

**REDD+ PROJECT READY TO BLOOM:
THOR HEYERDAHL CLIMATE PARK MYANMAR**

*To restore vital ecosystems, provide viable local revenue,
build community capacity, especially among women,
improve disaster prevention and climate change
adaptation globally and locally.*



Model of the Climate Park after restoration



**Proposal by Worldview International Foundation/Worldview Myanmar
in cooperation with Myeik University, Patheingyi University and
Ministry of Environmental Conservation and Forestry
Ayeyarwaddy Region Myanmar**

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Responding to UN Climate Panel's call for urgent action.

MANGROVE RESTORATION

*The most effective method to capture
and store large amounts of CO₂
in a permanent sink*

*

+ Adaptation to Climate Change
by saving lives and property from extreme weather

+ Increasing sea food stocks by up to 50%

+ Filtering and cleaning water

+ Providing large cooling effect

+

*All in a natural process
with the highest cost efficiency*

READY TO BLOOM

Project Proposal

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Executive Summary and Key Benefits:

The 1,800 acre Thor Heyerdahl Climate Park is ready to bloom in Myanmar, literally and figuratively. Rarely does a project offer so many potential simultaneous and synergistic benefits by planting of 700,000 mangrove trees with long term protection including securing the life of 600,000 young plants in healthy growth. The target is mitigation of 1.5 million tons of CO₂, including protection of carbon in the ground from the lost forest due to human activities.

It is well known that the mangrove is almost a miracle tree. For the human communities that depend on fishing, mangroves serve the vital purpose of nurseries for fish species and the detritus cycle on which fisheries depend for food. They are the vital foundation for a complex marine food chain and the detrital food cycle, sustaining fisheries and many forms of bird and wildlife, and in Myanmar it is estimated that 75% of the game fish and 90% of the commercial species in certain areas in Myanmar rely on mangrove systems.

Mangroves are also coastal physical barriers that can absorb shocks of extreme weather, storms and oceanic surges and without them, human lives are imperilled, as occurred in 2008 when hurricane Nargis hit coastal areas where there was no longer any mangrove protection and thousands of people were killed and displaced.

Mangroves preserve water quality and reduce pollution, filtering suspended material, assimilating dissolved nutrients in protection of coral reefs, and provide a substantial cooling effect. Moreover, mangroves have the ability to mitigate up to five times more CO₂ than rainforest trees.

On the other hand, despite these known ecological benefits, mangroves have also become the target of various coastal projects that require the destruction of the mangroves, including the production of charcoal by extremely poor local families who suffer nomadic and unreliable existences.

In Myanmar, only 20% of original mangrove cover remains in the vulnerable areas, and absent any intervention, it is projected that most if not all the remaining mangrove cover will be gone by 2020.

To help avert this disastrous ecological outcome and reverse the trend, and to provide significant economic human benefits, Worldview Myanmar proposes “ready to bloom,” an ambitious but viable project which has numerous synergistic components, including the fact that most of the beneficiaries of the ongoing project work thus far are women in disadvantaged communities.

Key Benefits:

Establishment of the Mangrove parks as the first step in national restoration of mangroves with the following key benefits

- **Reverse** devastating effects of Myanmar’s destructed natural mangrove forests
- **Provide** up to 50% more sea food with better and secured breeding environments
- **Mitigate** up to five times more CO₂ than rainforest trees and reduce escalations of global warming
- **Generate cooling effect** from planted trees with 60,000 BTU per tree

- **Create** high value-added livelihood opportunities to disadvantaged coastal communities by reducing poverty, especially women, including in raising orchids, developing nypa sap, bee honey and other new sources of revenue
- **Save lives** and improve quality of the environment for millions of people in adaptation to climate change
- **Contribute** to social and economic development of a peace building process in a new democracy

Additional components of a mangrove park will include

- Waterways.
- Research facilities.
- Observation and education facilities.
- Tissue culture lab for mass production of selected plants with high genetic value.
- Experimental planting methods and other practical scientific activities.
- Buildings for administration, mangrove museum and exhibition.
- Demonstration in sustainable forest management for maximum economic benefit.
- Livelihood creation in local communities by utilization of nypa mangrove palm.
- Recreation/resting facilities and other service for students and visitors.
- Gene bank for preservation of all mangrove species.
- Nurseries and planting of up to 1.
- 2 million mangrove trees as a national genetic resource with the highest CO2 mitigation and photosynthesis cooling capacity.
- Day care centers where needed in involved communities and villages



Bjorn Heyerdahl distribute solar light to village participants

The proposed project will be called Thor Heyerdahl Climate Park, in honour of the well known Norwegian author, scientist, environmentalist and explorer Thor Heyerdahl. He was among the first in the world to raise awareness on climate change and campaigned strongly for reduction of green house gases. Thor Heyerdahl was a founding member of Worldview International Foundation and served as its Vice President for many years. His son Bjørn Heyerdahl shares his father's commitment and is engaged in Worldview's mangrove research project in Myanmar in cooperation with leading universities. He has proposed the first mangrove park of this kind in Myanmar as a pilot project with the name "Thor Heyerdahl Climate Park" in honour of his father during the 100 years anniversary of Thor Heyerdahl to promote awareness and commitment for urgent action on Climate Change.

Mangrove Forests and REDD+

By UNEP Programme Officer, Gabriel Grimsditch



Credits: Katie Fuller, 2009. Marine Photobank

Mangrove forests are considered highly productive ecosystems and most carbon is either buried in sediments locally and in adjacent systems or stored in forest biomass as the trees grow. Three different global estimates for carbon burial within mangrove systems all converge on a value equivalent to $\sim 18.4 \times 10^{12} \text{ g C yr}^{-1}$ when applying a global area of 160,000 km² (Chmura et al. 2003). In comparison to tropical forests, mangroves have actually been found to be more efficient at carbon sequestration (Laffoley and Grimsditch, 2009). Mangroves are thus clearly an option for countries interested in developing REDD+ readiness plans.

Unfortunately, it is estimated that more than 50 per cent of the world's original mangrove forests have disappeared (Valiela et al. 2001), and the annual global rate of mangrove loss continues to be between one to two per cent (Spalding et al. 2010). In order to counteract the loss of mangrove forests and to provide incentives against deforestation, REDD+ projects could finance the protection of mangroves.

Apart from their value as carbon sinks, mangroves also provide many other socio-economic benefits including regulating services (protection of coastlines from storm surges, erosion and floods; land stabilization by trapping sediments; and water quality maintenance), provisioning services (subsistence and commercial fisheries; honey; fuelwood; building materials; and traditional medicines), cultural services (tourism, recreation and spiritual appreciation) and supporting services (cycling of nutrients and habitats for species). For many communities living in their vicinity, mangroves provide a vital source of income and resources from natural products and as fishing grounds. Ecosystem services from mangroves thus translate directly into economic benefits (see Table 1).

However, the economic value of mangroves is usually ignored or under-valued when economic analyses are being made for coastal developments, despite the obvious economic arguments for including ecosystem services. The products and services mangroves provide are usually externalized and not accounted for. Therefore it is difficult to determine what people lose when mangroves are destroyed until it is too late, and often other coastal developments such as infrastructure or aquaculture are deemed more profitable despite evidence to the contrary. If mangroves are to become viable investment options, it is important that thorough economic evaluations be carried out for all ecosystem services.

Financing mangrove conservation through REDD+ can 'unlock' the huge economic value that exists in these ecosystems, therefore providing more value per 'REDD+ dollar' than solely from carbon sequestration. Instead of investing in expensive infrastructure, mangroves provide many of the same services for a lower price, and this needs to be recognized by local and national governments. It is clear that as developing countries with relatively extensive mangrove forests prepare for REDD+, it is critically important to include mangrove forests in their strategies. Few other forest systems offer as many benefits for climate, conservation and development.

Table1

Ecosystem service	Value range from literature
Fisheries	750 to 16,750 USD per hectare
Penaeid shrimps	91 to 5,292 USD per hectare
Coastal protection	1,800 to 10,821 USD per hectare
Forest products	379 to 584 USD per hectare
Waste treatment	6,700 USD per hectare
Carbon sequestration (as burial in sediments)	139 g C per m ²

Financing mangrove conservation through REDD+ can ‘unlock’ the huge economic value that exists in these ecosystems, therefore providing more value per ‘REDD+ dollar’ than solely from carbon sequestration. Instead of investing in expensive infrastructure, mangroves provide many of the same services for a lower price, and this needs to be recognized by local and national governments. It is clear that as developing countries with relatively extensive mangrove forests prepare for REDD+, it is critically important to include mangrove forests in their strategies. Few other forest systems offer as many benefits for climate, conservation and development. It is thus strongly recommended that national governments consider the incorporation of mangroves in their REDD+ readiness plans.

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MANGROVE FOREST RESTORATION

An urgent challenge in CO2 mitigation and adaptation to climate change.



LIVELIHOODS UNDER THREAT

The livelihood conditions for millions of people in vulnerable coastal areas are in danger with escalating global warming. Dramatic change in weather patterns with more violent storms, hurricanes and cyclones, rising sea levels, tidal waves and other potential calamities are on the rise.

This happens simultaneously with depletion of the protective shield of mangrove forests in tropical coastal areas. In some developing countries, as in Myanmar, up to 80% of mangrove forests have been destroyed in vulnerable areas due to short sighted economic activities in establishing prawn farms, industrial development, alternative land use, charcoal production and firewood collection. For the poorest of the poor, harvesting mangroves have become an additional income for survival. This is a vicious circle, which can only be solved in a pragmatic and practical process.

Local communities have to be empowered with knowledge of mangrove's life protecting shield and its economic and environmental benefits. Mobilization of people's participation in replanting, combined with alternative livelihood creation and sustainable forest management, is the answer. Experience has proven that expected results will not materialize by only planting mangroves. It is equally important that plants will be cared for and protected by motivated local communities. Only a comprehensive and well planned programme with adequate capacity at all levels will bring back sustainable mangrove protection at a time with urgent needs.

Mangrove restoration has the capacity to mitigate large amounts of CO₂, with up to five times higher efficiency than rainforest trees, and contribute to increase food security by up to 50% higher yields in fish and prawn resources. Combining environmental support with poverty reduction will double the effect of development efforts. Worldview International Foundation started comprehensive research on mangrove restoration in Myanmar in 2012 in cooperation with Patheingyi University and Myeik University. This has yielded valuable knowledge and experience to undertake this pilot project as a model for national restoration of mangrove forests in Myanmar in cooperation with Myanmar university partners, local communities, regional and central environmental authorities. This is based on MOU with Ministry of Environmental Conservation and Forestry and NGO registration with Myanmar Ministry of Home Affairs.

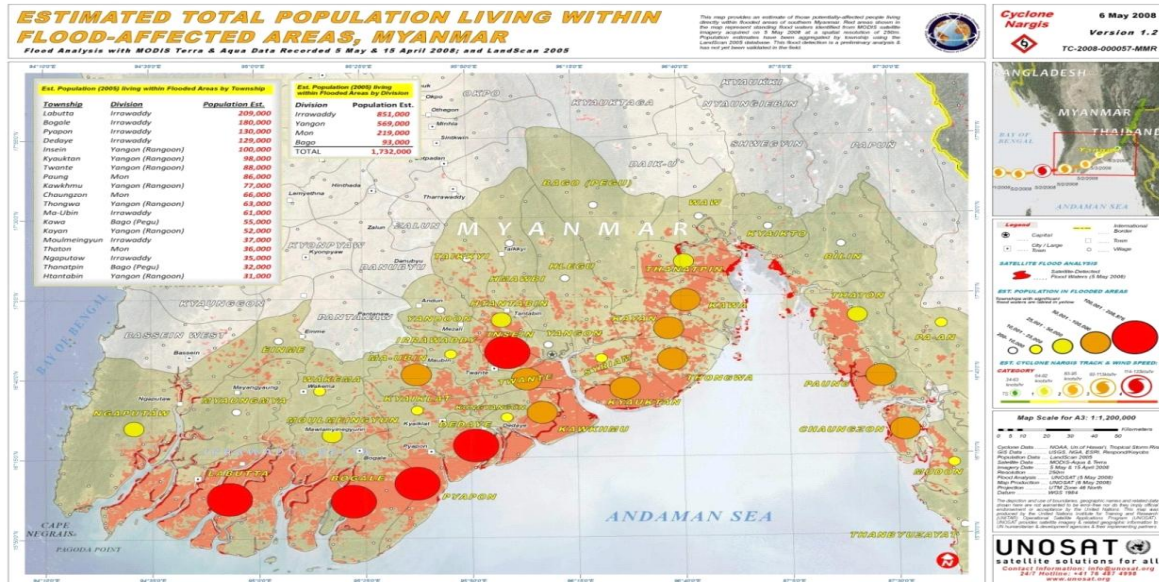
MYANMAR EXPERIENCE

Mangrove forests in vulnerable coastal areas have fast disappeared during the last 30 years with approximately only 20% of the original cover left in vulnerable areas. In most rice growing zones it is down to less than 5%. The government has therefore taken several steps to protect the remaining areas by banning establishment of new prawn farms and related illegal land use. In addition, the Ministry of Environmental Conservation and Forestry/Department of Forestry is maintaining nurseries and organizing replanting. NGOs and others are also engaged in this endeavour. But these valuable efforts are unfortunately not enough to even stop the trend of escalating destruction. With no tangible change, there is a danger that most of the remaining 20% of the mangrove forest cover in Myanmar will be gone by 2020. This project proposal is based on Worldview International Foundation's research project on mangrove restoration. The project has identified an alarming escalation in mangrove destruction and is proposing a viable and measurable solutions for immediate attention.

Taking into account the danger of climate change effects in vulnerable coastal areas, millions of people are be exposed to unnecessary risks without mangrove protection. A case in point is cyclone Nargis which hit the coastal areas in 2008 with massive destruction affecting millions of people. Mangrove restoration has in this context an effective disaster prevention capacity in view of threatening climate change.



