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Original Research Article

Mangrove Social and Ecological resilience geared in the Cameroon Estuary

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Mangrove wetlands perform a variety of protective, productive and economic functions and thus play a vital role in the livelihood security of the coastal communities. However, a recent survey indicates that the extent of Douala-Edea mangrove forests is degrading at an alarming rate due to human encroachment and eagerness for development, over exploitation for fish smoking and absence of mangrove policies. There is call for prompt action to conserve this productive ecosystem. The fight to reverse the degradation of mangrove forest brought about many efforts to restore degraded areas by the Cameroon Wildlife Conservation Society (CWCS) in the Douala-Edea Reserve (DER). Selected villages covering over 80 % of mangrove the reserve were involved and their participation, assess in all phases (sensitization, community organization, nursery and outplanting) geared towards mangrove restoration programme (2014) in the DER. The results revealed discrepancies in community participation (gender and occupation) during sensitization rated at 5.7 %. Overall, eight-village steering committees were formed, in which more female (54.39 %) than male (45.6 %) were represented to insure sustainability. However, more male (54.5 %) than female (45.97 %) participated in nursery and outplanting stages. These communities functioned to restore 3.82 hectares degraded mangroves. Hence, they are external underpinned factors hindering the successful realization of restoration gear. Recommendations arrived at enhancing community participation were made. They ranged from putting in place of a community day for mangrove, delineation of roles and responsibilities of members in committee and graduated sanctions for violation or disturbance of restored sites by a legal ramification to incentives.

Key words: Cameroon Wildlife Conservation Society (CWCS), foreign nationals, mangrove, selected villages, Douala-Edea Reserve (DER)

INTRODUCTION

The resilience of Cameroon's coastal low-lying mosaic vegetation type especially the extensive and diverse botanical amphibians 'Mangrove' (Rhizophora species (*R. mangle*, *R. harrisonii*, and *R. racemosa*); *Avicennia germinans*; *Conocarpus erectus* and *Laguncularia racemosa*...) that settled on approximately on 2000 km² (UNEP, 2007; ITTO et al 2010) is at risk. The practice of livelihood activities such as fishing, mangrove wood cutting and fish smoking by foreign nationals, especially from Benin, Ghana, Nigeria, etc., who consist of 80 % of the fishing camps and village population is a serious threat to the mangrove health. The Rhizophora spp. that constitute more than 85% of the mangrove ecosystem plant species is highly threaten by overharvest for wide uses especially for fish smoking in relation to its low moisture content 25-40%. Hence, a decrease of 30 % has been observed for the Cameroon mangrove for the past 25 years. The decrease is due to the synergy between pressure and drivers which include invasive Nipa palm (*Nypa fruticans*) that compete with native mangrove species and anthropogenic activities like urbanization, unsustainable practices, weak legal enforcement, etc.

In the Douala-Edea Reserve (DER), located in the Cameroon Estuary, mangrove are source of timber for house construction, fuel wood for cooking and fish smoking. All class of diameter of the Rhizophora spp. are exploited, rendering the mangrove stands more

vulnerable. Din et al. (2008) revealed that roughly 1000 ha are destroyed in the Cameroon Estuary annually. Most of the *Rhizophora* spp. wood compare to *Avicennia germinans*; *Conocarpus erectus* and *Laguncularia racemosa* are used especially to smoke the ethmalose (Ethmalose frimbriate) or 'bonga' on a traditional smoked oven 'banda' which is less energy efficient. A traditional oven has an average time of 21 hours as oppose to improved oven with less, 5-8 hours (Feka et al., 2009).

Responses efforts to reduce the threat and impacts on the mangrove in the DER, have been demonstrated by a national NGO "Cameroon Wildlife Conservation Society (CWCS)". These includes the introduction in 2003 of improved type Morrison designed smokehouses and sensitization campaigns. Despite these initiatives, there has been an annual increase of 46.4 % (between 1997 and 2008) of traditional smoked oven as opposed to close to 5 % of improved type Morrison designed smokehouses (IMDS) constructed (Moudingo, 2009. pers. com.) for fish smoking in the DER. Hence, fish smoking is the key driver for mangrove degradation (Ajonina et al., 2005). The introduction of the IMDS has yielded no desirable results and the mangrove woods are still overexploited. It obvious that mangrove that is under subjective and intensive anthropogenic activity will never recover 'pristine' conditions (FAO, 2007), more especially when resources extraction exceeds regeneration or restocking rates (Ajonina, 2008).

