $R_s=-0.054$) fishermen, 86 ($P<0.005$; $\chi^2= 11.483$, d.f=1; $R_s=0.339$) non-indigene and

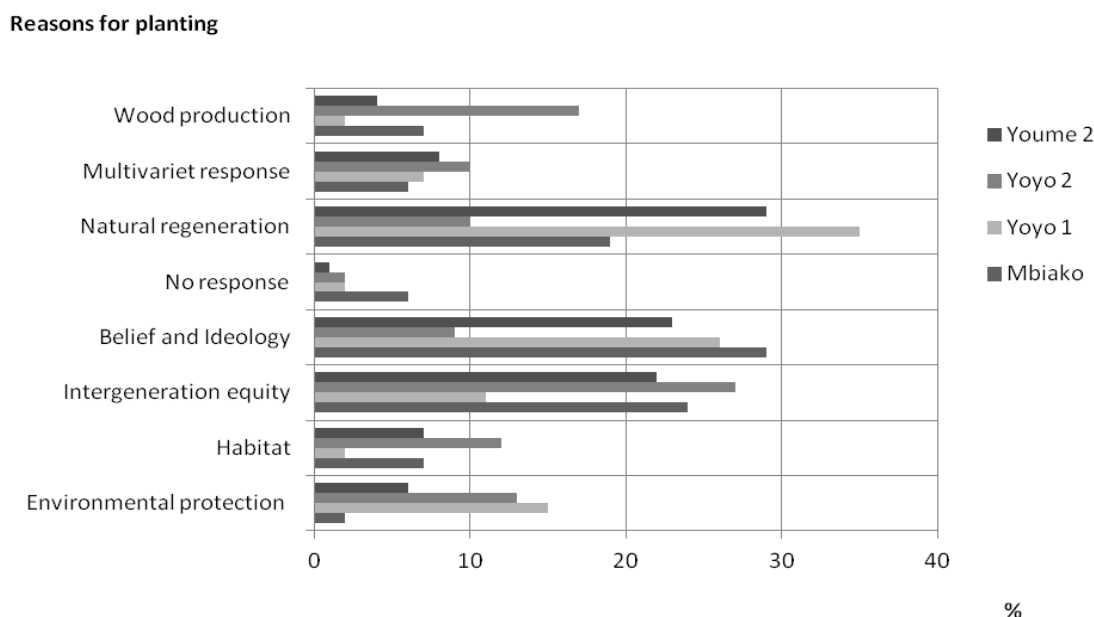


Figure 4. Portrayal of cluster distributions of community reasons on mangrove restoration in four selected villages in the Douala-Edea, Cameroon.

and 52 ($P < 0.005$; $\chi^2 = 17.851$, d.f=3; $R_s = -0.339$) non-scholars reported that they did not participate in *R. racemosa* nursery and outplanting activities. In Yoyo I, 54 ($P < 0.005$; $\chi^2 = 11.336$, d.f= 2; $R_s = 0.248$) Nigerians, 34 ($P < 0.005$; $\chi^2 = 18.161$, d.f= 3; $R_s = 0.33$) those with other occupations, 90 ($P < 0.005$; $\chi^2 = 8.804$, d.f= 1; $R_s = 0.297$) non-indigenes and 43 ($P < 0.05$; $\chi^2 = 8.682$ d.f= 3; $R_s = -0.21$) non-scholars answered that they did not participate in nursery and outplanting activities. Also in Yoyo II, significant differences were recorded within and across most of the community characteristics (nationality ($P > 0.05$; $\chi^2 = 1.049$, d.f=educational level ($P > 0.05$; $\chi^2 = 5.402$, d.f= 3; $R_s = -0.205$), longevity in site ($P > 0.05$; $\chi^2 = 3.32$, d.f= 4; $R_s = -0.009$), marital status ($P > 0.05$; $\chi^2 = 0.356$, d.f=4; $R_s = -0.023$) and age group ($P > 0.05$; $\chi^2 = 1.462$, d.f=4; $R_s = -0.07$)) replied that they “did not participate” in nursery and outplanting activities.

Finally, in Youme II, of the 100 interviewed, a significant large number within and across communities, 32 ($P < 0.005$; $\chi^2 = 22.803$, d.f= 3; $R_s = 0.147$) with other occupations (homemakers, traders, canoe makers, farmers, hunters and wine tapers) and 37 ($P < 0.05$; $\chi^2 = 11.091$, d.f= 3; $R_s = 0.105$) married respondents answered that they as well did not participate in nursery and outplanting activities. The statistical analysis (R_s) revealed weak correlation within and across community characteristics (Table 2). Analysis revealed incidental community participation in nursery and outplanting activities geared towards mangrove (replanting) restoration in the DER. In the village Youme II (made up 100% foreign nationals), most interviewed took part in nursery and outplanting stages.

Ego-rating of participation

Overall, of the 400 interviewed a significant ($P < 0.005$; $\chi^2 = 72.867$, d.f= 12; $R_s = 0.182$) proportion, 231 (57.8 %) rated their participation as ‘poor’ (Question 8: Tables 2 and 6). Of these 231, most (18.5 %) were from Yoyo I. Whereas, of the few 120 (30 %) who answered that their participation were ‘fair’, most were from Yoyo II, 48 (12 %). Also no significant difference was revealed within some community characteristics (gender ($P > 0.05$; $\chi^2 = 8.877$, d.f= 4; $R_s = -0.015$), nationality ($P > 0.05$; $\chi^2 = 18.535$, d.f= 12; $R_s = -0.075$), education level ($P > 0.05$; $\chi^2 = 14.667$, d.f= 12; $R_s = -0.083$) who answered that their participation was ‘poor’. R_s shows that all correlation association were weak (three negative and six positive). The majority of the respondents from selected communities were not involved in the *R. racemosa* restoration process for one reason or the other. The reason for poor participation is that, many were more concerned with overcoming livelihood difficulties rather than with conservation and restoration ethics.

