Community-Based Ecological Mangrove Restoration (CBEMR): re-establishing a more biodiverse and resilient coastal ecosystem with community participation

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Summary

West Africa is ranked high on the list of regions threatened by climate change. Severe drought, massive deforestation, unsustainable agricultural practices, and poor watershed management have left much of West Africa dangerously vulnerable to sea-level rise and extreme weather events provoked by climate change. Restoration and conservation of the region's wetlands, especially their mangrove ecosystems, is a vital part of disaster mitigation and coastal protection strategy proposed for the region.

Mangrove Action Project's Community-Based Ecological Mangrove Restoration (CBEMR) program seeks to empower local communities to restore and steward their mangroves while deriving sustainable mangrove-based livelihoods. Involving local communities in mangrove restoration is essential, as it offers participants a sense of empowerment and involvement in resolving their own environmental, social and economic issues of community development.

Traditional mangrove restoration efforts face a fair number of challenges in restoring healthy mangrove ecosystems. Most are erroneous attempts to establish monoculture plantations that lack biodiversity and true ecosystem function, or project designs that neglect underlying problems or stressors that impact mangroves and cause their loss in the first place, such as unusually high salinity or disturbed hydrology - tidal flow and mixing of salt and fresh water - essential to healthy mangrove ecosystems. Inland watershed problems, such as drought or flooding from dam releases or severe rainstorms, may affect flows of fresh water into the mangroves, negatively affecting hydrology. This may require creating ways to capture, store, and later release fresh water into the mangroves to maintain proper saltwater/ freshwater flow and balance.

CBEMR methodology, in contrast, works to restore underlying hydrology and considers adjustments to a disturbed area's topography, so that mangroves may regenerate naturally, resulting in true ecosystem restoration with a richer biodiversity. Importantly, local mangrove communities learn to perform this work, and in the process learn to restore, value, and responsibly steward their mangroves. Towards these ends, Mangrove Action Project (MAP) has joined forces with Wetlands International Africa to implement a training workshop in CBEMR in the Saloum Delta, Senegal that brought together and engaged 21 participants in April 2018.

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Background

Mangrove forests are vital for healthy coastal ecosystems in many regions of the world. These forest wetlands support an immense array of marine and coastal life, serving as vital fish nurseries, nesting and feeding grounds for migratory waterbirds, last stands for Bengal tigers and lemurs and a wide variety of other mammals including manatees and Proboscis monkeys, a myriad of insects and reptiles, including sea turtles. Mangroves also support the health and productivity of coral reefs and sea grass beds. In addition, mangroves play an important, life-supporting role for countless coastal communities and indigenous peoples who depend on mangroves for life and livelihoods. Mangroves now are recognized for their important role in reducing climate change, sequestering up to five times more carbon than other forest ecosystems, storing that carbon in their peat soils for hundreds, if not thousands of years. Mangroves are also living buffers against the forces of storms and waves that can otherwise devastate a coastline.

Yet, mangroves are one of the most threatened habitats on earth with an annual loss outpacing other tropical rainforests. It is estimated that less than 15 million hectares remain worldwide, less than half their original area. Their disappearance is primarily due to clearing for shrimp aquaculture, timber and fuelwood extraction, charcoal production, urban and agriculture expansion, pollution, coastal road construction and other industrial and infrastructure developments. Cleared forests and degraded wetlands are turned into shrimp ponds, oil ports, tourist hotels, golf courses and marinas. Today, it is imperative to counter these losses. This is one of the challenges taken up by Mangrove Action Project since its founding in 1992.

Wetlands International too has joined the movement for mangrove conservation and restoration in various places around the world. Wetlands International Africa has piloted local conservation and restoration projects extensively on the West African coast and in Kenya in the Eastern African region. Wetlands International Africa has worked with partners in West Africa for the adoption of a mangrove charter by governments. This experience is now being extended in a collaboration with the Abidjan Convention, which was established by participating nations of West Africa in 1981 via The Convention for Cooperation in the Protection, Management and Development of the Marine and Coastal Environment of the Atlantic Coast of the West, Central and Southern Africa Region (Abidjan Convention in short). It covers a marine area from Mauritania to South Africa, which covers 14 000km of coastline. The Convention provides an overarching legal framework for all marine-related programs in West, Central and Southern Africa.

Wetlands International Africa has identified a number of critical drivers of change for the degradation of mangroves, including issues of land clearance for agriculture, severe drought, increasing salinity and local wood harvest. Clearly these concerns are complex, dynamic and arising at multiple levels, some of which we dealt with during the CBEMR training workshop in April 2018 on Senegal's Saloum Delta.