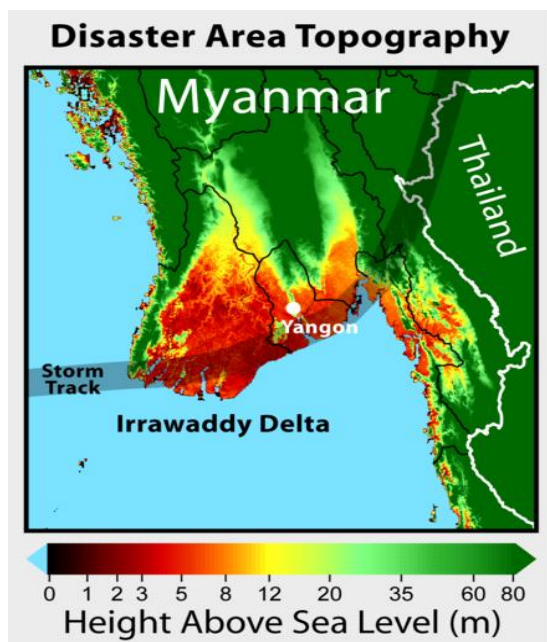
The latest report from IPCC published November 2014 underlines the urgency in mitigating CO₂ already in the atmosphere as an urgent need to meet global climate change targets. Blue Carbon, and in particular mangrove restoration is an effective method to capture and permanently store large amount of CO₂ with the highest efficiency and lowest cost, as mangroves captures up to five times more than rainforest trees. Worldview's test planting of 55,000 mangrove plants in Pathein University's dedicated 1,800 acres in MaGyi has yielded successful results and is now ready for planting of 700,000 mangroves during the next three years. This will in addition to protecting 600,000 young plants already on the ground, mitigate over 1.5 million tons of CO₂ when fully developed. The trees will be cared for and protected for years to come in a safe environment, protected from human destruction based on land guarantee by the Forestry Department to Pathein University for establishing Thor Heyerdahl Climate Park.



AYEYARWADY REGION – the most vulnerable area in Myanmar

On 2 May 2008 cyclone Nargis made landfall in Myanmar, crossing the south of the country during two days and devastated Ayeyarwady Delta region. According to official figures, 84,500 people were killed and 58,800 missing. A total of 37 townships were significantly affected by the cyclone. The UN estimated that as many as 2.4 million people were affected.

Reasons for the massive destruction was that 80% of the traditional mangrove forest on the coastal belts and river banks, are due to prawn and fish farming, rice farming, deforestation for charcoal production and cooking fuel, partly driven by rampant poverty in the area with no alternative livelihood for the poor who are struggling to survive on meagre incomes.



This region with its 6.6 million people is the most exposed area in Myanmar to threats of climate change. This is a flat low lying delta facing the Bay of Bengal, with myriads of waterways and rivers penetrating far into the country.

With no abatement for destructions, as of cyclone Nargis, with extreme weather and sea level rise due to climate change, it could substantially overshadow the damage of Nargis in 2008 for the whole region. For each degree of higher ocean temperature, the velocity of cyclones is estimated to increase by 25%. This will lead to serious consequences if no preventive action is taken in time. Cyclone Phailin that struck India in October in 2013 was the strongest on record (wind speed exceeding 200 KPH) is a frightening confirmation of this fact.

In order to identify practical cost effective options for protective measures while there is still time, Based on two years research on mangrove restoration, it has been concluded that establishment of mangrove climate parks is the most practical step forward in generating capacity and experience towards comprehensive restoration.

This proposal is a follow of the research to compensate for the loss of valuable life saving and sustainable environmental values of mangrove forests. It meets the urgent needs of immediate action as called for by the latest United Nations Climate Panel Report. It meets both the need for mitigation of large amounts of CO₂, as well as adaptation to Climate Change in vulnerable coastal areas, protecting lives and properties from expected extreme weather patterns.

THOR HEYERDAHL CLIMATE PARK

*A pilot project for Mitigation of Green House Gases
and Disaster Prevention Capacity in Adaptation to Climate Change.*



At the intersection of land and sea, mangrove forests support a wealth of life from starfish to people and may be more important to health of the planet than we ever realized. (National Geographic).

RESTORATION OF MAGNIFICENT FORESTS

The mangrove trees have the ability to grow where no other tree can, thereby making significant contribution to the environment. The coverage of costal shorelines and wetlands provide many diverse species of birds, mammals, crustacean and fish in a unique, irreplaceable habitat. Mangroves preserve water quality and reduce pollution, filtering suspended material, assimilating dissolved nutrients and provides a substantial cooling effect. Moreover, mangroves have the ability to mitigate up to five times more CO₂ than rainforest trees and represents a substantial cooling effect with more than 60,000 BTU units per tree.

The tree is the foundation for a complex marine food chain and the detrital food cycle. Due to destruction of mangroves, many of these species, whose continued existence depend on thriving mangroves, are endangered or threatened. It is estimated that 75% of the game fish and 90% of the commercial species in certain areas in Myanmar rely on mangrove systems.

Destructed mangrove forest lands is made available by for restoration to its former glory with various species of mangroves. Myanmar has a rich bio resource in 65 varieties of different mangrove species which can also benefit other countries. Pathein University will in addition to the climate park, also establish a genetic mangrove bank as its contribution towards full scale mangrove restoration in the country.

The two universities supported by Worldview's team in Myanmar, headed by its international science advisor and project director Dr.Ranil Senanayake, have provided the scientific and managerial capacity to the proposed project in a professional manner in cooperation with relevant local, regional and national institutions.



Sustainable mangrove restoration on a national scale is possible with a comprehensive step-by-step approach. The first period with research has generated scientific knowledge on vital national and local issues. It has identified the need for permanent mangrove parks as a necessary follow up towards national restoration. It is from these parks, functioning as resource centres in cooperation with local, regional and national institutions, a full scale effort can be successfully completed.

Pathein University is a leading academic institution in the coastal West, recently approved as a university of excellence. Worldview's ongoing research project has provided capacity building and necessary skills to students and academic staff. This has led to the contribution of 1,800 acres from the regional governments for mangrove restoration and adaptation to climate change.

A successful implementation of mangrove restoration in vulnerable coastal areas will save human lives and create new opportunities for the poorest of the poor. This will yield climate change protection as a catalyst for sustainable social and economic development.



THE CLIMATE PARK SOLUTION

Human Capital Development through Natural Capital Restoration:

Participation of people is vital in restoration mangrove forests. Worldview has during the last two years established several nurseries by engaging small scale farmers in local restoration projects, supported by students on research grants and monitored by professors in charge and the project's international director. Community participation is vital. The poorest of the poor will use any opportunity to generate income, and will only be able to fully participate as custodians of this future life saving process if there is an immediate economic benefit for their daily survival.

From the start, the Worldview research project has tested new livelihood activities as an alternative to mangrove destruction for survival. So far there are positive results from nypa sap harvest, soft shell crab nurseries, bee honey production and orchid growing in mangrove forests. These activities including development of sustainable mangrove management practises for income opportunities (harvest techniques and practises not harmful to the health of the forest) as a demonstration and training projects for local communities with people's participation. The parks will function as resource centres in scientific research and as a catalyst for sustainable livelihood for the poor. Mobilizing small farmers and especially women to establish mangrove nurseries for park development will add valuable income to local communities. A case in point is Kan Su village with 42 plant growers, most of them women. Employing villagers for planting and working in the park provides economic benefit for local communities as well as creating fruitful partnership for successful implementation.

THE ROLE OF WOMEN

Thus far we have observed that whether it is charcoal production, or raising mangrove seedlings, women are key partners and income generators for their families. In Myanmar, women are also afforded a voice in community discussions. We believe that direct investments in the climate park concept is a significant indirect investment in the empowerment of women, with well known multiplier effects. Indeed, in the nypa and orchid projects, most of the involved beneficiaries are women and in fact we have been told by local women how much they would value the inclusion of day care centers in the projects. Such

day care centers would become significant social development tools in themselves, of course, providing local children health and educational benefits.

Currently, village women not only take care of their children and families, but they also work daily in rice harvest and other traditional forms of work. Their days are full to say the least, leaving little time for learning new skills or entrepreneurial involvement. But if women could entrust their children to a nearby locally run day care center, they could be free to pursue higher value income generating projects such as the spin-offs of mangrove restoration. (It is also noteworthy that at Patheingyi University, almost all department heads are women, and all are eager to contribute to the inter-disciplinary research and activities inherent in the climate park projects.)

ASEAN MODEL: It is worth noting that Myanmar is the poorest country in the ASEAN region. The country deserves support in its efforts towards democracy and sustainable development. The proposed Mangrove Parks could be a flagship projects during Myanmar's ASEAN Chairmanship in 2014, with a wide demonstration effect to be shared with other ASEAN countries and beyond (ref. attached letter from Director General ASEAN).

Establishment of the Climate park as the first step in national restoration of mangroves with the following impact:

- **Reverse** devastating effects of Myanmar's destructed natural mangrove forests
- **Protect** coastal areas from the worst effects of cyclones and other adverse weather patterns, including tsunamis, with potential to save thousands of lives and properties
- **Provide** up to 50% more sea food with better and secured breeding environments
- **Mitigate** up to five times more CO₂ than rainforest trees and reduce escalations of global warming
- **Generate cooling effect** from planted trees with 60,000 BTU per tree
- **Create** livelihood opportunities to disadvantaged coastal communities by reducing poverty
- **Save lives** and improve quality of the environment for millions of people in adaptation to climate change
- **Contribute** to social and economic development of a peace building process in a new democracy.

Mangroves also contribute substantially to cooling of the environment. This is a valuable attraction at a time of global warming. Average cooling effect from photosynthesis is estimated at up to 120,000 BTU per plant of *Sonneratia*, *Rhizophora* and *Bugeria* species, equivalent to 10 room sized air-condition units in 20 hours operation (total 144 billion BTU). At a time with growing concerns for acidity in the oceans due to CO₂ emissions, it is also worth noting that this miracle tree also have capacity to clean polluted water.



Before



After

In sum, in Myanmar, mangroves, orchids, new livelihoods - the nation itself - is ready to bloom. This project is an essential component of “green economic growth” at a relevant scale and we believe it will prove vital and essential to the overall future of Myanmar.



NYPA MANGROVE PALM FOR LIVELIHOOD SUPPORT

It is imperative for the project to include livelihood creation as a vital part of the combined restoration efforts. The ongoing mangrove research project has identified several options in adapting food production with new type of saline resistant plants and methods in harvesting the nypa palm and other species with potential to withstand changes in sea level rise and other climate change problems.

Nypa is the oldest known palm in the world with a 70 million year’s history. It is a mangrove palm with trunk growing horizontal in the ground with the branches and leaves above. The fact that its trunk is protected in the ground makes it a perfect tree for survival in the climate change age. Moreover, its sap is 50% sweeter than the sap of sugar cane, containing healthy inverted sugar, high content of antioxidants, vitamins and minerals, and other health benefits.



The flower branch is cut for collection of nypa sap.
Each tree yields approximately one liter per day.

The value of nypa sap production was documented by Worldview's pilot project completed in 2014. Ten villages were engaged in nypa sap tapping for production of healthy sweetener syrup in a cottage industry facility. The project provided valuable income to the tappers and production staff, with production of 1000 litre readymade syrup of high quality packed in handy 300 ml bottles as a result.

Traditionally the palm's leaves are harvested for roofing material and therefore represents economic values. But the benefits of the sap is much more significant. Unfortunately, the old practise of tapping the sap as a sweetener lost most of its market in competition with less healthy white sugar, in spite of the fact that thousands of hectares of nypa palm forests represents a large potential in sustainable livelihoods for the rural poor in coastal areas.



High quality nypa golden nectar ready for the market.

An improved version of the production facility with vacuum cookers fuel by green bio energy will be launched as a co-operative project in the 10 villages, with a small production unit in each village. This is the first step towards utilizing the large potential in livelihood creation for poor communities as alternative to mangrove destruction.

Bee honey production in mangrove forests is another promising activity (Australia's best bee honey comes from mangrove forests). As the fungicide use in agriculture areas have been identified with Bee Colony Collapse Disorder (CCD) mangroves provide bee populations with a toxin free flowering forest environment.

Especially women have expressed interest in these activities, and the mangrove parks will follow up with practical training and facilitating support to women groups as alternative income. These efforts could generate income opportunities for thousands of poor in vulnerable coastal areas as well as reduce pressure on destruction of mangrove forests for survival.



Most of the beneficiaries of Worldview's ongoing mangrove project are women.

PEOPLE'S PARTICIPATION – a critical component

It is of great importance to include people's participation at all levels of mangrove restoration. The advantage of engaging local communities is that they will have the overall responsibility in planting, nursing and protecting the new plants, and thereafter manage the forests in a sustainable manner. The project will include training at all levels and will follow up with professional support from the universities on a regular scale.

Thor Heyerdahl Climate Park will function as resource centres for community parks and will in addition to scientific research, develop effective management methods for sustainable forests, including alternative livelihood activities. In addition to demonstration units of cottage industry nypa palm syrup and sweetener facilities, orchid growing and bee keeping as livelihood projects, the mangrove parks will also conduct research on the use of nypa fruit and develop other nypa products to generate income for coastal communities. This will mobilize people to become active custodians for the living plants and take a leading role for a safer and better future.

MOBILIZING SCHOOLS AND LOCAL COMMUNITIES



As part of a broad based public education programme, primary schools and other education institutions with link the local communities, will be key partners in awareness and information campaigns mobilizing for action.

Worldview's ongoing research project has already built relationship with schools in project areas and have gained valuable experience. A cartoon flyer has been produced as the first education tool. The response is very encouraging. This will be followed up with essay competition among schools in the project areas with solar lights prizes to students of the best schools. Wall papers, posters and participatory communication methods will also be introduced in local communities.