At village level (Question 8: Table 2), of the 100 interviewed the results showed a significant difference with respect to within and across community characteristics for selected villages. In Mbiako a larger number within communities, 51 ($P < 0.005$; $\chi^2 = 27.557$, d.f= 3; $R_s = 0.02$) non-indigenes, 32 ($P < 0.05$; $\chi^2 = 34.915$, d.f= 12; $R_s = 0.397$) those who have stayed in site for less than 10 years, 32 ($P < 0.005$; $\chi^2 = 31.569$, d.f= 3; $R_s = 0.416$) those aged between 20 and 29 held the view that their participation was poor. Also in Yoyo I, within communities 41 ($P < 0.05$; $\chi^2 = 16.176$, d.f= 8; $R_s = -0.223$)

Table 4. Overall analysis of community awareness on mangrove nursing in the Douala-Edea, Cameroon.

		Community characteristics																																						
		Sites					Gender			Nationality					Occupation					Origin																				
S/N	Question	Response	Mbiako	%	Yoyo 1	%	Yoyo 2	%	Younge 2	%	Total	%	Male	%	Female	%	Cameroonians	%	Nigerians	%	Ghanaians	%	Others	%	Fishing	%	Fish smoking	%	Wood cutting	%	Other	%	Indigene	%	None-indigene	%				
4	Are you aware that matanda can be nursed?	Yes	32	8.0	24	6.0	48	12	53	13.3	157	39.3	87	21.8	70	17.5	54	13.5	97	24.3	6	1.5	0	0.0	27	6.8	72	18	13	3.3	45	11.3	13	3.3	144	36				
		No	68	17	76	19	52	13	47	11.8	243	60.7	107	26.8	136	34	85	21.3	121	30.3	33	8.3	4	1.0	77	19.3	66	16.5	1	0.3	99	24.3	21	5.3	222	55.5				
		χ ² -Statistics						23.098				4.946				14.425				38.107				0.016																
		P						0.00				0.00				0.002				0.00				0.899																
		df						3				1				3				3				1																
		χ ² -Tabulated						7.81				3.84				7.81				7.81				3.84																
		95%						12.84				7.88				12.84				12.84				7.88																
		Significant						**				**				**				**				Ns																
Community characteristics																																								
		Education level					Longevity in site (years)					Marital status					Age group (years)																							
S/N	Question	Response	None	%	Primary	%	Secondary	%	Higher learning	%	<10	%	10-20	%	20-30	%	30-40	%	40>	%	Single	%	Married	%	Separated	%	Divorced	%	Widow(er)	%	<20	%	20-29	%	30-39	%	40-49	%	50>	%
4	Are you aware that matanda can be nursed?	Yes	65	16.3	57	14.3	31	7.8	4	1.0	58	14.5	34	8.5	30	7.5	17	4.3	18	4.5	27	6.8	100	25	27	6.8	0	0.0	3	0.8	2	0.5	35	8.8	54	13.5	44	11	22	5.5
		No	98	24.5	108	27	36	9.0	1	0.3	119	29.8	51	12.8	49	12.3	16	4.0	8	2.0	63	15.8	122	30.5	54	13.5	1	0.3	3	0.8	5	1.3	78	19.5	91	22.8	47	11.8	22	5.5
		χ ² -Statistics						6.425				15.076				8.482				9.12																				
		P						0.093				0.005				0.075				0.058																				
		df						3				4				4				4																				
		χ ² -Tabulated						7.81				9.49				9.49				9.49																				
		95%						12.84				14.86				14.86				14.86																				
		Significant						ns				**				ns				Ns																				

*Significant at $\alpha=95\%$, **Significant at $\alpha=99.5\%$, ns for (Not Significant).

Nigerians, 25 ($P<0.005$; $\chi^2=61.694$, d.f= 12; $Rs=0.26$) with other occupations, 35 ($P<0.05$; $Rs=0.416$) persons aged between 30-39 years shared the responses of those interviewed in Mbiako. The analysis also showed that for

respondents in Youme II, a significant number (26 ($P<0.05$; $\chi^2=21.953$, d.f= 12; $Rs=-0.218$) of Cameroonians, 27 ($P<0.005$; $\chi^2=44.528$, d.f= 12; $Rs=-0.284$) with other primary occupations (homemakers, traders, canoe makers, farmers,

hunters and wine tapers), 29 ($P<0.05$; $\chi^2=27.728$, d.f= 16; $Rs=0.356$) with longevity in site for less than 10 years, and 22 ($P<0.05$; $\chi^2=32.221$, d.f= 12; $Rs=-0.168$) married) said their participation was similar to those interviewed in Mbiako and