In the face of the challenges, CWCS planned between 2007 and 2009 and used a participatory wetland approach (PWA) to involve poor coastal communities to restore 10 ha of deforested and degraded mangrove in the DER. The term participation and participatory infuses the literature interchangeably, everyday language and rhetoric of sustainable development (FAO, 1998). Participation is nothing less than the framework of social life. People have always participated in survival strategies and in the development of their own cultures. Whether through formal or informal organizations or democratic means, a variety of participatory structures and procedures has evolved to define and address collective needs, to resolve conflicts and to make plans, take the necessary steps to implement them. The PWA consisted of sensitization, educational studies, nursery establishment and subsequent outplanting phases. The key species used in the PWA process was the *Rhizophora racemosa*.

Little or no study has been done in Cameroon, particularly in DER a protected area, in assessing the mainstreaming community participation (Cp) in mangrove restoration as response effort to strengthen ecosystem health. Hence, this unprecedented study was conducted as part of an effort to redress the downcast loss of mangrove. Generally, we set out to answer following question: Does the involvement of local people in mangrove educational talks, nursery establishment and subsequent outplanting phases have any significant impact on the restoration of mangrove forests in the DER? Alternatively, are communities able to incorporate voluntary mangrove tree planting habit in the DER?

Everything being equal, it will be accepted that this CWCS initiative will help share lesson learned to other Cameroon mangrove are especially in enhancing the resilience mangrove at any given scale with the involvement of local mangrove communities. The indebt of this study is not to look at the dynamics of mangrove stands restoration singularly but used it as a stepwise frame to assess community participation in selected sites of the future national park. Actually, this study revealed that communities functioned to restore mangrove stands irrespective of their social-cultural origin or background to restore approximately 4 hectares of degraded mangrove. Social-professional background is not a hindrance to mangrove restoration in the DER. Community approach in mangrove restoration is key to reinstate degraded are mangrove area. This paper is amongst a series the authors planned to carry out to buttress the knowledge on Cameroonian mangrove ecosystem.

2. Material and Method

2.1. Study area

The reserve is located within the Douala-Edea basin of the coastal Atlantic Ocean and spreads over 160,000 ha along the Cameroon coastal plains. The dense hydrological network defines naturally the boundaries of the reserve. The reserve is limited in the North by R. Wouri estuary; East by R. Sanaga, Dipombé and Kwakwa; the South by R. Nyong; and West by the Atlantic Ocean for some 100 km (52 national miles) coastline from R. Nyong to the Wouri estuary. The reserve is within the Littoral Region administratively, in the Edea (Yassoukou village) and Mouanko division.

This study concentrated on four (Mbiako, Yoyo 1, Yoyo 2 and Youme 2) mangrove forests, villages covering more than 80 % of Douala-Edea mangrove estimated at more than 16,000 ha where CWCS has been working for over 12 years. These villages are located between Latitude 3° 35'- 3° 48' N and Longitude 9° 38'- 9° 48'E as indicated by the GPS. Pertaining to the stewardship of resources; by legislation, all rivers, lakes, in effect all water bodies belong to the state. The Law 94/01 of the 20th January 1994 in its article 24 specifies ownership of the DER and it's environ resources.

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

After the gazettelement of the reserve in the early thirties, the local community (Malimba's) lost traditional rights on the lands, as it became state property. There are over 60 villages and hamlets with a total population over 12 000 people, while that of the four selected villages is 2490 people in the reserve. Native Bassas and Ewondos are recent settlers in the region while the 'Graffis' and Bayangis from the North and Southwest regions of Cameroon are attracted to the site due to its livelihood activities.