Public Education by the use of Media:

Radio, the main media in Myanmar will be extensively engaged to reach out to people with relevant information with tested, effective edutainment and awareness concepts. One of the radio formats will be based on "My community" model which empowers people from local communities to write and perform a series of radio dramas under guidance of a trained producer. This has proven very effective in mobilizing people for action.

The project will also produce interactive videos made by the local communities, as well as short video spots tailor made for decision makers at all levels.

Print media and regional/national television will be included in a multimedia approach. A docudrama in several episodes will be made for TV and CD distribution with a special version for cinema halls. The production process will be inclusive, starting with a script competition among the best drama writers in Myanmar and produced by the best drama director, with ordinary people as actors. Worldview has positive experience from using this concept in several countries as part of national public education and awareness campaigns. The project aims at total mobilization of the population at all levels to generate public trust and support for the project.

An additional contribution to the communication process will be mobilization of social media with tailor made web pages and interactive networks, including links to Facebook, Twitter and others.

Worldview’s 32 years experience in development communication will be applied in an inclusive process with relevant national partners.

Example of cartoon strip on mangrove awareness produce for distribution to school



Summary in English
The Advantages of the Mangrove for our future
Good Morning Teacher

- ▶ Today’s lesson is about the value of the Mangrove Forest. Now, tell me how much you know about the Mangrove. Maung Mya stood up!
- ▶ I know about the value of Mangrove because it saved my life when Nargis hit coastal areas in 2008. At that time I manage to save my life because of Mangrove tree and I could cling to and escaped from danger.
- ▶ The Mangrove forest in our village was like a barrier against strong wind. But other village has been washed out with the strong wind and water, because they didn’t have any prevention from Mangrove forest.
- ▶ Yes, you are right. Not only people can rely on Mangrove for protection but also all the aquatic fauna and animals rely on the Mangrove forest too.
- ▶ So do all of you know how to maintain the Mangrove Forest?
- ▶ We have to avoid cutting down the Mangrove trees for charcoal.
- ▶ Because of existence of Mangrove forests, the water at our village is cleaner and provide breeding place for aquatic animals that depend on this forest.
- ▶ Not only that. We have to replant where needed and we must protect to maintain the existing Mangrove Forest.
- ▶ So Teacher, "Let us all start planting nursery at our school to plant Mangrove trees for the safety of our village"

The End

MANGROVE - FOREST OF THE TIDE



The mangrove tree is a halophyte, a plant that thrives in salty conditions. It has the ability to grow where no other tree can, thereby making significant contributions that benefit the environment. The tree is the foundation in a complex marine food chain and the detrital food cycle.

The detrital food cycle was discovered by two biologists from the University of Miami, Eric Heald and William Odum, in 1969. As mangrove leaves drop into tidal waters they are colonized within a few hours by marine bacteria that convert difficult to digest carbon compounds into nitrogen rich detritus material. The resulting pieces covered with microorganisms become food for the smallest animals such as worms, snails, shrimp, molluscs, mussels, barnacles, clams, oysters, and the larger commercially important striped mullet. These detritus eaters are food for carnivores including crabs and fish, subsequently birds and game fish follow the food chain, culminating with man. Many of these species, whose continued existence depends on thriving mangroves, are endangered or threatened. It has been estimated that 75% of the game fish and 90% of the commercial species in certain areas rely on the mangrove system. The value of red mangrove prop root habitat for a variety of fishes and invertebrates has been quantitatively documented. Data suggest that the prop root environment may be equally or more important to juveniles than are sea grass beds, on a comparable area basis. Discovery of the importance of mangroves in the marine food chain dramatically changed the respective governmental regulation of coastal land use and development.

Despite increasing awareness regarding value and importance, the destruction of mangrove forest continues to take place in many parts of the world under a variety of economic as-well-as political motives. In some areas, mangroves are protected by law but a lack of enforcement coupled with the economic incentive to reclaim land can result in deliberate destruction. Escalating pressure on mangrove populations and increasing quantities of pollutants reaching coastal and intra-coastal waters has brought new interest in the importance of mangroves to a healthy marine ecology.

Mangrove has in addition to a number of benefits, capacity to mitigate Green House Gases (GHG) by representing a significant capacity in slowing global warming.

The beneficial effects mangroves have on the marine ecology include:

- Basis of a complex marine food chain.
- Creation of breeding habitat.
- Establishment of restrictive impounds that offer protection for maturing offspring.
- Filtering and assimilating pollutants from upland run-off.
- Stabilization of bottom sediments.
- Water quality improvements.
- Protection of shorelines from erosion and extreme weather patterns.
- Protection from cyclones and tidal waves
- Production of nutritious fruits and fuel wood as income generation activities, especially among women in coastal areas.
- Up to five times higher effect in mitigation of CO₂ than rainforest trees, partly due to its ability to store large amounts of CO₂ in the ground as a permanent sink. It also have an effective cooling effect through its photosynthesis process.

As natural members of the estuary system, mangroves mitigate the adverse effects of development and pollution. It plays a crucial role in maintaining a healthy environment in coastal areas in support of higher living standard for the population.



HISTORY OF THE PROJECT per November 2014.

The project proposal for a Climate Park and Mangrove Gene Bank at MaGyi, Ayeyarwady Division (PUR/01), is based on two year's mangrove restoration research, in cooperation with Myeik University, Patheingyi University, Ministry of Environmental Conservation and Forestry by Worldview International Foundation. This pilot climate park concept is for 1800 acres land to be restored with its original mangrove cover, including sustainable community development in local communities. This research grants are to further develop capacity at Patheingyi University's Marine Science Department, recently awarded Centre of Excellence by the Ministry of Education. It also includes support to Myanmar Forestry University/Department of Forestry for national follow up.

THE AIM OF THE PROJECT

The main aim is to restore 1800 acres degraded mangrove forest by charcoal production, timber and firewood harvest, prawn and crab farms. The restoration process is to make an ecological model for national restoration, in line with governmental policy. According to estimate, 1 million Ha of mangrove forests have been lost in Myanmar since 1980. A great part of this can be restored. It is in this large-scale context that the importance of a Gene Bank of Mangrove species should be established as part of the Climate Park proposal. This will preserve Myanmar's 45 species of mangroves, in addition to 20 hybrid varieties, as a valuable bio-resource for future development.



An additional important goal of the Climate Park concept is sustainable community development benefitting the coastal population in adaptation to Global Warming, and mitigation. In order to keep the present amount of carbon in the soil in the planting area from oxidation, there is a need for new plants to make a natural cover. This will maintain the large amount of carbon in the soil. Restoration on this land will capture additional carbon by planting, as well as securing the carbon in the ground, with a potential to secure up to 3,000 tons per Ha after replanting. This is a general estimate by the Scientific Basis Contribution of Working Group to the Third Assessment Report of the Intergovernmental Panel on Climate Change. (Donatus et al. (2011)) and CIFOR reports, with substantially higher efficiency in capture and storing than rain forest trees.

LOCATION

The proposed climate parks are located close to Patheingyi University's Aquaculture Training and Research Center which is a north-campus of Patheingyi University in Ayeyarwaddy Division, in the West of the country (See detail in area map).



Thor Heyerdahl Climate Park at Patheingyi University's dedicated planting area can be reached by car from Yangon (estimated 5 hours by car) and is 8 miles up north of Chaung-Thar beach. This area was densely covered with mangrove forest four decades ago. Due to



production of charcoal and other activities, no trees have been left unaffected by human activity. Patches of remaining trees of 1 to 2 meters high are sprouts from old roots. Bare-lands dominate the environment due to heavy destruction by human activities. This can only be restored by large scale planting to bring the forest back to its original status. The heavily damaged vegetation

will be given a chance to recover due to protection within the dedicated climate park area and thereby increase the effectiveness in CO2 mitigation, including mangrove benefits for vulnerable coastal communities.

SUPPORT FROM CENTRAL AND REGIONAL GOVERNMENT

The Prime Minister of Ayeyarwady Region have initially transferred 1800 acres land area for a climate park in April 2014 to Patheingyi University with potential for more land if required. His Excellency, Regional Prime Minister U Thein Aung is highly interested in this pilot project which leads to sustainable community development with adaptation to Global Warming in Ayeyarwady Region. Development of the mangrove park is also recognized by Ministry of Environmental Conservation and Forestry in the MOU with Worldview International Foundation, as part of a large scale national plan to be developed as this first university climate park in Myanmar as a model for further development.

MANGROVE RESEARCH TEAM

Field research has during the last two years been carried out by Myeik University and Patheingyi University. The research teams have been based on cross-disciplinary approach, organized with researchers from different departments of the universities, with the main contribution from marine scientists and 32 students supported by research grants from



Worldview. Three professors from Patheingyi University and Myeik University have been in charge of the research, guided by Worldview's Senior International Scientist Dr. Ranil Senanayake and visiting scholars.

AREA IDENTIFICATION

Area survey has been carried out for species diversity index, species richness, species evenness, and physico-chemical parameters of the environment. The two last surveys in April and May was to identify bare-land areas of pilot scale mangrove re-plantation for 42,000 mangrove saplings as the first step towards a full scale restoration process of the Patheingyi University park. Planting of the saplings was successfully concluded in July. Measurement of carbon in the ground is ongoing and will be concluded in early 2015.



BRIEF HISTORY OF STUDY AREA

Marine Science Department, Pathein University started the research works in this area in 2005. Biodiversity of the area have been studied since then. Environmental parameters data, more precisely, water quality and heavy metals concentrations, had already been investigated since 2007, followed up by extensive research since 2012.

PROCEDURE AND METHODOLOGY

The Procedure and Methodology was shared with Worldview and the Ministry of Environmental Conservation and Forestry. Details will be given on request. Species diversity index is based on random sampling method (see map area).

INTERACTIVE BASE MAPS

The determination of Nitrate-Nitrogen ($\text{NO}_3\text{-N}$) which is important for most plants and the interactive base-map (run by genuine GIS software) are the own contribution of Mangrove Research Team, Pathein University in cooperation with Worldview.

It is based on three research trips to north-campus of Pathein University where Climate Park is to be located.