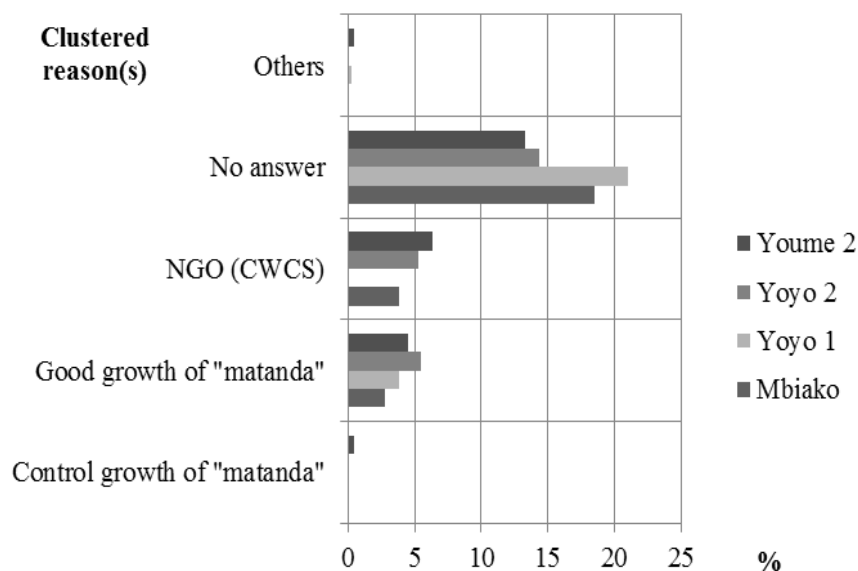


Figure 5. Cluster responses distributions of community awareness on the role of nursery in mangrove restoration in four selected villages in the Douala-Edea, Cameroon.

Yoyo I. No statistical analysis was recorded for the community by origin for the Youme II village since all inhabitants were recently settled there. On the other hand, in Yoyo II, community participation was significantly divided between 'poor' and 'fair' participation.

A larger number within communities characteristic namely 26 ($P < 0.05$; $\chi^2 = 27.304$, d.f. = 12; $R_s = -0.145$) with other primary occupations (homemakers, traders, canoe makers, farmers, hunters and wine tapers) and 25 ($P < 0.05$; $\chi^2 = 57.183$, d.f. = 16; $R_s = -0.137$) married respondents answered that their participation was 'poor'. Whereas most, 48 ($P < 0.05$; $\chi^2 = 11.231$, d.f. = 4; $R_s = 0.122$) non-indigenes answered that their participation was 'fair'. R_s shows weak correlation association (Table 2).

Community participation and incentives

Responses of the 400 individuals revealed that participation was significant ($P < 0.05$; $\chi^2 = 10.562$, d.f. = 3; $R_s = 0.161$) with a large proportion, 315 (78.8%) conditioned on incentives (getting compensation for work done) (Question 9: Tables 2 and 7). At village level, of these 315, most were from Mbiako, 87 (21.8%). Also, there was significant difference in within and across community characteristics of those interviewed; 135 (33.8%) ($P < 0.05$; $\chi^2 = 9.853$, d.f. = 3; $R_s = 0.11$) non-scholars, 127 (31.8%) ($P < 0.05$; $\chi^2 = 11.046$, d.f. = 4; $R_s = -0.14$) with longevity in site for less than 10 years, and 101 (25.3%) ($P < 0.005$; $\chi^2 = 17.703$, d.f. = 4; $R_s = 0.05$) aged between 20 to 29 years, answered that they needed incentives for participating in mangrove restoration in the

DER. No significant difference within and across some community characteristics (gender, nationality, occupation, origin, marital status) was revealed. R_s showed weak correlation associations. Hence, the majority of selected communities wish those conditions be met to have full participation in mangrove ecosystem restoration.

Furthermore, concerning community motivation, Figure 7 shows that, 97 (24.3%) and 96 (24%) wanted 'encouragement' (cash and kind) and salary in participating in mangrove restoration, respectively. The statistical analysis (Table 2) and the graph (Figure 7) provide strong evidence that community participation in mangrove restoration in the DER is conditioned by externalities such as incentives.

At village level, of the 100 interviewed the results showed that there was no significant difference across and within community characteristics for selected villages except for a few in Youme II. Community perceptions showed that incentive flow will enhance community participation in mangrove restoration in the Douala Estuary, Cameroon.

However, R_s showed a weak association for variables within and across community characteristics. Most of these villages shared the same motivation and concerns on incentives at different percentages, for example 30 (7.5%) in Mbiako, 14 (3.5%) in Yoyo I, 30 (7.5%) in Yoyo II and 23 (5.8%) in Youme II said that they needed encouragement (Figure 7).

Thus, the major factors to consider, when involving communities in the DER wetlands restoration, according to the survey are community well-being (salary, food,

Table 5. Overall analysis of community perception in mangrove nursery-outplanting work in the Douala-Edea, Cameroon.

			Community characteristics																																		
			Sites								Gender				Nationality								Occupation								Origin						
S/N	Question	Response	Mbiako	%	Yoyo 1	%	Yoyo 2	%	Youme 2	%	Total	%	Male	%	Female	%	Cameroonians	%	Nigerians	%	Ghanaians	%	Others	%	Fishing	%	Fish smoking	%	Wood cutting	%	Other	%	Indigene	%	None-indigene	%	
5	Have you ever taken part in mangrove nursery work?	Yes	5	1.3	7	1.8	4	1.0	25	6.3	41	10.3	19	4.8	22	5.5	17	4.3	23	5.8	1	0.3	0	0.0	6	1.5	18	4.5	7	1.8	10	2.5	6	1.5	35	8.8	
		No	95	23.8	93	23.3	96	24	75	18.8	359	89.8	175	43.8	184	46	122	30.5	195	48.8	38	9.5	4	1.0	98	24.5	120	30	7	1.8	134	33.5	28	7.0	331	82.8	
	χ2-Tabulated	χ²-Statistics																																			2.21
		P																																			0.137
		df																																			1
		95%																																			3.84
		99.5%																																			7.88
		Significant																																			ns