The community structure (Mbiako, Yoyo 1 & Yoyo 2,) is four-dimensional (A chief, council of elders, representative and groups, households, and individuals) while that of Youme 2 is three-dimensional (no chief). Foreigners (Nigeria (mainly the Yorubas from Elaijahs and Ogoni tribes), Ghana, Benin, etc...) dominate the mangrove coastal zone, where they constitute more than 80 % of the coastal population. The Youme 2 is made of non-national. Of which Nigeria alone is having more than 60 % of the total population with migratory following the fishing months April to November. Their primary occupational activities set then as actors. They are fishermen, woodcutters, fish smokers, carpenters, poachers, etc....

2.2. Methods

To achieve the stated objectives, all activities geared toward mangrove restoration were assessed through three (sensitization, community organization and nursery-outplanting) stages (Figure 1) is seemingly wrong. In here, communities seeded case of sustainable management through basic processes and functionalities of mangrove restoration using in situ reference ecosystems. This paper is amongst a series the authors planned to carry out to improve the buttress the knowledge base of the Cameroonian mangrove ecosystem.

The collection followed field observational studies from October 2007 to January 2009.

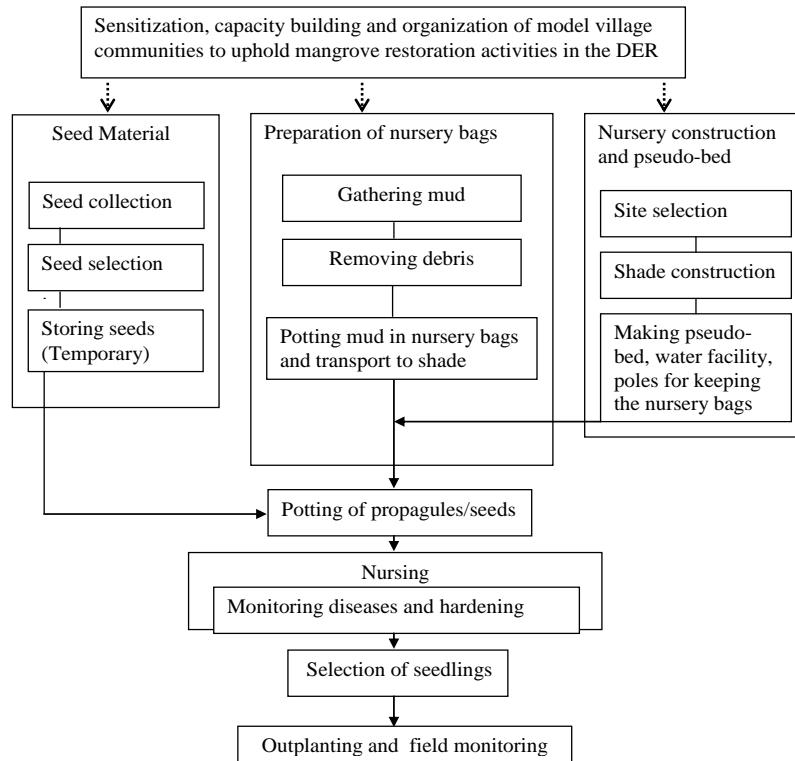


Fig 1: Chart of stages towards mangrove restoration using nursery seedlings in the DER (adapted from Ravishankar & Ramasubramanian, 2004; Lewis et al. 2006)

Key → Learning by doing link to produce nursery stock for restoration (dynamic)

→ Pre-restoration activities link (reflexive)

Both primary and secondary data were used in analyses. The primary data used in this study span over a period of 14 months from observational studies (Moudingo, 2007). It consisted in taking stock of individuals involved per stage during activities. Secondary data come from various quarters, namely articles in scientific journals, books, newsletters, and reports. User-friendly statistic software (Microsoft Excels) provided opportunities to encode and analyze the raw tally chart. To support and corroborate these results, descriptive statistics were used.

3. Results

3.1. Sensitization

3.1.2. Community participation by gender

Globally, 142 (6 %) inhabitants participated during sensitization for mangrove restoration (Table 1). Of the 142 inhabitants more male [75 (53 %)] participated during sensitization than female [67 (47 %)] while no children participated (Fig. 2). A marked disparity was found between the four villages.