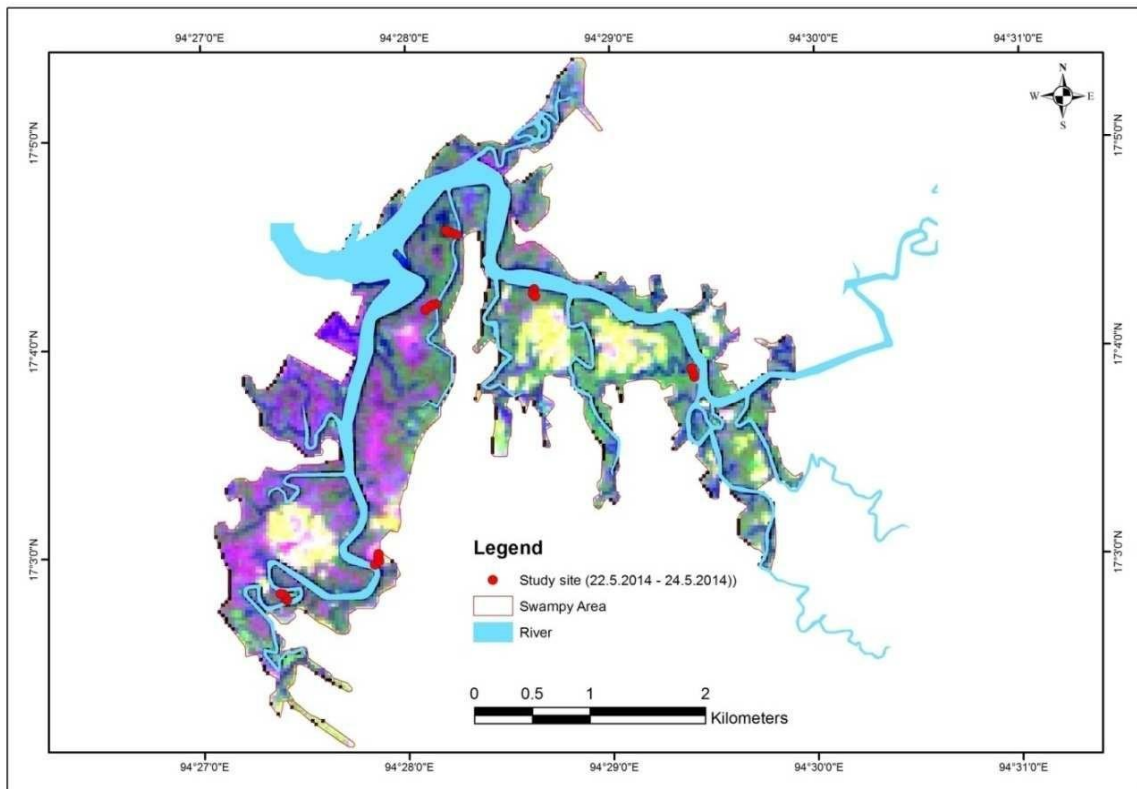
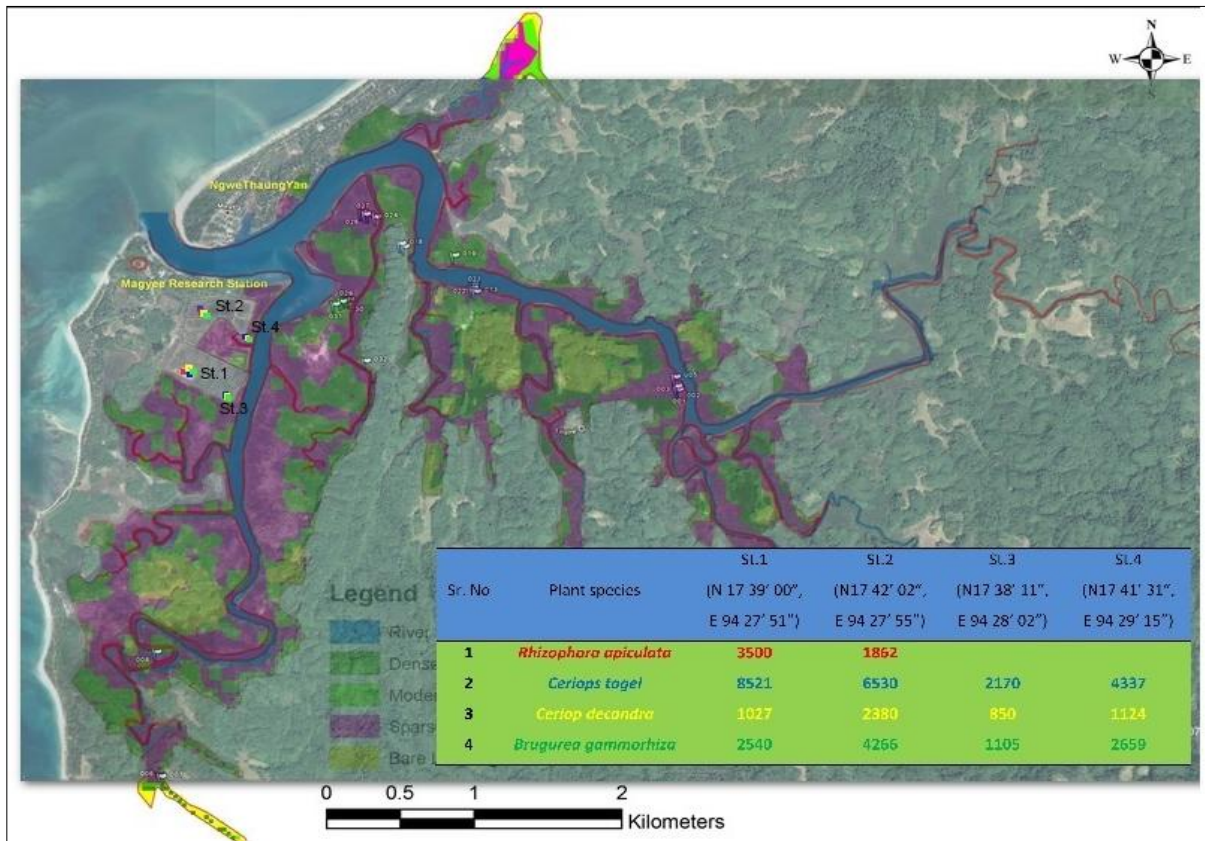
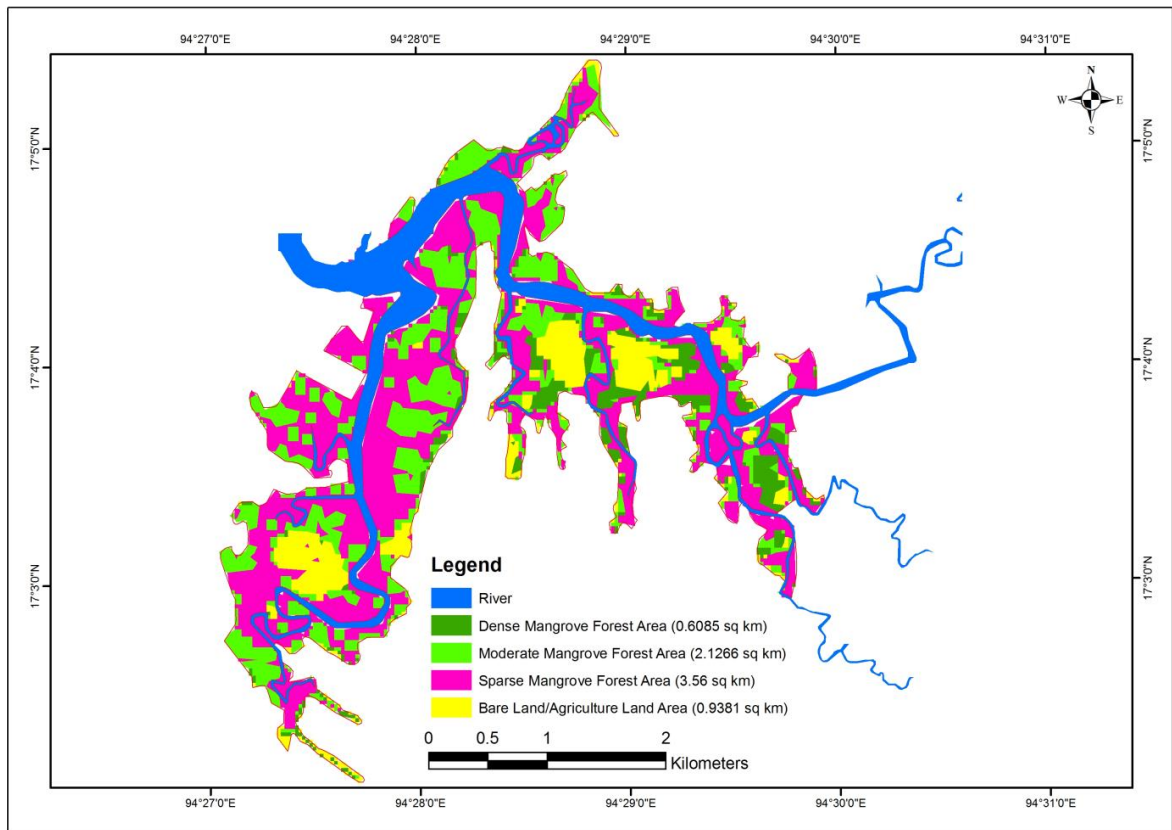


Figure1. Survey areas (red color) of Thor Heyerdahl Climate Park in May (22.5.2014 - 24.5.2014) Table 1.Detail Parameters of Station 1 (Single Quadrate Line, 4 plots)





Summary of results of test planting July-August 2014.

The status of the first 55,000 plants in the mangrove park by September 2014, is encouraging. The plants are setting roots with a healthy appearance in their new environment.



COMMUNITY MANGROVE FOREST

Worldview has gained experience in establishing community mangrove forests during 2013-2014 by engaging 46 farmers in Kan Su Village to establish nurseries. A total of 26,000 plants were produced. 4,000 of the plants were used for fencing in Kan Su, and the balance 22,000 plants were shared with farmers in Wat Su village to make a flood fence for protection of their rice fields. The project was successfully completed in August 2014 with all plants in the ground. The feedback from the villages is very encouraging. This has given Worldview an additional practical experience at grass root level, in addition to the scientifically based research and plant development with Pathein University.

COMMUNITY PARTICIPATION

It is essential to include the local community in all mangrove restoration efforts. This will be followed up in completion of planting at the proposed Thor Heyerdahl Climate Park in MaGyi with emphasis on women participation. The villagers will be engaged in



establishing nurseries, including planting and follow up activities, as well as partnering in creating new livelihood opportunities, to substitute for charcoal production and other mangrove destruction activities. The plants in the mangrove parks can only be fully protected when the local community has ownership in the project and see direct benefits for themselves, in an area plagued with abject poverty.

The project will also provide extensive public education for the local population, to create the necessary understanding of the project's benefit, aiming at social mobilization of the people in the area.

LIVELIHOOD PROJECTS

Based on the first survey in MaGyi for livelihood/community development, Worldview has been invited by the charcoal producers to help them restart their livelihood income by establishing soft shell crab production, orchid growing and bee honey production from honey mangroves, and to establish a nypa golden nectar production unit by utilizing potentials with the nypa mangrove plants in the area. Worldview has already completed test production of nypa golden nectar, as well as propagation of endangered endemic orchid species in its tissue culture lab (over 100,000 plants ready for replanting by early 2015). These activities will be essential in mobilizing the local community and providing the disadvantaged with new livelihood opportunities. Special efforts will be taken to engage women in the development activities. Worldview's international community development/communication specialist has since 2013 been engaged in the livelihood program in cooperation with local project staff.



Farmers participating in mangrove restoration.

THE TEAM

U Aye Lwin, former Director General of ASEAN, founder member and board member Green Growth, Green Economy, Advisor to Sasakawa Peace Foundation, Advisor to Nippon Foundation, President Yangon Rotary Club and Chairman Worldview Myanmar.

Ms. Win Sandar, Lawyer and Chartered Accountant.

U Htein Lin Aung, former Foreign Ministry Administrator

U Wing Maung, Mangrove specialist with 33 years' experience in forestry and mangrove restoration (former UNDP/FAO consultant and Director Forestry Department).

U Aung Phyo Wai, Project Assistant

Ms. Thandar Ko, Project Secretary

U Htay Aung, Field Manager, Mangrove Specialist, former professor at Marine Science Department, Patheingyi University

U Htoo Lwin Aung Assistant Field Manager, PhD student in Mangrove Science

Mr. Joacim Kotny, Plant Science Intern from Life Science University, Norway

Ms. Amy Hla, Project Assistant

Science Panel:

Dr. Khin Maung Cho, Pro Rector Myeik University and former Head of Marine Science Department Patheingyi University

Dr. U San Tha Tun, Head Marine Science Department Moulmein University and former professor at Patheingyi University

Dr. Ms. Nang Mya Han, Head Marine Science Department, Myeik University

Dr. Ranil Senanayake, Senior International Science Director, Worldview International Foundation

Assisted by 32 students on research grants (B.A, Master and PhD.) attached to the Mangrove Research Project.

Community Development and Public Education:

Ms. Soe Sandar Oo, Advisor/Media Specialist, Chulalongkorn University

Mr. Nazrul Islam, Media Director, former Country Director Worldview Bangladesh with experience in sustainable community development and public education in 16 countries in Asia, Africa and North America.

ICT and Social Media Worldview International Foundation:

Mr. Samyak Chakrabarty, Social Media Specialist

Mr. Kapila Gunewardene, Graphic Designer and Web Manager

Ms. Khin Sandi Linn, Media Project Assistant

Mr. Viktor von der Fehr, Social Media Advisor

International Coordination:

Dr. Arne Fjortoft, Secretary General Worldview International Foundation.

Dr. Bremley Lyngdoh, Climate Change Specialist, Columbia University/London School of Economics

Ms. Paula di Perna, Senior Consultant, Author and International Specialist on Marine Science and Global Warming.

Climate Park Project Manager

CURRICULUM VITAE

- | | |
|--------------------|--|
| 1. Name | - U Win Maung |
| 2. Date of Birth | - 16 th April 1953 |
| 3. NRC No | - 14/LPT(N) 005543 |
| 4. Nationality | - Myanmar |
| 5. Marital status | - Married |
| 6. Sex | - Male |
| 7. Height & weight | - 5' 6", 180 lb |
| 8. Position | - Project Manager (MERN/CLEARR) |
| 9. Organization | - MERN/CLEARR |
| 10. Address | - 166-168 6 th floor, Ngauwar road , Ahl
Yangon. E-mail: winmaung.mangrove@gmail.com
Mobile: +95 9 450049759 |



Qualification

- B. Sc (Forestry) 1973-1978. Arts and Science University , Yangon.
- Introductory Training on Participatory Rural Appraisal (PRA) from 18.11.94 to 8.12.94 in the Community Development of Ayeyarwady Mangrove Project. (UNDP-FAO/MYA/93/026) office in Bogalay and Laputta Townships.
- Training Course for the Greening of the Dry Zone of Central Myanmar in Korea, from 28 Sep to 25 Oct 2009, organized by Korea International Cooperation Agency and the Korea Forest Service under the International Cooperation Program of the Government of Korea.
- Complete 1st Regional Shared-Learning Workshop Mangrove Conservation as a part of Coastal Management in Southeast Asia in Surabaya, 4-10 November 2012.

Work Experience

- Totally over 33 years experience including 18 years in Mangrove area of Laputta Township, Ayeyarwady Division. Also 18 months experiences as a National Project Professional Person (Mangrove Product Specialist) in UNDP-FAO/MYA/93/026 project.
- Three months experience as a national consultant (Community Forestry Extension and Development) in UNDP/FAO project in Laputta and Bogalay Township.
- During 1981 to 1997, establish over 13000 acres of mangrove plantation in Laputta Township.
- During 1995 to 1997, organized 30 Community Forestry User Group in Laputta Township and prepared the management plan for user groups.
- In August 1998, handed over the Community Forestry Certificates to 20 user groups for 20 villages for 8812.45 acres.
- During 2002 to 2004 organized two villages for community forestry project of JICA and prepared Management Plan and conduct training on "How to implement Community Forestry" for the staffs of Laputta and Bogalay townships.
- 4 years experience in Forest Research Institute from 1998 to 2002.

- From 2006 to 2007 worked as a Project Field Manager in the Integrated Mangrove Rehabilitation and Management Project through Community Participation in the Ayeyarwady Delta in Myaungmya and Pyapon Districts.
- 20 months experience in Dry Zone Greening Department for Rehabilitation and Greening Program.
- 1 year experience in Management and Conservation of Southern Shan State, including Inlay lake greening program and community forestry.