			Community characteristics																																					
			Education level								Longevity in site (years)								Marital status								Age group (years)													
S/N	Question	Response	None	%	Primary	%	Secondary	%	Higher learning	%	<10	%	10-20	%	20-30	%	30-40	%	40>	%	Single	%	Married	%	Seperated	%	Divorced	%	Widow(er)	%	<20	%	20-29	%	30-39	%	40-49	%	50>	%
5	Have you ever taken part in mangrove nursery work?	Yes	14	3.5	14	3.5	13	3.3	0	0.0	16	4.0	9	2.3	8	2.0	4	1.0	4	1.0	8	2.0	29	7.3	3	0.8	0	0.0	1	0.3	0	0.0	9	2.3	20	5.0	6	1.5	6	1.5
		No	149	37.3	151	37.8	54	13.5	5	1.3	161	40.3	76	19	71	17.8	29	7.3	22	5.5	82	20.5	193	48.3	78	19.5	1	0.3	5	1.3	7	1.8	104	26	125	31.3	85	21.3	38	9.5
	χ2-Tabulated	χ²-Statistics																																						5.291
		P																																					0.259	
		df																																					4	
		95%																																				9.49		
		99.5%																																				14.86		
		Significant																																				ns		

*Significant at $\alpha=95\%$. **Significant at $\alpha=99.5\%$. ns for (Not Significant).

etc.), capacity building and material needs due to the difficult environment of activities. The future management of mangrove through replanting in the reserve can be improved, if financial incentives and/or payment for environment services play a key role in alleviating poverty.

However, it might be too early to make an evaluation on these expected co-benefits, because, since time immemorial, forest protection in general received finances. However these finances targeted only terrestrial forest under protection leaving out mangrove forest.

Community recommendations to enhance participation

Of the 400 inhabitants interviewed, a majority, 148 (37%) cluster responses showed that greater sensitization should be employed to enhance

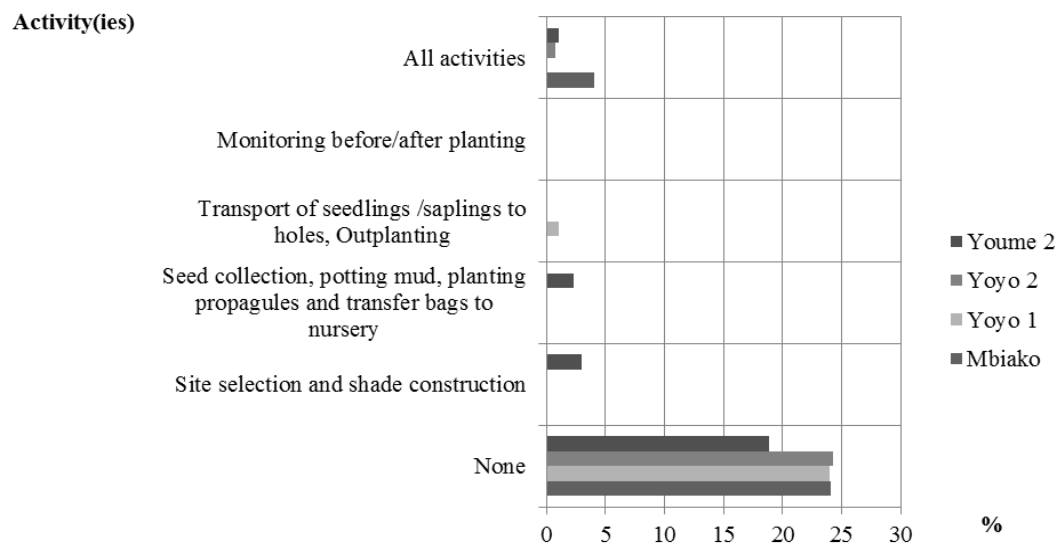


Figure 6. Portrayal of community participation in nursery and outplanting in the Douala-Edea, Cameroon.

community participation. Globally, 135 (33.75 %) answered that training of community would also boost Community participation (Figure 8). The results showed that inhabitants interviewed in the DER requested for greater sensitization, more training sessions, Community Day for Mangrove and clear collaboration since most were not aware of the processes geared towards mangrove restoration.

DISCUSSION

The results of the surveys can be discussed based on the two points; the lack of information characterising community participation in mangrove ecosystem conservation and the gap between community participation and local residents' knowledge of conservation.

Results at the local level show that compared to other villages, Youme II kept a profile of interest during all activities though not headed by an administrative authority such as a chief. Restoration done by non-nationals (Nigerians) went well in this village probably because everyone in the community was answerable to the council of elders. Statistical analysis (Rs) provided prove that Youme II is inclusively habited by non-nationals. Hence, nationality is not a barrier for restoring *R. racemosa* through nursery in the DER, Cameroon estuary. It can be seen that at the local and global levels, respondents acknowledged that mangrove deforestation and degradation is ongoing due to their activities (amongst which we have wood harvesting for fish smoking and cooking). These results support the work conducted by some researchers (Ajonina and Usongo,

2010; Feka and Ajonina, 2011; Feka et al., 2009). Especially, at the local level (except in Mbiako), many people (for example, non-indigenes etc.) acknowledged that mangrove was deforested and degraded at different degrees by their activities. When extrapolating such perception of mangrove deforestation and degradation, the study support the works of Ajonina (2008) for a loss 30% of mangrove forest in Cameroon at large. Knowledge is surely necessary for these local people if they are to use these natural ecosystems in a sustainable manner. This is why additional results showed that most local residents agreed for its restoration (Table 3), even though they were ignorant that mangrove were nursed in site to restore degraded and deforested areas. Though selected communities restored successfully close to 4 hectares of *R. racemosa*, their participation was varied and dismal as revealed in Table 5.

The limitations in meeting the target of restoring 10 hectares of mangrove forest with *R. racemosa* and the inconstancies in community participation have hidden causes which are either induced or direct. Among other reasons include their educational level (Figure 3) coupled with their livelihood activities that are limiting factors for community's participation in mangrove restoration in the DER as well as in some hinterland regions in Cameroon. Despite the fact that they were lagging behind in a domain like education, some respondents in the DER understood the importance of restoring *R. racemosa* to some degree though they were lacking in knowledge and skill for propagating the mangrove species. Globally, the selected communities were not significantly ($P < 0.005$; $\chi^2 = 72.867$, $d.f = 12$; $R_s = 0.182$) mobilised toward mangrove restoration activities as they rated their participation as 'poor' (Tables 2 and 6).