Seeking the most effective path towards long-term mangrove conservation and recovery, Mangrove Action Project (MAP) promotes the concept and practice of Community-based Ecological Mangrove Restoration (CBEMR). This holistic approach to mangrove restoration views the proposed plant and animal communities to be restored as part of a larger ecosystem, connected with other ecological communities that also have functions to be protected or restored. Mangrove forests can self-repair, or successfully undergo secondary succession, if the normal tidal hydrology is restored and if there is a ready source of mangrove seedlings or propagules from nearby stands that are accessible to reseed an area.

CBEMR focuses on re-establishing the hydrology, which will facilitate this natural regeneration process. CBEMR also engages local communities in the restoration process, empowering them to be stewards of their environment, and enabling them to regain the livelihoods ruined when the mangroves were destroyed. Five to ten-day intensive workshops train local people to do CBEMR, and long-term community management and monitoring plans ensure project sustainability.

Working with local communities and NGOs, MAP has been holding trainings in CBEMR and helping to develop and implement small successful

CBEMR projects in Senegal, Thailand, Indonesia, India, Myanmar, Honduras and El Salvador. MAP is planning further CBEMR training workshops in both East and West Africa, working with field-based NGOs such as Wetlands International Africa in Senegal and Guinea Bissau. Many challenges remain, however, such as the need for more robust monitoring and evaluation with internationally recognized outcome indicators. Also, there are challenging issues of land tenure and site availability; restrictions imposed by donors; carbon offset plantings encouraging ecosystem conversion rather than true mangrove restoration; and securing government permits and approvals.

Reforestation programs where the mangroves have been lost would therefore aim to re-establish mangrove forest protection, while furthering the potential for sustainable development. The improvement of mangrove ecosystems through restoration will enhance their functions as a natural water treatment system and spawning and nursery grounds for fish and shrimps, thereby improving health and livelihood possibilities to the benefit of marginalized local communities; and restoring the vital carbon sequestration powers of these forests.

MAP has witnessed the all too frequent failures of the so-called "traditional" hand planting approaches when performed at large scale. There is great need for the wider dissemination of the ecological mangrove restoration methodology to improve the success of mangrove restoration. The challenge was to adopt and introduce ecological mangrove restoration, only described previously in scientific journals, to the socio-economic and cultural situation of mangrove communities, NGOs and governments of developing countries in Africa, Asia and the Americas. In the process, based on the principles of ecological mangrove restoration MAP has developed CBEMR, a sustainable model that engages and integrates local communities in the long-term process of conservation, restoration and management.

Community-Based Ecological Mangrove Restoration (CBEMR) defined

Ecological Mangrove Restoration (EMR) was first developed by Robin Lewis over the 40 years of his extensive international work on mangrove restoration. EMR is a more holistic approach to mangrove restoration that also includes a view of the proposed plant and animal community to be restored as part of a larger ecosystem with other ecological communities that also have functions to be protected or restored. Lewis has used EMR very effectively to restore both the biodiversity and functionality of mangrove ecosystems (Lewis, 2009). EMR aims to restore certain ecosystem traits and replicate natural functions as mangrove forests can self-repair or successfully undergo secondary succession over periods of 15–30 years if:

1) the normal tidal hydrology is not disrupted; and, if disrupted, attempts are made to restore that prior hydrology
2) the availability of waterborne seeds (propagules) of mangroves from adjacent stands is not disrupted or blocked (Lewis, 1982; Cintrón. and Shaeffer-Novelli, 1992).

Since mangrove forests may recover via their natural reseeding process, , the need for labor-intensive hand planting and mangrove nurseries can be greatly reduced. It has been recommended that restoration planning should first look at the potential existence of stresses such as blocked tidal inundation that might prevent secondary succession from occurring, and plan on removing those stresses before attempting restoration (Hamilton and Snedaker, 1984; Cintrón and Shaeffer-Novelli 1992).

Long-term observations or monitoring should be carried out over six months to one year to verify if natural seedling recruitment is occurring once the stressors have been removed. There should be evidence of volunteer seedlings on site within one year of the hydrological adjustments. If not, a reassessment of the attempted restored hydrology and identification of other potential problems should be undertaken. If seed limitation is a factor, then collected seeds can be broadcast or released on an incoming neap tide, which can then recolonize the area in question. Only if natural recovery is not occurring should the third step of assisting natural recovery through planting be considered. (Brown, B., 2008).