Detail of the post from 1/1979 to Date

1/3/2012 to Date	- Project Manager, Coastal Livelihood and Environmental Assets Restoration in Rakhine (CLEAR) under Myanmar Environmental Rehabilitation Network (MERN)
5/2009 to 29/2/2012	- Director in Dry Zone Greening Department, Shan State Forest Department and Forest Research Institute, Forest Department.
8/2007 to 5/2009	- Deputy Director, Planning and Statistics Division, Forest Department, Ministry of Forestry.
11/2004 to 7/2007	- Assistant Director of Myaungmya District of Forest Department and Project Field Manager of the Integrated Mangrove Rehabilitation and Management Project through Community Participation in the Ayeyarwady Delta.
8/2002 to 11/2004	- Assistant Director of Divisional Forest Department Office, Ayeyarwady Division, Patheingyi.
9/1988 to 8/2000	- Assistant Director, Forest Research Institute.
4/1996 to 9/1998	- Staff officer of Laputta Township and also staff officer of Environmentally Sustainable Food Security and Micro Income Opportunities in the Ayeyarwady (Mangrove) Project (MYA/96/008). Implement Community Forestry activities and Income-generation activities.
10/1994 to 4/1996	- National Expert in the Community Development of Mangroves Project, (MYA/93/026)
7/1988 to 10/1994	- Forest staff officer of Laputta Township and also staff officer of Feasibility Study on Mangrove Reforestation Project, (UNDP/FAO-MYA/90/003)
4/1981 to 6/1988	- Plantation Assistant Officer for Mangrove plantation in Laputta Township
1/1979 to 3/1981	- Plantation Assistant for Teak plantation, Kawlin Township

International Co-operation Experience

- Six weeks Study Tour to Thailand and Malaysia mangroves forest area
- Workshop on Sustainable Resource Management for Mangroves area of Vietnam
- One week Study Tour to Mangroves area of Japan
- International Symposium on Conservation and Wise Use of Mangroves in Southeast Asia from 6 to 8 October, 2003 in Brunei Darussalam
- Workshop on Mangrove Rehabilitation and Sustainable Development of Mangrove Ecosystem from 20-2-2007 to 24-2-2004 in Phuket, Thailand
- Joint Counterparts' Seminar on Forest Management Policy Sustainable Forest Management with Collaboration of Local Government and Community at Nagoya University, Japan from 22-10-2007 to 9-11-2007

Senior International Science Director

Falika Ranil Senanayake - Curriculum Vitae

Personal Profile / Personal Attributes

- A forty year history of consistent work on Ecosystem Restoration
- An Eighteen year history of working on climate change issues in relation to Agriculture and forestry
- Author and creator of Analog Forestry an internationally recognised system for Ecosystem Restoration
- The practise of conservation, philosophically, scientifically and practically
- Practice of a scientific philosophy that encompasses epistemology, logic and metaphysics as its underlying foundations.
- Practice of a moral philosophy that recognizes personal responsibility and accountability for ones actions
- Personal engagement in hands-on activities, i.e. Plant Trees, engage in social work
- Be compassionate with all living beings. i.e. Take time to help creatures in distress.

Personal Detail

- Name : Falika Ranil Senanayake
- Address: 41 1/1 Gregory's Road Colombo 7
- Phone numbers: +94 11 2693613 : 077 6582662
- Email: r_senanayake@yahoo.com
- DOB (date of birth): 19th January 1943
- marital status: Married
- driving licence : Sri Lanka, Australia
- dependents (children) : three

Education and qualifications

- **G.C.E.** St. Thomas' College 1960 Mt. Lavinia, Sri Lanka
- **B.A. (Honours)** University of California 1975 San Diego.
- **M.S. Ecology** University of California 1977 Davis.
- **Ph. D. Ecology** University of California 1980 Davis.

Hobbies

- Collecting Epiphytes
- Collecting Utility plants
- Photography
- Independent research
- Writing

Language proficiency:

English/Spanish/Sinhalese/Tamil

Experience

- Trained and worked as a Tea and Rubber plantations. 1961-1963 as Assistant Superintendent, Strathdon and Kiriporuwa Estates, Tea and Rubber plantations managed by the Scottish-Ceylon Tea Company. Sri Lanka.
- Trained in Managing Zoological collections. 1964-1966 as Research Assistant at London Zoological Society, Regents Park Zoo and Whipsnade Park Zoo.UK.
- Worked as Researcher on underwater film locations for Cmdr. J. Cousteau, 1971 Thalassa Inc. Los Angeles, USA
- Performed taxonomic research for of the American Museum of Natural History, as Field Associate 1964-70 Department of Herpetology, New York.
- Worked on Design and planning of Herpetological Research Centre. The Lanka Snake Park, Kapuhena, Gampaha. 1973- 1979. Construction completed and established by 1978.
- Developed planning for a multi trophic system of aquaculture for the Muthurajawela Swamp. 1974 Ministry of Fisheries, Colombo, Sri Lanka.
- Designed, planned and established the Uva Herbarium. A field experimental station for the conservation of medicinal plants. 1984-1986. Mirahawatte, Uva, Sri Lanka
- As Co-Executive Director, Environment Liaison Centre International, Nairobi, Kenya.1993-1997 organized Environmental NGO's worldwide on global issues.
- Designed Analog Forestry applications. Sri Lanka, Australia, Philippines, Viet-Nam, Zimbabwe, Mexico, Guatemala, Costa Rica, Ecuador and Brazil. 1982- present
- Designed and testing a certification system for the products of Analog Forestry. Forest Garden Products (FGPs) for the International Analog Forestry Network (IAFN). 1985-present
- Worked on the effects of Climate Change and the Greenhouse Phenomenon on Asia, as Advisor, Minister of Environment, State Govt of Victoria, Australia 1991- 1992
- Designed and established a certification system for Ecological Mined Gold for. Colombia, Coalition. Oro Verde Medellin, Colombia 1999 – 2001
- Trainer of inspectors for Organic, Forest Garden and Carbon 1995-present
- Developed 'Conservation Carbon' as a trading mechanism for the Carbon Market with RTGL 2003
- Developed the standards for Carbon Trading for the International Analog Forestry Network (IAFN) 2007

Achievements

- B.A. (Honours) University of California 1975 San Diego.
Special studies at Scripps Institute of Oceanography La Jolla, California on breeding of the Portunid Crab *Scylla serrata*. Thesis research was performed at the Department of Biology on the ecological effects of felling in tropical rainforests.
- M.S. Ecology University of California 1977 Davis.
Thesis research was performed at the Department of Entomology on the factors leading to the resurgence of the malaria vector *Anopheles culicifacies*, its ecology and integrated control strategies.
- Ph. D. Ecology University of California 1980 Davis.
Thesis research was performed at the Department of Wildlife and Fisheries Biology on the ecology and biogeography of the inland fishes of Sri Lanka. The history of the freshwater communities and factors leading to present distribution patterns.
- Successful translocation of four species of endangered rainforest fish extending their range and reducing their vulnerability. 1981
- Development of the ‘Analog Forestry’ concept as a tool for ecosystem restoration.
Publication of the theory with John Jack in 1998. Analog Forestry: An Introduction Monash University Publications. Monash Univ. Clayton, Vic. Australia.
- Developed the soil carbon sequestering model at the University of Melbourne, Australia. 1993
- Committee member for the production of UNEP’s Global Biodiversity Assessment
- Initiator of the need for traditional perspectives of Biodiversity, culminating in UNEP’s 1999 Voices of the Earth. In Cultural and Spiritual Values of Biodiversity
- Assisting in the identification of Nutritional deficiency after the Tsunami in Sri Lanka and responding to this need with Rainforest Rescue International. (RRI) Galle .Sri Lanka by creating the Nutritional Security program of RRI.
- Identification of and action on the Kaneliya –Sinharajah corridor that seeks to link the last large remnants of Sri Lanka’s rainforests. 2004
- The development of a certification system for Forest Restoration Products termed Forest Garden Products (FGP’s) including Carbon standards. With an international accreditation system and an independent third party inspection system.

Career History:

- 2002 – present Chairman of Rainforest Rescue International, Sri Lanka
- 1997 - present Scientific Director, Counterpart, Washington, D.C.
- 1993 - 1997 Co-Executive Director, Environment Liaison Centre International, Nairobi, Kenya.
- 1991- 1993 Senior Research Scientist, the Environmental Management Unit, Monash University, Melbourne.
- 1990 Visiting Fellow Dept of Forestry, Australian National University, Canberra,
- 1989 – 1992 International Crops Inspector National Association for Sustainable Agriculture Australia, Sydney. (Tea, Sri Lanka 1989; Apples, Victoria, 1989; Vegetables, Victoria 1990; Coffee, Papua New Guinea 1990; Coffee Papua New Guinea 1991; Spices, Sri Lanka 1991)
- 1988 - 1990 Research Fellow (Ecologist) with the Centre for Farm Planning and Land present Management, Faculty of Agriculture and Forestry, Melbourne University. Major work in generating models for sustainable agriculture.
- 1987 Consultant Ecologist for the Canadian International Development Agency (CIDA). Major work was to survey the environmental problems of the Upper Mahaveli system in Sri Lanka and propose environmental rehabilitation projects.
- 1983-1986 Chairman, Kahatagaha Mines Ltd. Sri Lanka's oldest graphite mining company.
- 1981-1983 Co-Director, Program in Food, Land and Power, Sri Lanka. A program of Pomona College, Claremont, California.
- 1981-1982 Consultant, Forestry, State Timber Corporation of the Government of Sri Lanka. Major work on the design and development of high diversity forestry models. 3500 acres implemented.
- 1980-1981 Consultant, Fisheries Biology at the Marga Institute, Colombo. Design of inland, multi-trophic aquaculture systems.
- 1979-1980 Consultant, Ecologist at the Ministry of Land and Land Development, Government of Sri Lanka. Developed 'root-balling' techniques for large, tropical forest trees for the Department of Land Development.
- 1971 Researcher for Cmdr. J. Cousteau, Thalassa Inc. Los Angeles on salt water crocodiles and the underwater desert.
- 1964-1966 Research Assistant London Zoological Society, Regents Park Zoo and Whipsnade Park Zoo.
- 1961-1963 Assistant Superintendent, Strathdon and Kiriporuwa Estates, Tea and Rubber plantations managed by the Scottish-Ceylon Tea Company.

Member of Science Panel :

Dr. Khin Maung Cho
Pro Rector
Myeik University

1	Name	Khin Maung Cho
2	Date of birth	27 May 1956
3	Place of birth	Yangon
4	Religion	Buddhism (Siravada)
5	Nationality/ Race	Myanmar/ Bama
6	Identity No.	10/malama(N)-058656
7	Height	5' 7"
8	Education	PhD
9	Diploma	Education Management (Post-graduate)
10	Designation (Present Status)	Professor /Head Marine Science Department Patheingyi University, Ayeyarwady Region Pro-rector Myeik University 2014
11	Field of study	Fishery Biology/ Biochemistry (MSc) Oceanography (PhD)
12	Publications (recent)	2 (best) papers in Marine Science (awarded by Myanmar Academy of Arts and Science)
13	Certificates	Warmwater Aquaculture (Hawaii, 1984-1985) Advanced Computer Courses (Mawlamyine University) University Training Corps (Yangon and Mawlamyine Universities, 1973-1987)
14	Marital Status	married

Member of Science Panel :

		CURRICULUM VITAE (8.11.2014)				
1	Name	Dr. Nang Mya Han				
2	Date of Birth	23.3.1956				
3	Birth Place	Lashio, Northern Shan State, Myanmar.				
4	Parent Name	U Khun San Kain, Daw Kham Kyi				
5	Spouse Name	U Tint Tun				
6	Children Name	Nang Aye Mya Han Tun, Nang Amara Han Tun				
7	Religion & Race	Buddhist, Shan				
8	N.R.C Number	12/Sa Ka Na (Naing) 046329				
9	Occupation & Present Position	Professor & Head, Department of Marine Science, Myeik University, Myeik.				
10	Duration of Service	28 years & 9 months				
11	Present Address	Palei Daewe Teacher's Chummary, Myeik University, Ph: 059-42049, 09422207526				
12	Permanent Address	No.69, Room (3), Sanchaung Street, Sanchaung Township, Yangon. Ph: 01-513165, 095158738, 094 50992595, 09422207526, nmya.han@gmail.com				
13	Qualifications	Degree	Specialization	Year		
		BSc	Marine Biology	1979		
		MSc	Marine Biology	1985		
		DEM	Education Management	2002		
		PhD	Marine Science	2014		
14	Title of M.Sc Thesis	Some Aspect of the Biology of Tetraodontidae (Gymnodontiformes) of Setse Waters, Mon State				
15	Title of Ph.D Thesis	Fishery Biology of Mugilidae in Myeik waters, Taninthayi Region				
16	Research	Attached with Appendix				
17	Resume	From	To	Post	Department	University
		06.2.86	24.6.93	Demonstrator	Marine Science	Mawlamyine
		25.6.93	29.1.98	Assist. Lecturer	Marine Science	Mawlamyine
		30.1.98	17.4.03	Lecturer	Marine Science	Mawlamyine
		18.4.03	7.3.05	Associate Professor	Marine Science	Myeik
		08.3.05	Today	Professor & Head	Marine Science	Myeik
18	Awards	No	Date	Name of award		
		1	30.8.89	State Peace and Tranquility Award		
		2	2.4.92	Solidarity Law and Order Restoration Award		
		3	Oct. 2007	Art & Science Research Best Award		
		4	23.6.2008	Myanmar Women Affair Honorable Award (For Research)		
		5	15.8.2008	Myeik University Honorable Award (For Research)		
		6	24.2.2011	12 th Anniversary of Myeik University Award (For Research)		
		7	16.8.2011	Myeik University Honorable Award (For Research URJ)		
		8	Oct. 2014	Art & Science Research Best Award		
19	Punishments	Nil				



Name : Dr. San Tha Tun
Date of birth : October 11, 1961
NRC No : 10/MLM(N) 024253
Place of birth : Myebon, Myanmar
Nationality : Myanmar
Family Status : Married
Mother Tongue : Myanmar
Foreign Languages : English
Address : Thein-Gi Hall, Mawlamyine University,
Mawlamyine , Myanmar
Mobile : 09-254099341
Email : santhatun@ gmail.com



Education	Degrees	Years attended	Major Fields
	B. Sc.(Hons:)	1985	Marine Science
	M. Sc.	1991	Marine Science
	Ph. D.	2011	Marine Science

Employment : Professor, Marine Science Department, Mawlamyine University
Service : 29 years
Work experience : Studies on the mangroves of Myanmar Coastal areas; Ecotone IX Workshop in the Philippines in 2000; Marine Living Resources Management in Singapore in 2005; Research collaboration with NGO such as ‘Mingalar Myanmar’, Worldview Myanmar and FFI (Myanmar) especially for the rehabilitation and conservation of mangroves.