Furthermore, at the local level almost all people

Table 6. Overall analysis of ego-assessment in community in mangrove restoration in the Douala-Edea, Cameroon.

S/N	Question	Response	Community characteristics																																							
			Sites								Gender				Nationality						Occupation						Origin															
			Mbiako	%	Yoyo 1	%	Yoyo 2	%	Yoyume 2	%	Total	%	Male	%	Female	%	Cameroonians	%	Nigerians	%	Ghanaians	%	Others	%	Fishing	%	Fish smoking	%	Wood cutting	%	Other	%	Indigene	%	None-indigene	%						
8	How can you rate your participation?	Unsure	2	0.5	6	1.5	2	0.5	1	0.3	11	2.8	7	1.8	4	1.0	3	0.8	6	1.5	2	0.5	0	0.0	2	0.5	4	1.0	0	0.0	5	1.3	2	0.5	9	2.3						
		Poor	60	15	74	18.5	46	11.5	51	12.8	231	57.8	101	25.3	130	32.5	89	22.3	117	29.3	21	5.3	4	1.0	69	17.3	61	15.3	2	0.5	99	24.8	20	5.0	211	52.8						
		Fair	35	8.8	14	3.5	48	12	23	5.8	120	30	68	17	52	13	33	8.3	72	18	15	3.8	0	0.0	28	7.0	55	13.8	5	1.3	32	8.0	7	1.8	113	28.3						
		Good	0	0.0	2	0.5	1	0.5	13	3.3	16	4.0	10	2.5	6	1.5	2	0.5	13	3.3	1	0.3	0	0.0	3	0.8	10	2.5	2	0.5	1	0.3	0	0.0	16	4.0						
		Very good	3	0.8	4	1.0	3	0.8	12	3.0	22	5.5	8	2.0	14	3.5	12	3.0	10	2.5	0	0.0	0	0.0	2	0.5	5	1.3	5	1.3	7	1.8	5	1.3	17	4.3						
	χ^2 -Tabulated	χ^2 -Statistics	72.867								8.877								18.535								59.475								9.642							
		P	0.00								0.064								0.1								0.00								0.047							
		df	12								4								12								12								4							
		95%	21.03								9.49								21.03								21.03								9.49							
		99.5%	28.30								14.86								28.30								28.30								14.86							
		Significant	**								ns								ns								**								*							

S/N	Question	Response	Community characteristics																																					
			Education level								Longevity in site (years)								Marital status								Age group (years)													
			None	%	Primary	%	Secondary	%	Higher learning	%	<10	%	10-20	%	20-30	%	30-40	%	40>	%	Single	%	Married	%	Seperated	%	Divorced	%	Widow(er)	%	<20	%	20-29	%	30-39	%	40-49	%	50>	%
8	How can you rate your participation?	Unsure	8	2.0	2	0.5	1	0.3	0	0.0	5	1.3	1	0.3	4	1.0	0	0.0	1	0.3	1	0.3	7	1.8	2	0.5	1	0.3	0	0.0	0	0.0	2	0.5	2	0.5	6	1.5	1	0.3
		Poor	87	21.8	100	25	40	10.0	4	1.0	118	29.5	52	13	44	11.0	11	2.8	6	1.5	59	14.8	109	27.3	58	14.5	0	0.0	5	1.3	3	0.8	81	20.3	90	22.5	36	9.0	21	5.3
		Fair	54	13.5	49	12.3	16	4.0	1	0.3	40	10.0	24	6.0	23	5.8	18	4.5	15	3.8	23	5.8	79	19.8	18	4.5	0	0.0	0	0.0	4	1.0	23	5.8	33	8.3	44	11.0	16	4.0
		Good	8	2.0	6	1.5	2	0.5	0	0.0	4	1.0	4	1.0	3	0.8	3	0.8	2	0.5	3	0.8	13	3.3	0	0.0	0	0.0	0	0.0	0	0.0	5	1.3	5	1.3	3	0.8	3	0.8
		Very good	6	1.5	8	2.0	8	2.0	0	0.0	10	2.5	4	1.0	5	1.3	1	0.3	2	0.5	4	1.0	14	3.5	3	0.8	0	0.0	1	0.3	0	0.0	2	0.5	15	3.8	2	0.5	3	0.8
	χ^2 -Tabulated	χ^2 -Statistics	14.687								36.713								57.867								48.387													
		P	0.259								0.002								0.000								0.000													
		df	12.000								16								16								16													
		95%	21.03								26.30								26.30								26.30													
		99.5%	28.30								34.27								34.27								34.27													
		Significant	ns								**								**								**													

*Significant at $\alpha=95\%$. **Significant at $\alpha=99.5\%$ ns for (Not Significant).

Table 7. Overall analysis of community perception and incentives in mangrove restoration in the Douala-Edea, Cameroon.