At the village level, therefore, Mbiako had more female [26 (40 %)] than male [19 (25 %)] compared to the three others villages. More female participated in Mbiako probably because they had more time than the male, they do not go for fishing, but rather stay back to take care of the family. In addition, because Mbiako is an island, accessibility is only by boat which highly dependent on tides and the season. This condition highly limits movement of some inhabitants to and fro within the reserve. Contrary to Mbiako, Yoyo 2 had more

male [28 (37 %)] than female [17 (28 %)]. The reason is that accessibility is somewhat easy and high dwellers either by the earth road or by water. Moreover, Yoyo 2 hosts the car station where everybody moves to and from the earth road to either Youme 2 or Yoyo 1. The earth road ends at this village. Additionally, more males are present because most use their physical strength to perform for livelihood subsistence.

Table 1: Community participation rates during sensitization in the DER

Village	Total population	Total participant	% of total participant
Mbiako	703	40	6
Yoyo 1	541	26	5
Yoyo 2	530	47	9
Youme 2	716	29	4
Total	2490	142	6

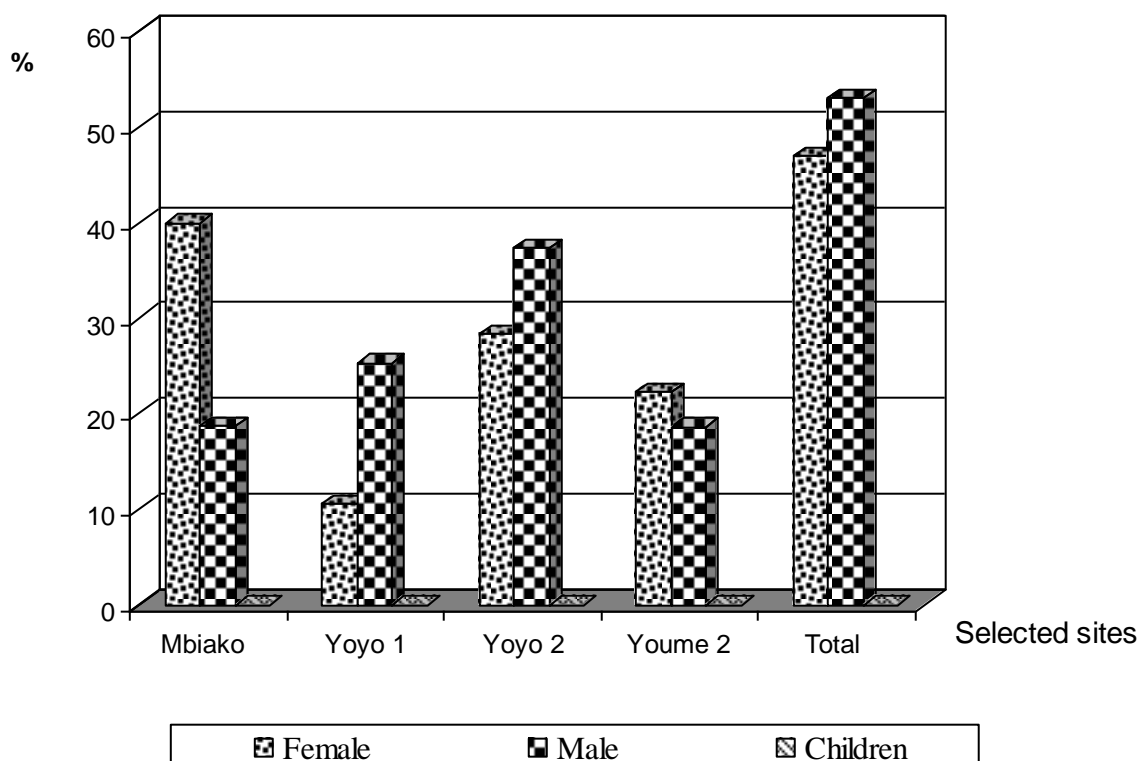


Fig 2: Community participation by gender during sensitization in the DER

3.1.3. Community participation by primary occupation

Amongst the 142 participants, more fish smokers [53 (37.32 %)] participated than woodcutters [48 (33.8 %)], others [28 (19.72 %)] and fishermen [13 (9.15 %)] (Table 2).