MEMORANDUM OF UNDERSTANDING
BETWEEN
UNIVERSITY OF PATHEIN (UP)
(The designated Centre of Excellence in Myanmar in Marine Science Technology and
Micro-biology)
AND
WORLDVIEW INTERNATIONAL FOUNDATION /
WORLDVIEW MYANMAR (WM)
ON DEVELOPMENT OF MANGROVE PARK AND MANGROVE GENE BANK
FOR RESEARCH AND DEVELOPMENT IN SUPPORT OF MANGROVE RESTORATION
IN MYANMAR

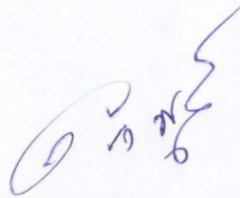
1. UP will undertake to establish a long needed "Gene Bank" for Mangrove and Mangrove Park for research and development as the first of its kind in Myanmar in support of national restoration of mangrove forest in the country. This will include:
 - a) establish a model "Mangrove Park" for research and development related to national mangrove restoration in Myanmar; the park will also serve as resource centre to service organizations, communities and schools towards mangrove conservation and restoration;
 - b) tissue culture lab for selective propagation of high quality eco-type species for Myanmar to produce the highest plant quality materials;
 - c) "Gene Bank" to conserve all mangrove plants, presently available in the country, as a future bio-resource in mangrove restoration;
 - d) development and enhancement of knowledge capacity in support of 20 students/support staff in research grants, 30 Master degree students and 15 Ph.D students for knowledge-based capacity in mangrove restoration;
 - e) public education to support local communities and local schools for establishment of nurseries and planting of mangrove in designated restoration areas;
 - f) upgrade and repair of existing University buildings and related infrastructure needed for the project;

- g) capacity building and upgrade of scientific and communication equipment and University library.
2. WM will support the above agreed activities of UP with financial and management resources based on the three-year agreed budget.
 3. UP will establish a dedicated bank account for the operation of the project.
 4. UP will provide quarterly report and accounts on the progress of the project and will accommodate any information needed by WM and donor.
 5. UP and WM will assess the quarterly reports and jointly agree on solutions on any identified problem.
 6. UP will provide yearly audited accounts to WM and Donor.
 7. A conference will be held on a yearly basis with the donor and other partners to discuss the progress of the project and decide on any action needed for successful implementation.

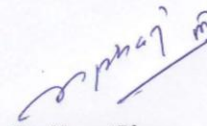
Dated 15th November 2013.
Patheingyi, Myanmar.



Dr. Arne Fjortoft
Secretary General



U Aye Lwin
Chairman



Dr. Nyunt Phay
Rector

Worldview International Foundation Worldview Myanmar University of Patheingyi

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE FOREST DEPARTMENT OF THE MINISTRY OF ENVIRONMENTAL CONSERVATION AND
FORESTRY, THE REPUBLIC OF THE UNION OF MYANMAR
AND
WORLDVIEW INTERNATIONAL FOUNDATION (WIF) / WORLDVIEW MYANMAR
ON
CAPACITY BUILDING, RESEARCH AND DEVELOPMENT ACTIVITY OF MANGROVE
REFORESTATION IN THE AYEYARWADY DELTA

- Considering the urgent measures for the restoration and rehabilitation of degraded mangroves in the Ayeyarwady Delta
- Strengthening the capacity building for the mangrove management
- Providing educational facilities in order to fulfill the needs of scientific research in the mangrove conservation and management

We have agreed as follows:

Article 1. Objective

The objective of this cooperative relationship is to help organize a three year research project on mangroves with the aim of completing a national plan for restoration and rehabilitation of coastal area by mangrove plantations, and also to provide funds for the capacity building of future generation of the forestry and environmental fields in order to ensure the sustainability of mangrove resources.

Article 2. Fields and activities of cooperation

1. The cooperation activities will be in Ayeyarwady Region, Rakhine State and Tanintharyi Region where the mangrove forests exist. The parties may cooperate in, but not limited to, establishing mangrove plantations and supporting funds for equipment and academic resources to university library, research facilities to Forest Research Institute and scholarships to forestry students for undergraduate and post-graduate study.
2. The Ministry of Environmental Conservation and Forestry fully supports the initiative taken by WIF to establish a Mangrove park in cooperation with the Myeik University.
3. If this project is realized, it could be made Flagship Project of Myanmar during the ASEAN Chairmanship.

Article 3. Responsibilities of WIF

1. Establish nurseries and mangrove plantations in areas decided by the Forest Department (FD) for the purpose to implement necessary materials and best planting techniques for the restoration and rehabilitation of destroyed coastal areas mangroves, in Myanmar with a national plan to be completed within the three year operation of the project.

2. WIF will support the FD in Myanmar with equipments and library and teaching materials for the study/research at the University of Forestry and provide scholarships to the students in the fields of forestry and environment.
3. WIF will provide the FD with a highly competent Science Advisor with the International experience in mangrove development, on a part time basis, as well as to meet other relevant costs to be decided in consultation with FD, including a liaison officer appointed by the FD for coordination of activities and speedy implementation of the project.
4. WIF will prepare the work plan for the relevant period of the project.

Article 4. Responsibilities of the Forest Department of the Ministry of Environmental Conservation and Forestry

In accordance with the existing laws, rules, regulations and instructions of the Government of the Republic of the Union of Myanmar, FD shall:

1. Review and permit the project proposals submitted by WIF according to the existing departmental procedures.
2. Monitor and evaluate the activities of the project according to the work plan submitted by WIF.
3. Assist in getting permission for visa and in-country travel arrangements on behalf of WIF and other organizations with whom it is affiliated.
4. Assist in purchasing travel fares (e.g airline ticket, train ticket).
5. Recommend, endorse and assist WIF application to obtain INGO status to facilitate WIF in discharging its responsibilities as agreed in this MOU.
6. Appoint a liaison officer for smooth coordination with WIF

Article 5. Execution of the Program

1. WIF shall remain responsible for its program and shall assume in collaboration with the Forest Department primary responsibility for the functioning of its operations.
2. WIF and the FD will jointly establish a five member Steering Committee for the project.
3. With the approval of the Forest Department of Ministry of Environmental Conservation and Forestry, WIF personnel shall have access to the project sites. The Forest Department shall permit WIF personnel to implement, operate and monitor all places of WIF operations.
4. WIF assumes the responsibility of all costs related to the execution of the activities described under this Memorandum of Understanding.
5. Equipment for mangrove plantations, research activities, the library of the University of Forestry, and project implementation will be purchased by WIF. Any equipment provided by WIF shall become the property of the Forest Department upon the termination of WIF activities.
6. WIF makes consultation with the Forest Department in allocating budget for all activities which are jointly conducted with the Forest Department.

[Handwritten signature]

[Handwritten initials]

Article 6. Funding of the Program

WIF shall take the responsibility of covering all costs related to the execution of this program and which are not covered under government contributions. WIF will spend US\$ 1 million during this MoU period.

Article 7. Time Frame

This Memorandum of Understanding will apply from the date of signing and will be valid for a period of three (3) years and can be extended under evaluation and agreement between both parties.

Article 8. Amendments, Interpretation, Extension and Termination

1. Any dispute between the parties regarding the interpretation or implementation of this memorandum shall be settled amicably by consultation or negotiation.
2. This memorandum shall come into force on the date of its signing by all persons listed below and will terminate after three years unless renewed through the expression of mutual interest by institutions concerned.
3. This Memorandum of Understanding may be terminated unilaterally by either Party hereto upon Sixty, (60) days prior written notice by one Party to the other. Unless otherwise agreed in writing, any programs undertaken pursuant to this agreement will be allowed adequate time beyond the termination date to be brought to a reasonable conclusion.
4. The agreement may be amended by mutual written consent of both parties.

IN AFFIRMATION:

**Signed on behalf of Forest
Department:**

**Signed on behalf of
Worldview International
Foundation (WIF):**

**Signed on behalf of
Worldview Myanmar:**

Signature:



Dr. Nyi Nyi Kyaw
Director General

Forest Department
Ministry of Environmental
Conservation and Forestry
No.39, Nay Pyi Taw
The Republic of the Union of
Myanmar
Tel: 95-67-405015
FAX: 95-67-405427
Email: dg.fd@mptmail.net.mm

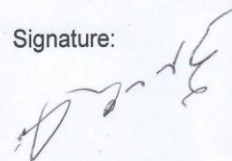
Signature:



Dr. Arne Fjortoft
Secretary General WIF

Haneborgveien 28 1470
Lorenskog Norway
Tel: 47-67903277
FAX: 47-67903278
Email: arnefjor@msn.com

Signature:

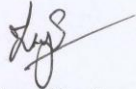


U Aye Lwin
Chairman

Worldview Myanmar Limited
70 Yawmingyi (York) Road,
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Tel: (01)1220512
Mob: 95-9-5002470
Email: jplwin@gmail.com

WITNESS

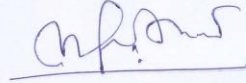
Signature:



U Zaw Win -4
Deputy Director General

Forest Department
Ministry of Environmental
Conservation and Forestry
The Republic of the Union of
Myanmar
Tel: 95-67-405018
FAX: 95-67-405079
Email:zwfdmoecaf@gmail.com

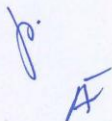
Signature:



U Htein Lin Aung
Admin. Director

Myanmar Worldview Limited
65 Yawmingyi (York) Road,
Dagon P.O. Yangon
Tel: 95-9-5002470
Email:hteinlaung@gmail.com

Date: 2-5-2014, Nay Pyi Taw





REPUBLIC OF THE UNION OF MYANMAR
MINISTRY OF FOREIGN AFFAIRS
NAY PYI TAW

U Aye Lwin
Chairman, Worldview Myanmar and D.G (Retd.), ASEAN Dept.
70, Yaw Min Gyi Street, Dagon Township
Yangon

2 May 2014

Dear Sir,

I had a very good discussion with Dr. Arne Fjortoft at the Ministry of Foreign Affairs today, 2 May 2014. I am pleased to be informed about the proposed Mangrove Park Proposal presently under review by the Royal Norwegian Ministry of Foreign Affairs. The project under consideration is, indeed timely, and certainly meets the urgent development needs in our country as an effective response to the latest United Nations Climate Panel Report.

Measures that provide protection from negative effects of Climate Change will be of great benefit to Myanmar. Lessons that we learn and the experience we gained, can be shared with the countries in our region with similar needs.

In this connection, we are very interested to support that project that will conserve mangrove forests of Myanmar and other ASEAN countries. We also hope that practical implementation of the project would be realized during our ASEAN Chairmanship. I also would like to express my continued support to your endeavours to conserve our environment and the mangrove forests in Myanmar and in our region.

Yours sincerely,

A handwritten signature in blue ink, appearing to read 'Aung Lynn', written over the typed name.

(Aung Lynn)
Director-General
ASEAN Affairs Department

ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ
ပြည်ထဲရေးဝန်ကြီးဌာန
အသင်းအဖွဲ့များ ဖွဲ့စည်းခွင့်ပြုရေးနှင့်ကြီးကြပ်ရေးဗဟိုအဖွဲ့

နိုင်ငံတကာ အစိုးရမဟုတ်သောအဖွဲ့အစည်းများ မှတ်ပုံတင်လက်မှတ်

ရန်ကင်း တိုင်းဒေသကြီး/ပြည်နယ်၊ ဒေသ ဖြန့်ဖြူး
 ယေဘုယျ ပြီးစီးမှု နံရံ ရပ်ကွက်/ကျေးရွာအုပ်စု၊ ယေဘုယျ ပြီး လမ်း
 အမှတ် (၇၀)၊ ထွင် ဖွင့်လှစ်ထားရှိသော ပထမဇယပ်၊ အခန်း (၀၀)

Worldview International Foundation(WIF)အား
 သတ်မှတ်ထားသော စည်းကမ်းချက်များနှင့်အညီ မှတ်ပုံတင်ခွင့်ပြုလိုက်သည်။

ဖော်ပြပါအဖွဲ့အစည်း၏ မှတ်ပုံတင်လက်မှတ် အမှတ်သည် (၀၀၉၀) ဖြစ်၍
 ၂၀၀၀ ခုနှစ်၊ ဇူလိုင်လ (၃၀) ရက်နေ့အထိ အတည်ဖြစ်ပါသည်။

အဖွဲ့အစည်းသည် ဤမှတ်ပုံတင်လက်မှတ်ကျောက်တွင် ဖော်ပြထားသော
 စည်းကမ်းချက်များကို လိုက်နာရမည်။

အမိန့်အရ

ဖူး

 အတွင်းရေးမှူး (စိုက်စါး)

(စိုက် စါး ၊ စိုက်စါးထွက် ဝေး မှု ၊)

ရက်စွဲ၊ ၂၀၀၀ခုနှစ်၊ မေ ၀၀ ရက်။

NATIONAL RESTORATION PLAN

The overall aim is to complete the proposed Thor Heyerdahl Climate Park and generate experience in producing a national plan for restoration of mangroves in Myanmar, in cooperation with the Ministry of Environmental Conservation and Forestry. Myanmar's five coastal universities will be engaged in the process, with a Mangrove Specialist heading the drafting team for first version of the National Plan by February 2015 and Final completion by end of June 2015.

This will be the foundation for full restoration of mangrove forests in Myanmar, on planting sites to compensate for most of the lost 1 mill. Ha since 1980. This is an urgent project with high national priority. It should be implemented without delay, especially to create protection in the coastal areas to save lives and properties from extreme weather as result of Global Warming..