			Community characteristics																																	
			Sites								Gender				Nationality						Occupation						Origin									
S/N	Question	Response	Mbiako	%	Yoyo 1	%	Yoyo 2	%	Youme 2	%	Total	%	Male	%	Female	%	Cameroonians	%	Nigerians	%	Ghanaians	%	Others	%	Fishing	%	Fish smoking	%	Wood cutting	%	Other	%	Indigene	%	None-indigene	%
9	Do you need incentives for taking part in mangrove restoration?	Yes	87	21.8	83	20.8	75	18.8	70	17.5	315	78.8	166	41.5	149	37.3	106	26.5	172	43	33	8.3	4	1.0	88	22	103	25.8	11	2.8	113	28.3	29	7.3	286	71.5
		No	13	3.3	17	4.3	25	6.3	30	7.5	85	21.3	40	10	45	11.3	33	8.3	46	11.5	6	1.5	0	0.0	16	4.0	35	8.8	3	0.8	31	7.8	5	1.3	80	20
		χ ² -Statistics					10.562									0.852					2.399								3.54						0.951	
		P					0.014									0.356					0.494								0.316						0.329	
	χ ² -Tabulated	df					3									1					3								3						1	
		95%					7.81									3.84					7.81								7.81						3.84	
		99.5%					12.84									7.88					12.84								12.84						7.88	
			Significant					*									ns					ns								Ns						ns

			Community characteristics																																					
			Education level								Longevity in site (years)								Marital status								Age group (years)													
S/N	Question	Response	None	%	Primary	%	Secondary	%	Higher learning	%	<10	%	10-20	%	20-30	%	30-40	%	40>	%	Single	%	Married	%	Seperated	%	Divorced	%	Widow(er)	%	<20	%	20-29	%	30-39	%	40-49	%	50>	%
9	Do you need incentives for taking part in mangrove restoration?	Yes	135	33.8	131	32.8	44	11	5	1.3	127	31.8	73	18.3	64	16	27	6.8	24	6.0	75	18.8	175	43.8	58	14.5	1	0.3	6	1.5	5	1.3	101	25.3	100	25	71	17.8	38	9.5
		No	28	7.0	34	8.5	23	5.8	0	0.0	50	12.5	12	3.0	15	3.8	6	1.5	2	0.5	15	3.8	47	11.8	23	5.8	0	0.0	0	0.0	2	0.5	12	3.0	45	11.3	20	5.0	6	1.5
		χ ² -Statistics				9.853											11.048										5.491									17.703				
		P				0.02											0.026										0.241									0.001				
	χ ² -Tabulated	df				3										4											4									4				
		95%				7.81										9.49											9.49									9.49				
		99.5%				12.84										14.86											14.86									14.86				
			Significant				*										*											ns								**				

*Significant at $\alpha=95\%$. **Significant at $\alpha=99.5\%$. ns for (Not Significant).

interviewed in Mbiako, Yoyo I and Yoyo II replied that they did not take part in nursery -outplanting work, while approximately one quarter of respondents in Youme II answered the other way. Within these communities, movement for survival

of nationals or non-nationals from one hamlet, village or region to another is common and frequent. This surely has reduced the chances of getting persons who have worked on mangrove restoration. Worst still, though nationality is not a

barrier to mangrove replanting, non-nationals who frequently participated in CWCS mangrove restoration activities might have returned to their home country or refused to provide the adequate response for fear of reprisal. Consistent with this,

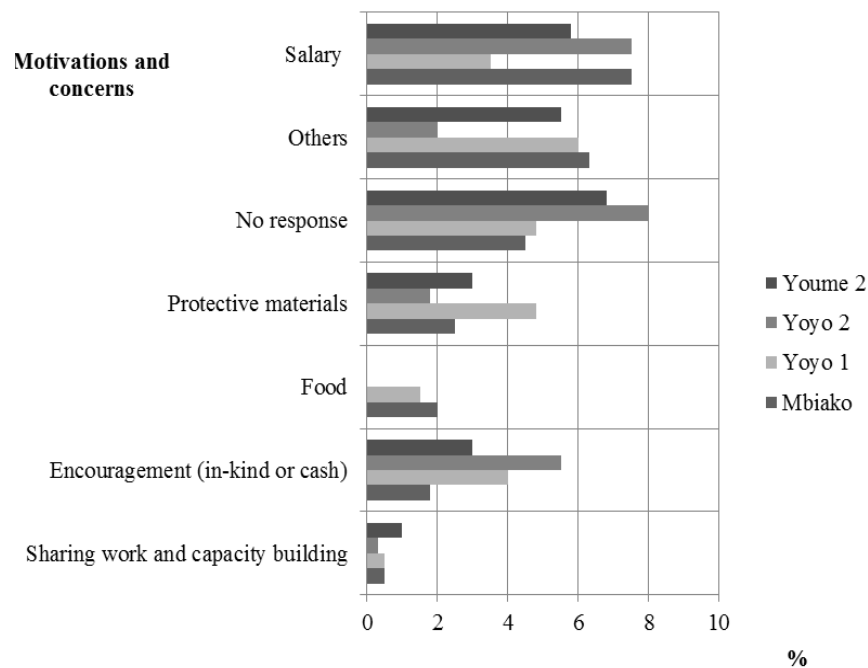


Figure 7. Portrayal of community perception of incentives (motivations and concerns) distributions in mangrove restoration in the Douala-Edea, Cameroon.