At village level, a difference was found: Mbiako had more fish smokers [20 (50 %)] than Yoyo 1, Yoyo 2 and Youme 2 (Table 2). Yoyo 2 had more wood cutters than Mbiako, Yoyo 1 and Youme 2.

Table 2: Community participation by occupation during sensitization in the DER

Village	Primary occupation							
	Fish smokers	% of fish smokers	Wood cutter	% of wood cutters	Fishermen	% of Fishermen	Others	% of others
Mbiako	20	50	12	30	3	7.5	5	12.5
Yoyo 1	7	26.9	12	46.2	2	7.7	5	19.23
Yoyo 2	11	23.4	20	42.6	3	6.4	13	27.66
Youme 2	15	23.4	4	13.8	5	17.24	5	17.24
Total (142)	53	37.3	48	33.8	13	9.2	28	19.7

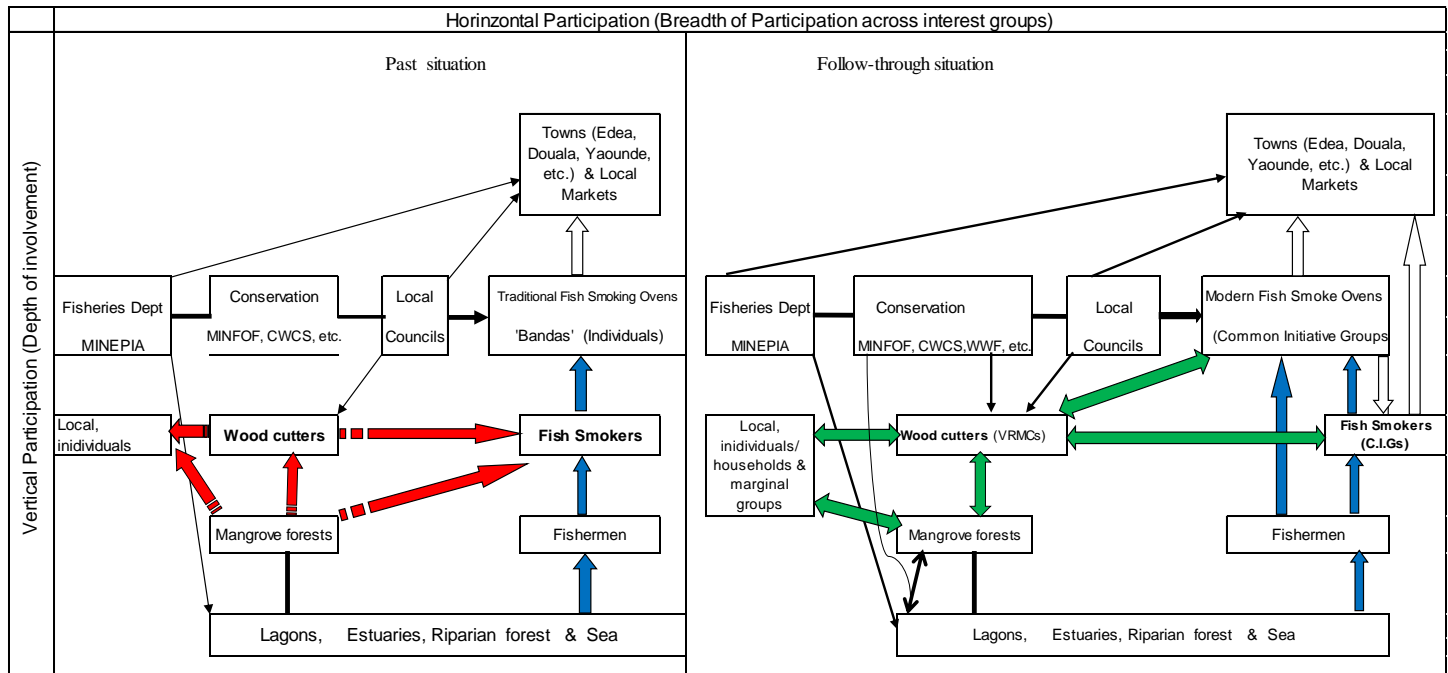


Fig. 3: Chart of community organization at village level (past and follow-through governance structure) in the DER.