GREEN ECONOMY AND GREEN GROWTH



By **U Aye Lwin**, Chairman Worldview Myanmar,
 Founder Member Green Economy Green Growth Myanmar,
 Advisor to Nippon Foundation and Sasakawa Peace
 Foundation, President Yangon Rotary Club and former
 Director General ASEAN

The efforts being made for the restoration and protection of mangrove on a national scale by Worldview International Foundation and Worldview Myanmar in collaboration with University of Patheingyi, University of Myeik and the authorities concerned of Regional and Union Government of the Union of Myanmar is in line with and in support of the aims and objectives of Green Economy and Green Growth (GEGG) Association formed in Myanmar.

Green Economy Green Growth Myanmar (not for profit) Association was approved by Union Cabinet of Myanmar on 5 October 2012 and registered with the Myanmar Ministry of National Planning and Economic Development.

The Objectives of the Association is *“A professional not-for-profit catalytic and enabling group that will encourage and support sustainable, resilient, inclusive and equitable green economy green growth. The group will foster national and international partnerships and mobilize knowledge and resources to support the programmes and projects of the Union of the Republic of Myanmar*

In pursuit of its aims and objectives, GEGG held its First Green Economy Green Growth Forum in November 2011 participated by 220 participants and the Second GEGG Forum in November of 2012 participated by 500 national and international participants.

The First and Second GEGG Forums have started the process to increase awareness and catalyze policies and projects to promote green economy green growth in Myanmar. This is a continuous process, strengthened and accelerated with experience and knowledge gained and with the multiple benefits becoming more discernible.

The Third GEGG Forum was held from 20th November in Nay Pyi Taw and 21st and 22nd November 2013 in Yangon. The Third GEGG Forum further its aim to move the greening process in Myanmar forward and faster. It focused its attention on the critically important and emerging Nexus of Energy – Water – Food.

The Nexus is imperative for green economy green growth, functioning of ecosystem services, sustainability and resilience.

To foster inclusive and equitable growth in Myanmar, increasing and improving Intra-Regional, i.e. between and amongst the 14 Regions and Divisions of the Republic of the Union of Myanmar is imperative.

The Nexus will also provide increased coherence to promote Inter- Regional cooperation and integration, in particular with ASEAN and Mekong countries and beyond.

As Myanmar Chairs ASEAN in 2014 and the AEC implemented by end 2015, energy, water, food and their inter-connectedness are critical for cooperation and promoting sustained economic development and poverty alleviation.

The aims and objectives of Worldview International Foundation and Worldview Myanmar to develop mangrove parks and mangrove “Gene Bank” in collaboration with Universities of Patheingyi and Myeik for research and development towards mangrove restoration on a national scale, are not only in line with the aims and objectives of GEGG but what is more important is that the “Mangrove Restoration Project” will provide practical support to GEGG’s continuous process to move the greening process in Myanmar forward and faster.



THE IMPORTANCE OF MANGROVE IN THE AGE OF GLOBAL WARMING



Dr. Ranil Senanayake
Senior Scientist and Project Director
Worldview International Foundation,
Chairman Rainforest Rescue International
and Founder, International Analog Forestry

All forests have unique and critical characteristics that must be recognized in their function of providing Ecosystem Services. In an age of Global Warming and consequential Climate Change phenomena, the Mangrove ecosystems of the planet hold out extraordinary promise as well as a tenuous existence on anthropogenic landscapes.

Mangroves are littoral and tidal influenced plant formations of tropical and subtropical sheltered intertidal areas. Mangrove comprises trees, shrubs, climbers, fern and palms. Among mangroves plants of the genera *Rhizophora* and *Bugeria* have been especially vulnerable due to the demand of their wood that is converted into charcoal. This trade has been operating for a long time and has been a primary reason for the loss of these shelters providing species and the consequent damage wrought by cyclones such as Nargis. Mangrove ecosystems play a crucial role in protecting coastal regions, preventing coastline from storm damage, floods and soil erosion.



Mangroves are ecosystems, situated at the interface of fresh and salt water to act as a filter for much of the land based riverine outputs. For instance, sediments, nutrients and toxins carried by runoff are first filtered by coastal forests, then by mangrove wetlands, and finally by sea-grass beds before reaching coral reefs. The existence and health of [coral reefs](#) are dependent on the buffering capacity of these shoreward ecosystems, which support the environmental conditions needed by coral reefs. Mangroves supply nutrients to adjacent [coral reef](#) and [sea-grass](#) communities, sustaining primary production and general health in these habitats. Mangrove root systems slow water flow, facilitating the deposition of sediment. [Toxins](#) and

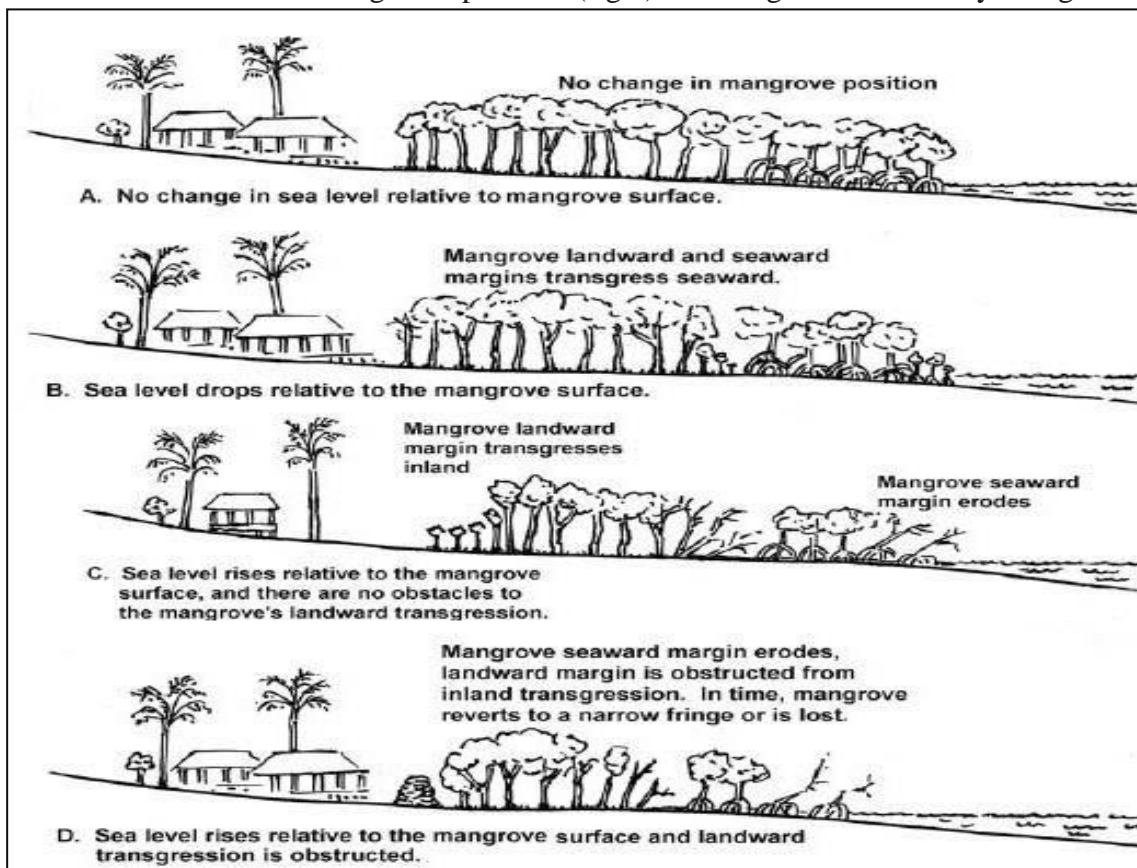
[nutrients](#) are bound to sediment particles or within the molecular lattice of clay particles and are removed during sediment deposition.

One aspect of the response to Global Warming has been the interest in sequestering atmospheric Carbon Dioxide and providing long term sinks for that sequestered Carbon. The capacity of mangroves, sea grasses, and salt marshes to sequester carbon dioxide from the atmosphere is becoming increasingly recognized at an international level. Of all the biological carbon captured in the world it has been estimated that, over half (55%) is captured by mangroves, sea grasses and salt marshes.

These coastal vegetations sequester carbon as far more effectively (up to 100 times faster) and because their soils are organic, anoxic, clay or silt, it can store carbon more permanently than terrestrial forests. Further, these deep, organic rich soils store up to five times more carbon than most other tropical forests around the world. In fact, mangroves have more carbon in their soil alone than most tropical forests have in all their biomass and soil combined. The entangled root systems of mangroves, which anchor the plants into underwater sediment, slow down incoming tidal waters, allowing organic and inorganic material to settle into the sediment surface.

Thus mangrove ecosystems present a great potential in sequestering atmospheric carbon over a long time period.

Two serious concerns for coastal communities facing climate change are the protection of their living spaces and their livelihoods both under threat by the current changes. As the level of the sea rises so will the range of salt water intrusion from the sea, this will affect agriculture through the salinated zone as traditional crops such as rice, beans or sugar will become impossible to grow in such soil. The other is that as sea level rise begins, if there is no backward movement of mangroves possible (fig 1) the mangrove community will go extinct.



Mangrove forests offer a unique and highly efficient approach to climate change mitigation and adaptation. Restoring mangrove ecosystems in degraded areas, establishment of planting designs for areas to be salinated and computing the Carbon Gain are some of the urgent actions needed. However, these plantings are generally even aged monocultures, without the biodiversity characteristics of the original mangrove ecosystem.

Thus a new approach to mangrove restoration was being called for. Early work using Analog Forestry in Mangrove ecosystems in Sri Lanka and Honduras suggested that plantings should follow the salt gradient and flood profiles. The feature of mangrove ecosystems to build soil was also designed where practical.

In response to the threat of increasing salinity, it is crucial to identify plants with an income potential that come from the mangroves.

Our studies have indicated that, 'value adding to existing resources and increasing biodiversity, could be achieved through retrofitting the existing production system to be more analogous to the natural Mangrove ecosystems of the region.

For the creation of an example of this approach, a mangrove plant that had traditional use but without market demand was chosen as a 'Mangrove Product'. Applied research has developed a process for high quality product from the sap of the Mangrove Palm (*Nypa fruticans*). The project developed a group of rice farmers whose only source of outside income was labour, to tap the *Nypa* palm for a sweet sap which was purchased by the project. The farm income tripled as a consequence and the farmers began to look at the hitherto unappreciated *Nypa* groves as a source of regular income.

There are many unaddressed areas in Mangrove research that need to be developed. For instance, the current work on Ecosystem Services suggests that plant leaves should act as Ecosystem Services Proxies {ESP's} because of the cooling factor as well as the oxygen production factor. Very little is known about the potential of mangroves to contribute to Ecosystem services such as, Water cleansing, evaporative cooling, Cloud Condensation Nuclei (CCN) production, Gas exchange capacity etc.

Thus the establishment of research and education related to Thor Heyerdahl Climate Park being designed with the University of Pathein provide an institutional base for such critical research.



With this project, the urgency of mangrove restoration can be highlighted. It has been pointed out by many scientists that restoration of mangrove is more than just planting trees. It had to develop an ecosystem that was productive and provided an alternative livelihood to the poor. This could lead to other sources of income rather than charcoal and fire wood production. It will also motivate and educate the population in coastal areas to appreciate the existence of mangrove in their neighbourhood and to appreciate the value of mangrove in their neighbourhood. The project therefore embarked on pilot projects to explore alternative livelihood opportunities.

- Production of nypa golden nectar, with the aim of utilizing nypa sap as a new economic opportunity for people in the mangrove areas.
- Propagation of orchids in mangrove forests. A tissue culture lab is in operation for propagation of wild orchids, with the aim of rescuing endangered wild orchids from extinction and creating alternative livelihoods in mangrove areas.
- Production of bees honey in mangrove areas. This will produce premium quality honey with valuable income to the participants.
- Distribution of simple solar light on community credit to disadvantaged families in coastal areas.

More info on the web – wif.org.lk and information on the ongoing projects on YouTube:

MANGROVE FOR LIFE

<http://www.youtube.com/watch?v=dfxCHc3IedQ>

NYPA FOR LIFE

<http://www.youtube.com/watch?v=Tt2cPWSUYvs>

Endorsement by the Champion for Myanmar’s Sustainable Development



“I am thankful to Worldview International Foundation for its long-term support to democracy and sustainable development in Burma”.

Dr. Aung San Suu Kyi, MP

Noble Peace Laureate, Secretary General and Chairman of National League for Democracy.