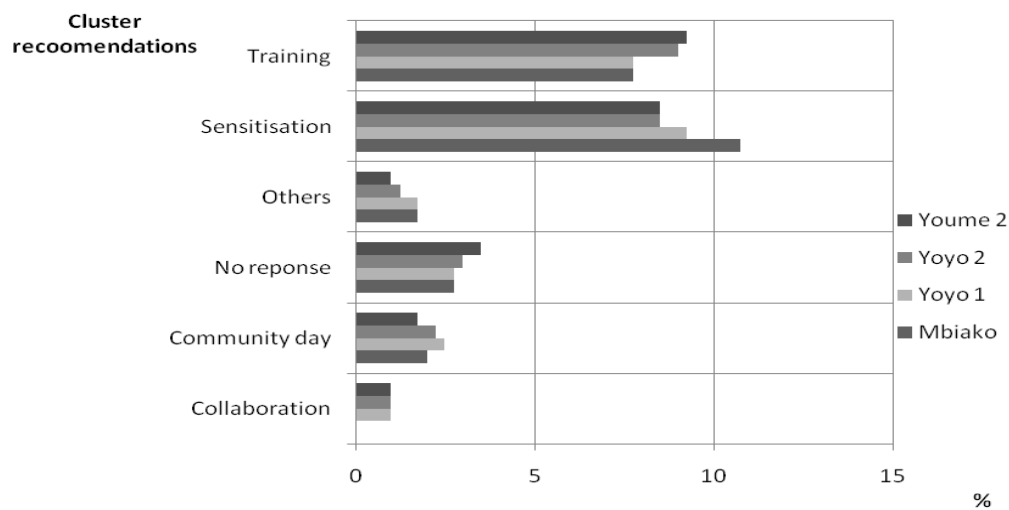


Figure 8. Community recommendations to strengthen participation in mangrove restoration in the Douala-Edea, Cameroon.

what came up in the correlation test is the fact that the results clearly showed this was some kind of “bad faith” on the part of some non-nationals who claimed that they have been off-site and just returning whereas the majority have been leaving there for 10 years or so. The psychology of some of these communities’ respondents may also be questioned. Also, the fear of the mangrove milieu and the traditional beliefs towards mangrove for

instance that the mangrove trees are planted by “God” might equally have been a barrier for communities involvement. But, that is nullified by Youme II participating effectively. In the light of this, measures to involve local mangrove community should include scoping studies in order to understand the community past history and attitude.

Actually, this initiative in assessing the community

participation was unprecedented, and proves that there are some changes in the attitude and perception of members of some communities with respect to restoration of mangrove in the DER, Cameroon estuary. Essentially, of the 400 respondents a significant ($P < 0.005$, $\chi^2 = 32.04$, d.f = 3; $R_s = -0.21$) large proportion, 359 (89.8%) did not participate in nursery and outplanting activities (Tables 2 and 5).

Community characteristics equally shown in Table 6 and Figures 7 and 8 prove that *R. racemosa* restoration in the DER, Cameroon estuary has a long trail to follow. Some have interest in mangrove restoration but did not participate at all in nursery and outplanting activities for reasons presented in Tables 5, 6 and 7. This discrepancy is better illustrated in Figure 6 as some respondents participated in one activity or more while others did not participate at all in mangrove nursery activities. For example, community members participated in one of the following activity of nursery and outplanting activities: nursery site selection, shade construction, gathering and potting mud in bags, transport of bags, propagules collection and potting, dibbling and Outplanting (Moudingo et al., 2015). Thus, *R. racemosa* restoration in the DER, Cameroon estuary followed a stepwise process; therefore participation was also a stepwise process.

Participating in at least one step of the restoration means that one has participated. People or community participated in restoration for either financial, material or personal satisfaction (Figure 7).

Generally, economic factors should affect conservation attitudes of local people; the richer the people are, the more aware and mobilised they are of conservation or they have a high degree of perception on conservation (Harada, 2003) action through replanting. Those who are rich usually reach higher level of education and have a wider level of understanding compared to a person with no formal education. Hence, very few people will work with empty stomach or work without expecting any compensation either in cash or kind. Hence, selected communities said that financial and material conditions should be put in place to encourage their participation in mangrove outplanting using *R. racemosa* in the DER, Cameroon (Tables 2 and 7).

In this study, meaningful relationships between the levels of affluence as proposed by Harada (Harada, 2003) and the perception of conservation action were found (Figures 7 and 8). Meeting targeted goal in building the resilience of an ecosystem like that of the mangrove through community efforts is not straightforward and individual, companies or government can compensate needs external inputs such as financial incentives. coastal communities through NGO like CWCS Cameroon Ecology or the Cameron Mangrove Network and its partners to sustain livelihood, and conservation and enhancement of carbon stocking in the midst of climate change abatement.

Conclusion

The prominence of mangrove forest and its resources to man, the role in re-establishing ecological roles and services cannot be overstated. However, results from the perception study showed that the first trial for selected communities was unprecedented, though community participation (within and across characteristics) showed significant discrepancies in the stages geared towards mangrove restoration. The communities understood the status of mangrove forest and the need to uphold the forest resources, but were not aware that *R. racemosa*, like most angiosperms can be nursed for restoration. This poses the problem as to what degree the communities should be sensitized for full engagement in such initiative. It is obvious that the pathway is not easy, as long as 60.8% of the communities are not aware that mangrove can be restored using nursery stock, 57.8% rate their participation to be "poor" and as many as 89.9% say that they never took part in restoration activities.

According to 78.8% of interviewees, community participation can be fully geared into mangrove restoration, if they are provided with food, salary or encouragement, and if they are well sensitised and trained. Can sustained financial mechanism overturn such problems and meet the demands of the livelihood of these poor coastal communities? Yes, it can. Results from this work portray a very complex picture of community participation in mangrove restoration practices and awareness in a diverse community of foreign nationals and tribes within Cameroon, living in the four mangrove covered villages. The road to restoring mangrove resilience to pristine conditions is not only "rough and sloppy" but it is equally "uneven and unsteady" as the mangrove environment itself. However, it was a valuable learning process working with the CWCS team and the locals in identifying some of the salient problems that shaped mangrove restoration efforts in the DER, Cameroon. The originally perceived idea of community participation in mangrove restoration proved to be too time consuming and complex. Actually, communities said they participated at one stage like nursery construction and not at the others such as growth monitoring because of lack of protective material and incentives. We had passive and active community participation in using the species *R. racemosa* to restore degraded mangrove area in the DER. In the light of this, if we looked at mangrove restoration as an on-going and open process where people participate in different restoration stages, then mangrove restoration is a holistic and dynamic process. More attention has to be accorded to both human and financial resources if we want to meet the Millennium Development Goals, since both triggers the development of sustainable solutions to adaptation and mitigation strategies to climate change. If this synergy is properly developed and mainstreamed, then there will be no barrier in combining mitigation and

adaptation strategies; hence we will move from strategies to action. In the absence of flexible finances such as Payments for Ecosystem Service or Reduced Emissions from Deforestation and Forest Degradation (REDD+), can mangrove restoration efforts be sustained?