Key Fresh fish movement Wood movement (win-win solution) Wood movement (be-all and be-end solutions) Institutional regulation Linkage

MINFOF: Ministry of Forests and Wildlife, MINPIA: Ministry of Fisheries and Animal Husbandry, CIGs: Common Initiative Groups

3.1.4. Community organization geared towards nursery-outplanting activities

Globally, eight committees were formed in the DER for future institutional liaison. Each village has two committees (focus groups) i.e. one village restoration mangrove steering committee (VRMSC) and the other a fish smokers committee to put forward ways to improve traditional fish smoking house in each site (Fig. 3). From the 142 inhabitants sensitized (Table 4), overall 57 individuals (Moudingo, 2007) were democratically selected into the committees, of which they were more female [31 (54.39 %)] than male [26 (45.61 %)] (Table 4). These focus groups (two per site) acted in synergy to mobilize more community members in mangrove restoration. From now on, these committees pave way from a be-all and be-end solution (red arrows) to win-win solution (green arrows).

Table 4: Community participation by gender at committee level in the DER

Village	Total participants	% of total participants	Gender			
			Female	% of female	Male	% of male
Mbiako	18	31.58	10	32.26	8	30.77
Yoyo 1	13	22.81	6	19.35	7	26.92
Yoyo 2	12	21.05	5	16.13	7	26.92
Youme 2	14	24.56	10	32.26	4	15.38
Total (57)	57		31	54.39	26	45.61

3.2. Nursery and outplanting sessions

3.2.1. Community participation in nursery-outplanting demonstration

During this session not only those in the focus groups were trained, but also those who are not in the group, as the amount of trainees increase by 11 [(68-57=11)] individuals during nursery-outplanting (NO) demonstrations (Table 5).

A difference was found at village level. Of these 68 participants [27 (39.71 %)] fish smokers [25 (36.76 %)] woodcutters were the most represented. Equally, the results showed that fish smokers (in Mbiako and Youme 2) and woodcutters (in Yoyo 2) had more participants, [9 (33.33 %)] and [11 (44 %)] respectively. The slight increase in the number of participants shows the willingness of users to become managers of mangrove resources in the DER.

Table 5: Community participation by occupation during capacity building in the DER

Village	Toatal participant	Primary occupation							
		Fish smokers	% of fish smokers	Wood cutters	% of wood cutters	Fishermen	% of fishermen	Others	% of others
Mbiako	24	9	33.33	8	32.00	2	66.67	5	38.46
Yoyo 1	8	3	11.11	3	12.00	0	0.00	2	15.38
Yoyo 2	21	6	22.22	11	44.00	1	33.33	3	23.08
Youme 2	15	9	33.33	3	12.00	0	0.00	3	23.08
Total (68)	68	27	39.71	25	36.76	3	4.41	13	19.12

3.2.2. Community participation in nursery and out planting activities

Globally, 298 individuals participated in NO activities, of which more male [161 (54.3 %)] than female [137 (45.97 %)] were involved (Table 6). A difference found in the number of participants at the village level, which had influenced the productivity seedlings and outplanting activities. It showed that no female was involved in NO activities in Yoyo 1 and Mbiako. Eight-nursery shades were constructed to produce 10,171 *R. racemosa* seedlings, of which 9,550 were out-planted (Table 7). Youme 2 constructed more nursery shades and produced more seedlings compare to Mbiako, Yoyo 1 and Yoyo 2. In the DER, outplanting through community efforts yielded a surface cover of 3.82 ha though seedlings from Mbiako site were not transplanted, for a mortality rate of 21.76 % was recorded in the nursery. The surface restored is less than that initially stated objective of the project that is 10 ha.