Contrary to this scenario, many mangrove restoration projects move immediately into planting of mangroves without determining why natural recovery has not occurred. There may even have been a large capital investment in growing mangrove seedlings in a nursery and time and labor in hand planting before the stress factors are assessed; this often results in failures of planting efforts. Unfortunately, very little effort goes into monitoring and evaluating these types of restoration efforts, whereby failures are not noted, nor reported, and valuable lessons not learned. Instead of this kind of non-scientific approach, MAP supports the restoration of a naturally functioning habitat through the six-step EMR approach to restoration and does not support "plantation forests" which disregard natural species biodiversity and zonation. (Lewis, 2005).

This method has proven extremely successful in numerous past endeavors by Robin Lewis – for example in West Lake, Florida where 14 ha of mangroves were restored at a very low cost. CBEMR has been implemented by MAP in small-scale projects in Honduras, El Salvador, Indonesia and Thailand (see Figure 1).

Figure 1. Photo sequence of a successful CBEMR project MAP helped initiate in El Salvador eight years ago resulting in good mangrove recovery after the blocked hydrology was restored by volunteers from the resident communities.

In the last few years, MAP has been working in Thailand to introduce CBEMR at 10 sites, working closely with the local communities along the Andaman Sea coast. The program aims to build capacity to implement CBEMR and empower selected local leaders from the villages to disseminate CBEMR to other communities, and to advocate the CBEMR approach to government. This is occurring through field visits, training, coaching and building capacity with study tours, environmental education and sustainable livelihoods.

Such small-scale projects serve as working models, intended to inform and inspire larger-scale applications of CBEMR where it is needed. MAP is especially interested in restoring some of the estimated 400 000 ha of abandoned shrimp farms, rice paddies and cleared charcoal concessions in former coastal wetland areas in Africa, Asia and Latin America (Robin Lewis, pers. comm. 2012). MAP and Wetlands International Africa have recently launched a partnership to work together for this aim in the Saloum Delta region.

Advantages of Community-Based Ecological Mangrove Restoration over other current methods

Community-Based Ecological Mangrove Restoration (CBEMR) involves a more methodological ecosystem approach than the usual monoculture restoration efforts, incorporating natural mangrove dispersal and ecological recovery. The key is in the restoration of the hydrology of the area being considered for restoration, and then working with nature itself to help facilitate regeneration of the area's naturally occurring mangrove species. Adequate monitoring and evaluation follow this at each site to assess progress and take corrective action to ensure success and replicability (Lewis et al., 2006). CBEMR is based on principles of community engagement and

empowerment, recognizing that sustainable restoration requires the active participation of the affected local communities. The importance of local community involvement in mangrove conservation and restoration cannot be overstated, as it is these local communities who reside on-site and have most to gain from a healthy, living mangrove buffer, including improved livelihoods from increased wild fisheries and protection from storms and wave surges, These communities also possess important local knowledge of their community base and surroundings, and are more able to monitor and assess the status of their mangrove areas on an ongoing basis.

Challenges, obstacles and opportunities ahead

The majority of past and current restoration efforts utilizing the traditional hand planting techniques have been failures. A comparative analysis of current methodologies is needed, so we can learn from our mistakes and avoid these in the future. We need to define more clearly what constitutes "restoration" and what should be labeled a "success." Too often, just planting a certain large number of Rhizophora (red mangrove) propagules represents success, when in reality these mass hand-plantings may be dismal failures with quite poor seedling survivability, and if "successful" resulting in the forced conversion of one important wetland ecosystem (a mudflat or salt flat where most of these mass plantings occur) into another (a mangrove). These mass single-species plantings most often result in monoculture plantations at best, or, more often, large-scale failures at worst. Planting competitions have even been introduced to the "restoration" scene, when one-day mass plantings of over a million mangrove seedlings have set and reset superficial Guinness World Records in countries such as Pakistan and the Philippines among others. However, what do such records mean if these planted seedlings do not survive, or if once viable coastal ecosystems are irreversibly altered?

And, who is doing the follow-up and noting the particulars of these "restoration" attempts? There clearly needs to be a follow-up on the many attempts at restoration to ensure restoration is actually occurring, and these follow-ups need to be done over a period of at least five years or more to confirm the results. How can we learn the lessons that need to be learned, and avoid the mistakes that need to be corrected, without such follow-up assessment and evaluation with an agreed upon set of "best practices" as guidelines for mangrove restoration?

Further analysis is needed to determine more accurate values of selected benefits and services, and the intrinsic worth of such factors as biodiversity and resilience to restore an ecosystem that benefits both nature and livelihoods.