RECOMMENDATIONS

Recommendations to strengthen community participation in future programmes and initiatives in the DER should be put in place. Cameroon estuary in order to sustain their livelihood security, and strengthen the mangrove ecosystem and associated coastal ecosystem should include sensitization, community organization, and nursery and outplanting programs among others.

Conflict of interests

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENTS

The author's appreciation goes to International Tropical Timber Organization (ITTO) and CWCS for providing financial and material supports. Their sincere thanks are equally due to Professor Dr. H. C. PELZ DIETER, University of Freiburg, Germany, for his advice on data analysis and statistical interpretations during his visit to the Douala-Edea mangroves. They also equally show gratitude to the staff of CWCS especially: Mr. TIMBA Martin, Mrs. NKAN Marie, Mr. DIYOUKE Eugene, Ms. AGBOR EYONG Charlotte (Focal Point for Africa, Ramsar), Ms. ESSOPI Jolie, Mr. DIBI Elector, Mr. MBENGA Omere and Mr. LAISIR Bruno for their wonderful hospitality. Special thanks are also due to the chiefs and inhabitants of selected sites in the DER for their collaboration to the success of this work. We enjoyed their energy, hospitality, humour, wits and devotion to the interest we all share. They made it all much easier for us.

Abbreviations

CWCS, Cameroon Wildlife Conservation Society; **DER**, Douala-Edea Reserve; **COPVAM-French acronym**, Village Mangrove Restoration Steering Committee; **PDM**, participatory data matrix; **χ^2** , Pearson's chi-square; **R_s** , Spearman's correlation; **d.f.**, degree of freedom; **Probability**, (P at either *Significant at $\alpha=95\%$ or **Significant at $\alpha=99.5\%$).

REFERENCES

- Agresti A, Finlay B (2009). Statistical Methods for social sciences, 4th edit. Pearson International Edition, Pearson Education, Inc. USA, 609p.
- Ajonina G, Tchikangwa B, Chuyong G, Tchamba M (2009). The challenges and prospects of developing a community based generalizable method to assess mangrove ecosystems vulnerability and adaptation to climate change impacts: Experience from Cameroon. *FAO Nature Faune* 24(1):16-25.
- Ajonina GN, Usongo L (2001). Preliminary quantitative impact assessment of wood extraction on the mangroves of the Douala-Edea Reserve, Cameroon. *Trop. Biodivers.* 7(2):137-149.
- Ajonina G, Tchikangwa B, Chuyong G, Tchamba M (2009). The challenges and prospects of developing a community based generalizable method to assess mangrove ecosystems vulnerability and adaptation to climate change impacts: Experience from Cameroon. *FAO Nature Faune* 24(1):16-25.
- Ajonina GN (2008). Inventory and modelling mangrove forest stand dynamics following different levels of wood exploitation pressure in the Douala-Edea Atlantic Coast of Cameroon. Ph.D. Thesis, Faculty of Forestry and Environmental Sciences, University of Freiburg, Freiburg -Germany. P 215.
- Ajonina GN, Diamé A, Kairo J (2008). État actuel et conservation des mangroves de l'Afrique: vue d'ensemble. *WRM* 133:1-4.
- Ajonina PU, Ajonina G N, Jin E, Mekongo F, Ayissi I, Usongo L (2005). Gender roles and economics of exploitation, processing and marketing of bivalves and impacts of forest resources in the Douala-Edea Wildlife Reserve, Cameroon. *Int. J. Sustain. Dev. World Ecol.* 12(5):161-172.
- FAO (2007). The World's Mangroves 1980-2005: A thematic study prepared in the framework of the Global Forest Resource Assessment 2005, Food and Agriculture Organization (FAO) forestry paper No 153. Rome, Italy. pp. 2-20.
- Feka NZ, George B, Chuyong, Ajonina GN (2009). Sustainable utilization of mangroves using improved fish smoking systems: A management perspective from the Douala-Edea Wildlife Reserve, Cameroon. *Trop. Conserv. Sci.* 2:4.
- Feka NZ, Ajonina GN (2011). Drivers causing decline of mangrove in West-Central Africa: a review. *International J. Biodivers. Sci. Ecosyst. Serv. Manag.* 7(3):217-230.
- Giri C, Ochieng E, Tieszen LL, Zhu Z, Singh A, Loveland T, Masek J, Duke N. (2010). Status and distribution of mangrove forests of the world using earth observation satellite data. *Global Ecol. Biogeogr.* 20(1):154-159.
- Harada K (2003). Attitudes of local people towards conservation and Gunung Halimun National Park in West Java, Indonesia. *J. For. Res.* 8:271-282.
- ITTO, ISME, FAO, UNEP-WCMC, UNESCO-MAB and UNU-INWEH, (2010). World Atlas of Mangroves. New York, Earthscan.
- Kathiresan K, Bingham BL (2001). Biology of mangroves and mangroves ecosystems. *Adv. Marine Biol.* 40:81-251
- Letouzey R (1968). Etude Phytogéographique du Cameroun, *Encyclopédie-Biologie*, Edition Paul Lechevalier, Paris. 511p
- Mbog DM (1999) Rapport sur les mangroves du Cameroun: Connaissance, Conservation, biodiversité et Valorisation, GEF-UNEP. 11p.