Table 6: Community participation by gender in NO activities using propagules in the DER.

- I. Propagules collection and processing. II. Propagules selection & temporal storage.
 III. Gathering and potting mud, transport to nursery and sowing of propagules.
 IV. Exploiting hydrologic facilities and using poles to keep nursery bags.
 V. Clearing and shade construction. VI. Outplanting and monitoring*

Community characteristics		Nursery activities				Outplanting	Total	
		Seed material	Preparation of nursey	Nursery bed preparation				
Village	Gender	I & II	III	IV	V	VI	Female	Male
Mbiako	Female	0	0	0	0	0	0	
	Male	4	7	3	10	0		24
Yoyo 1	Female	0	0	0	0	0	0	
	Male	5	7	9	13	8		42
Yoyo 2	Female	10	13	0	0	16	39	
	Male	7	7	8	8	12		42*
Youme 2	Female	29	35	0	5	29	98	
	Male	3	4	16	16	14		53
						Total	137	161
						As % total (298)	45.97	54.3

Table7: Areas restored through community efforts in four-selected village in the DER

Site	Number of shade constructed	Total propagule potted	Number of seedlings obtained	% mortality	Number of seedlings outplanted	Number of saplings in the field at 31/12/08	Estimated surface (ha)
Mbiako	1	2,100	621	70.43	0	0	0
Yoyo 1	2	2,200	1,963	10.77	1,963	1,817	0.79
Yoyo 2	2	3,200	2,885	9.84	2,885	2,152	1.15
Youme 2	3	5,500	4,702	14.51	4,702	4,405	1.88
Total	8	13,000	10,171	21.76	9,550	8,374	3.82

4. Discussion

Tables 4 to 6 at the globally and locally that the local people have received information concerning mangrove restoration in some extent through learning by making process. Cp (gender and primary occupation) inconsistencies in increased through sensitization, community organization and demonstration sessions for NO activities. Though the strategy put in place by the CWCS team worked as trainees passed on the message to those absent, which therefore mobilized more participants, but their involvement was incidental. Why communities are not fully geared/involved in the MR in the DER? Probably other underlying factors influence their involvement in such activities. Few subjects did understand MR activities and could perceive that their participation plays key role to meet their demand in mangrove wood now and in the future while other stayed away due one or other reason.

Additionally, figure 3 showed that communities organized to collaborate in to tenurial rights; with more male than female present (Table 4). The organization of these mangrove area inhabitant increased the scope (vertical and horizontal) of selected sites to fit and participate in the wise use of mangrove resources in the purported terrestrial and maritime national park as proposed by Ajonina et al. (2009) governance structure. The organisation of the community is inbeded in Steering committee for collaborative management of the mangrove ecosystems in the Douala- Edea Wildlife Reserve 'COPVAM- French acronym' in the Douala-Edea, Cameroon to be created. Better still, community (Table 6) possesses already the aptitude to produce *R. racemosa* seedlings as they used the majority of seedlings produced to restore degraded areas in the DER (Table 7).

Community stewardship in mangrove restoration has been carried in mangroves bound country in Africa and Asia as well. In the latter, more precisely in India, it was done in three villages' Gadavari and Krishna, which revealed a slight contradiction in term of number of species use, number of seedlings produced and gender is compared to that in the DER. Communities participated in raising 30,000 mangrove species, including *Avicennia*, *Agallocha* and *Excoecaria* seedlings, of which more female (71.29 %) than male (28.71 %), though the operation received a wage (Ravishankar and Ramasubramanian, 2004). Those saplings mangroves were raised in backyard of houses and not in situ (near or in degraded sites) as is the case in this study. Equally community stewardship towards mangrove restoration showed that less seedlings of *R. mucronata* were transplanted in Mbweni Mangrove Forest in Tanzania after 8 months (Wagner et al., 2000), compare to *R. racemosa* in the DER over a period of 14 months. In addition, the West African Mangrove Initiative (WAMI) including Senegal, Gambia, Guinea Bissau and Sierra Leone replanted 20 ha of mangroves after the year 2008 though not information regarding community involvement was given (Nellemann and Corcoran, 2010). Also, no more detail was given as to the proportion of land restored by each country. Nevertheless, Cote D'Ivoire has succeeded in reforested about 100 ha of mangroves over 5 years and so (Egnankou, 2008).