Success is often judged by percentage of surviving seedlings at 3–6 months, and sometimes one or two years after the attempted restoration, but several years are needed to better understand the nuances that determine success or failure at each unique restoration site.

Restoration practitioners must define more clearly and much earlier the outcome indicators used for determining the result. What exactly are they looking for in determining what constitutes a successful restoration - restored biodiversity, forest density and height, number of surviving seedlings, or other factors? But such assessments are not short-term. Monitors need to implement long-term assessments of at least 5 years to determine if the restoration effort succeeded and to deal with issues that may arise.

Funder-driven restrictions

Too often, funding restrictions of donors make it hard to pursue effective CBEMR programs by providing only one or two years of funding, whereas medium to long term funding (at least five years) is needed to carry out CBEMR effectively because of the more intense monitoring and evaluation needs. Donors seeking to support only short-term results are unwittingly engendering long-term failures. Support for several year's monitoring and assessment of a restoration project is crucial. In other words restoration is not a one-moment event, but an ongoing one that must include the M & E effort as integral to the whole process. What did we do right, what went wrong? We can learn much from such evaluations, and in so learning improve on our methodology to ensure future greater success. This is what restoration should entail - a significant learning process, where success increases with experience, and we do not repeat the same mistakes over and over. We need not hide our failures to

avoid embarrassment, which is seen to threaten chances for further funding. Though CBEMR may not provide the cute images of photogenic school children planting red mangrove propagules by hand, our approach does ensure a much better chance of real success involving much better informed restoration practitioners. And, if needed, we can show good photo images of local community participants involved in various stages of the CBEMR process (See Figure 2).

Figure 2. Local community participants involved in CBEMR training Saloum Delta, Senegal.

Source: The CBEMR training workshop in Saloum Delta, Senegal; 17th April to 1st May 2018.

Limited number of mangrove experts.

In many countries with significant mangrove populations, and in particular in the African region, there is a dearth of mangrove experts who can help provide the science base of conservation activities, perform necessary action research, collect and interpret data from field activities, integrate local knowledge and practitioners' experience to build a knowledge base and feedback into the conservation and restoration projects. Wetlands International Africa has launched a Mangrove Course in West Africa in 2018 working with the Cheikh Anta Diop University in Dakar (UCAD) and the Abidjan Convention. Wetlands International has already supported the same course in East Africa working with the Kenya Marine and Fisheries Research Institute, the African Mangrove Network, the Nairobi Convention and other partners. The specialists trained out of that program will be a positive asset for further implementation of CBEMR in Africa.

Challenges caused by climate change

Climate change and consequent rising sea levels present urgent cause for concern for the future of our planet's mangroves. New siting challenges will arise because mangroves will need open areas upland to colonize when rising sea levels force them to migrate inland, otherwise they will be permanently submerged and drown. Therefore, forethought must go into planning to establish and preserve a buffer behind the mangroves where mangroves can "migrate" inland as the sea level rises to re-establish themselves above the rising low tide mark. This will prove a challenge because of the extensive development happening behind mangroves, including roads, shrimp farms, industrial complexes, hotels, agriculture and urban centers. These will potentially hinder or block the necessary access areas which mangroves can colonize as sea levels rise. The infrastructure and dikes, berms and roads can also block important freshwater inputs into the mangroves, causing high salinity and stress.

Conclusion

MAP is currently engaged in a timely endeavor to disseminate the CBEMR approach on a wider scale. With the majority of past mangrove restoration efforts by others failing and the continuing losses of primary mangrove forests to unsustainable developments, prospects are dim for our planet's coastal rainforests and the bountiful marine and terrestrial life these wetlands support. Working collaboratively with Wetlands International Africa is a great opportunity for MAP to demonstrate the principles of CBEMR to a new and interested audience, and teach mangrove restoration practitioners the skills to implement this more natural, science-based ecosystem approach to restoration that better ensures long-term success. MAP hopes that the recently concluded (April 2018) first CBEMR training workshop in Senegal's Saloum Delta has opened doors to work in other parts of coastal Africa where mangroves are found. We also hope to introduce our "Marvelous Mangrove Curriculum" to Senegal and other parts of West Africa as a way to educate the future generations of decision makers about the importance of mangroves. (see Youtube- Marvellous Mangroves Curriculum)

There is still much to do, and we are really only now at the starting gate, but with time and opportunity, MAP hopes to collaborate further with Wetlands International Africa and others in teaching more mangrove restoration practitioners the principles of CBEMR. We are in this race together to win back our planet's mangrove wetlands and prevent their further loss.

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