Dissimilarities in proportion of gender involved from other mentioned experiences can explain by the fact that in the DER, communities do not have mangrove conservation ethics and, they are turning primarily towards livelihood activities. Nevertheless, most of the restoration done elsewhere did not involve the community from the start to finish, making this study holding a good place in a case study of adaptation to

climate change. Secondly, the number of seedlings produced and transplanted was probably due to the availability and quantity of mature propagules, degraded areas and equally by the number of individuals involved in NO activities, alongside environmental stressful conditions, which do not permit easy movement by foot to restoration sites. More so, other African countries mentioned have more or less firm soil in the mangrove area making replanting easy. The short span of the project might have also acted as a limiting factor. Moreover, seedlings in Mbiako were not transplanted probably due to difficulties to access restoration sites, worst still bad weather and tide fluctuation at the time of the study. A mortality rate reduced the productivity, which was probably due to leaf feeder and root borers such as scale insects, caterpillars and crabs.

5. Conclusion and Recommendations

Owing to the importance of mangrove and its resources to man, the role in re-establishing ecological functions cannot be over emphasized. This implies that restoration through community efforts which is a low cost approach for ecosystem restoration have significant impact in re-stocking mangrove carbon in the DER. If allowed to recover through constant monitoring, it will further influence biodiversity breeding in this area.

Globally, it was an 'eye-opener' for many communities and came at the right time, as they organized (functional participation) to collaborate due to tenurial right to increase their scope (vertical and horizontal) to participation in the wise use of mangrove resources in the purported Douala-Edea National Park of about 2,960 km². Better still, having moved from strategies to actions irrespective of gender specificity, communities are now fitted to produce *R. racemosa* seedlings *in situ* to restore degraded areas. Community participation (within and across characteristics) showed discrepancies in the stages geared towards mangrove restoration in the DER. Though, its a rich and learning process working with the locals and identifying some of the salient problems that impinge on mangrove restoration management in the DER. A number of questions arose from this restoration study even with the use of the PWA. Why the target of 10 ha was not met? As to why did we have a significant involvement in the penultimate stage following Ravishankar & Ramasubramanian (2004) and Lewis et al. (2006)? It is obvious that other factors control community participation in mangrove restoration and it processes.

In the light of this, its a rich and learning process working with the locals and identifying some of the salient problems that impinge on mangrove restoration management in the DER. The originally perceived easy idea of community participation in these activities proved to be not only long but also complex and flexible. Therefore, more attention has to be accorded to both human and financial resources since its set paste for the development of sustainable solutions and strategies. Mangrove restoration therefore, should be looked at holistic intentional actions and processes not achieved through the manipulation of isolated indicators or individual elements. Thus, upscaling mangrove policy, strategy and research should therefore have no missing link.

Based on the results and discussion, the following recommendations can be made to strengthen community participation in future restoration and resource management initiatives.

5.1. Sensitization

More long-term sensitization efforts to enhance the visibility of the project objective(s), communication and environmental awareness can be made including:

- Organizing and introducing environmental mangrove education scheme in schools;
- The enactment of “community day for MR” and
- Need to use opinion leaders to pass the message of MR for change in belief and ideology.

5.2. Community organization

There need to establish more community groups and pool adjacent villages where mangrove is important or not. Whatever the organizational structure chosen by the collaborators, roles and responsibilities of participants must be clearly delineated. Leadership and organizational structures should have legal ramification and be provided with technical documents.

5.3. Nursery and outplanting initiatives

The youth should be targeted in MR activities due to their tremendous energy. The facilitators and the villagers should monitor the success of restoration, so that it empowers more villagers or fishing camps inhabitants. Equally, graduated sanctions should be made for violation or disturbance of restored sites.

Alongside, these follow-through stages, several general recommendations can be made. These are:

- Need for long term planning;
- Need to integrate other conservation initiatives in restoration works; and
- Need for further research.

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