BUDGET	1st Year	2nd Year	3rd Year
1 Clearing of Climate Park Pathein	55,000	30,000	20,000
2 Project Transport Capacity Pathein	75,000	20,000	10,000
3 Nurseries / Plants US\$ 0.4 per plant 1st Year 100,000 plants, 2nd Year 250,000 plants, 3rd Year 350,000 plants	40,000	100,000	140,000
4 Collection of seeds and transport for planting	5,000	12,000	12,000
5 Planting US\$ 0.4 per plant including professional support with follow up/ protection 1st Year 100,000 plants, 2nd Year 250,000 plants, 3rd Year 350,000 plants	40,000	100,000	140,000
6 Scientific equipment and library for Pathein University	45,000	30,000	20,000
7 Establishment of tissues culture laboratory Pathein University and Plant Production	80,000	45,000	45,000
8 Establishment/maintenance of Mangrove gene bank Pathein University	50,000	20,000	20,000
9 Study grants for Pathein University 10 studentsx250x12	30,000	30,000	30,000
10 Scholarships Pathein University 15 Masters 15x400x12	72,000	72,000	72,000
11 Scholarships Pathein University 5 Ph.D 5x500x12	30,000	30,000	30,000
12 Public education and local community participation	80,000	80,000	80,000
13 Media production for local, regional and national media/ communication	150,000	150,000	110,000
14 Field office/ Equipments/ Transport	50,000	30,000	30,000
15 Day care centre and community development (In support of women participants)	65,000	45,000	45,000
16 Monitoring and reporting	60,000	60,000	60,000
17 Audit and quality control	55,000	55,000	55,000
18 Management Committee 6 meetings and field visits USD 3,000/meeting visit	18,000	18,000	18,000
19 Project Manager 3,000x12	36,000	36,000	36,000
20 Assistant Project Manager 1,000x12	12,000	12,000	12,000
21 Project Accountant 1,000x12	12,000	12,000	12,000
22 Project Secretary 800x12	9,600	9,600	9,600
23 International consultant 8 months 9,000x8	72,000	72,000	72,000
24 Security arrangement and park observation equipment	32,000	32,000	32,000
25 4 watcher 300x4x12	14,400	14,400	14,400
26 Office Rent 4,000x12	48,000	48,000	48,000
27 Office Equipment and Furniture	24,000	-	-
28 Communication 2500x12	30,000	30,000	30,000
29 Travelling Myanmar 3000x12	36,000	36,000	36,000
30 Travelling Regional/ International 4000x12	48,000	48,000	48,000
31 2 Workshops/Seminars 16,000x3	32,000	32,000	32,000
32 Mapping of costal area for National Restoration Plan	65,000	25,000	-
33 Repair/ Upgrade of University Building for climate park	80,000	50,000	30,000
34 Research Support to Forestry University/ Department Forestry	80,000	80,000	80,000
35 Contingencies 3%	49,000	44,000	43,000
	1,680,000	1,508,000	1,472,000
36 8% overall management and coordination	134,500	120,000	118,000
	1,814,500	1,628,000	1,590,000
Total USD Amount	5,032,500		

COMMENTS TO THE BUDGET

The overall aim of Thor Heyerdahl Climate Park is to establish a pilot project for national mangrove restoration, including capacity of Patheingyi University in the vulnerable Delta area, as resource centre for climate adaptation and mangrove restoration in the country. The budget has a sizeable component for capacity building of this leading coastal university, including human resources with research grants to students/university staff, scholarships to Master students and PhD students. This will create a significant knowledge base for mangrove restoration and other environmental and climate change challenges in Myanmar.

Universities in Myanmar are starved for resources. The Mangrove Research Project initiated by Worldview in 2012 has been able to assist partner universities to overcome some of their acute capacity shortages, as well as developing computer labs, Internet facilities and supplying teaching material and library books.

Patheingyi University was recently awarded status as university of excellence in Marine Science Technology and Micro Biology. It is located in the most vulnerable area exposed to climate change in Myanmar. Its Marine Research Station in Nga Pu Taw island was seriously damaged by cyclone Nargis in 2008 and needs urgent repair. The renovated buildings will be used as a base for development and maintenance of the climate park. The gene bank will be located in the university's botanical garden at the university premises in Patheingyi. The tissue culture lab in Patheingyi will cater for high quality production of selected species of high standard mangrove to secure the best planting material for national restoration projects. It is in this connection important to include Department of Forestry as part of the project, with special research support to Forestry University under its supervision. This will bring in the national aspect of climate change adaptation and mangrove restoration, especially related to development of a national restoration plan.

The project will plant 700,000 trees in a dedicated area for mangrove restoration, and protect 800,000 young plants already in the ground, as well as establishing a gene bank with all 64 species of mangroves found in Myanmar in support of the country's rich biodiversity. Local communities will be empowered as active partners, with special emphasis of women participation. Proven cost effective methods will be implemented, including media and communication for awareness and public education. Local communities will benefit from job creations and related income opportunities in a poverty reduction drive.

The final aim of the projects is to further support research on climate change and mangrove restoration with capacity building. This will include protection of 1,5 million mangrove trees based on long term sustainability to mitigate 1.5 million ton CO₂. In addition, securing more than 1 million ton already in the ground as part of REDD+ objectives. The total impact of CO₂ mitigation is estimated to be 2.5 million tons when fully developed. Exact measurement of stored carbon in the climate park before restoration will be established by ongoing research to be completed in early 2015.

Economic values of mangroves

(in US Dollars)

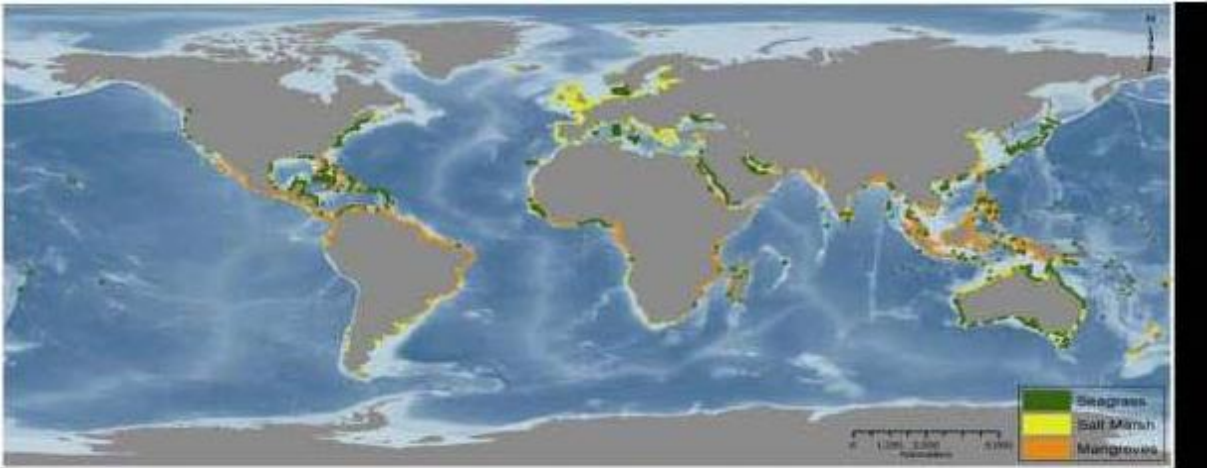
- \$200,000-900,000/ha - all products and services they provide (Wells et al. 2006)
 - \$300,000/km of shoreline storm protection and flood control in Malaysian coastline
(From Gilman et al. 2008)
 - Value of mangroves for fisheries - \$37,500/ha 7yr (Mexico) (Aburto-Oropeza et al. 2008)
- "Social value" of Blue carbon = \$41.00/ton (Pendleton et al. 2012)



Mangroves are considered as high priorities in climate change adaptation and mitigation strategies throughout the world.

This is for at least 4 reasons:

1. They have exceptionally high carbon stocks – among the highest of any ecosystem on earth;
2. Their rates of land cover change/deforestation are the highest in the tropics;
3. Their emissions from land cover change far exceed emissions from land conversion of upland forests; and
4. Mangroves provide a number of ecosystem services that are vital to the sustainability of local communities, livelihoods, and infrastructure.



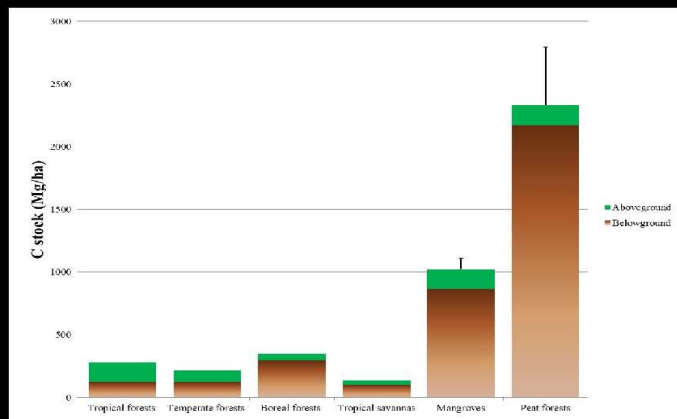
Mangroves - a unique tropical forest type

- 138,000 - 152,000 Km² (145,000 Km²)
- Occur in tropical and subtropical tidal zones
- Widely Distributed - 123 countries
- Critical provision of ecosystem services

Spalding et al. (2010)



Forest Carbon stocks



Data are from: IPCC, 2001: Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change ; Donato et al. (2011), and this presentation.



THOR HEYERDAHL CLIMATE PARK PROMOTING BLUE CARBON



83 % of the global carbon cycle is circulated through the oceans. Coastal habitat contains 2% of the total ocean area, but account for approximately 50% of the total carbon sequestered in ocean sediments.

Blue Carbon is a recent concept which is increasingly being recognized as the most cost effective method to mitigate CO₂ in adaptation to climate change. It supports ecosystems management and enhances natural resource values by restoring coastal habitat such as mangrove forests, sea-grass meadows and saltwater marshes. It has a prominent presentation in the latest report by the Intergovernmental Panel on Climate Change with picture of mangrove restoration on its front page, which illustrates its importance in recent climate change efforts. The marine biosphere is a major component to the global carbon cycle, responsible for around half of the annual photosynthetic absorption of the green house gas (GHG) carbon dioxide (CO₂) from the atmosphere. (Field et al. 1988, adapted from Lutz et al. 2007). It is high time to utilize its cost effective potentials with mitigation as an urgent need to reduce carbon in the atmosphere in addition to reduce emissions to secure global climate change targets.

The proposal to establish mangrove parks in Myanmar is a pioneering initiative in line with newly energized global efforts, as stated in abstracts from a few selected papers by UNEP, IPCC, Blue Carbon Initiative and others:

BLUE CARBON INITIATIVE

The role of coastal ecosystems in climate change mitigation

Fifty-five per cent of the atmospheric carbon captured by living organisms – as UNEP’s 2009 report *“Blue Carbon* Greenhouse gas emissions from human activities are changing the world’s climate and reducing them, is at the centre of current climate change discussions. However, the critical role of oceans and their ecosystems has been vastly overlooked.

– *The role of healthy oceans in binding carbon*” noted – is taken up at sea. Between 50-71% of this is captured by the ocean’s vegetated “Blue Carbon” habitats - mangroves, salt marshes, sea-grasses, and seaweed - which cover less than 0.5% of the seabed, but therefore play an

important role in the world's climate and in mitigating change. These habitats, the report adds (while highlighting the considerable uncertainty surrounding estimates, and the level of understanding of their carbon storage) sequester between 114 and 328 Teragrams of carbon per year. Another 2009 report, by Laffoley and Grimsditch, synthesized current scientific information on carbon sequestration in coastal ecosystems and highlighted their importance in the global carbon cycle (www.iucn.org/dbtw-wpd/edocs/2009-038.pdf). UNEP and IUCN collaborated in publishing both these reports, which complement each other in providing general information and highlighting the considerable gaps in knowledge on the value of coastal ecosystems for sequestering carbon. Further seminal reports by the World Bank and Duke University have further highlighted the importance of coastal ecosystems in mitigating climate change.

These rates of carbon sequestration and storage are comparable to and often higher than rates in carbon rich terrestrial ecosystems such as tropical rainforests or peat-lands. Unlike most terrestrial systems, deposition of carbon dioxide in coastal ecosystem sediment can continue over millennia. Current rates of loss of mangroves, sea-grass beds and salt marshes, driven largely by human activities such as conversion, coastal development and over harvesting are more than twice as high as the rate of rainforest loss. This is of considerable concern with respect to their role in carbon sequestration and emissions.

Halting the decline of the Blue Carbon sinks is a missed opportunity in the current portfolio of climate change mitigation strategies. At the moment, there are no international regulatory frameworks or conventions to protect the value of coastal and marine ecosystems for sequestering carbon and mitigating climate change. Maintaining and managing Blue Carbon ecosystems both provides the global community with an additional tool for mitigating carbon dioxide concentrations in the atmosphere, and maintains the valuable ecosystem services they supply to local communities – including protection against storm surges and sea-level rise (important for adaptation to climate change), food security gained from fisheries, revenue from tourism and the potential medicinal value of wild species.

WHAT IS BLUE CARBON?

The problem: The growing emission of carbon dioxide from a wide range of human activities is causing unprecedented changes to the land and sea. Identifying effective, efficient and politically acceptable approaches to reduce the atmospheric concentration of CO₂ is one of society's most pressing goals.



The blue carbon solution: One of the most promising new ideas to reduce atmospheric CO₂ and limit global climate change is to do so by conserving mangroves, sea-grasses and salt marsh grasses. Such coastal vegetation, dubbed “blue carbon”, sequesters carbon far more effectively (up to 100 times faster) and more permanently than terrestrial forests. Carbon is stored in peat below coastal vegetation habitats as they accrete vertically. Because the sediment beneath these habitats is typically anoxic, organic carbon is not broken down and

released by microbes. Coastal vegetation also continues to sequester carbon for thousands of years in contrast to forest, where soils can become carbon-saturated relatively quickly. Therefore, carbon offsets based on the protection and restoration of coastal vegetation could be far more cost effective than current approaches focused on trees. Furthermore, there would be enormous ad-on benefits to fisheries, tourism and in limiting coastal erosion from the conservation of blue carbon.

Characteristic	Coastal vegetation	Terrestrial forests
Sequestration rate ¹ gC m ⁻² yr ⁻¹	High ^{2,3} : marsh 210 ⁴ , mangrove 139, seagrass 83 ⁵	Low ^{2,3} : tropical: 2, temperate 1-12, boreal: 1-2
Sequestration permanence	High ²⁻⁵	Low ^{2,3}
Fire risk	None ³	High ³
Carbon saturation potential	Low ²⁻⁵	High ^{2,3}
Area	Low ^{2,3}	High ⁶
Recent loss rate and trend	~1-5% yr ⁻¹ , increasing ^{2,3,7,8}	~0.8% yr ⁻¹ , stable or decreasing ⁹
Self-expansion potential ¹⁰	High / rapid ^{11,12}	Low

Notes and References: ¹ values are averages, sequestration is defined as the burial and storage of carbon in the soil/sediment, ²Laffoley and Grimsditch 2009, ³Nellemann et al 2007 and references therein, ⁴Chmura et al 2003, ⁵Duarte et al 2005 but note more recent studies indicate average rates of 160 to 186 gC m⁻² yr⁻¹ (Duarte et al. in review), ⁶IPCC 2007, ⁷Waycott et al 2009, ⁸Polidoro et al 2010, ⁹FAO Global Forest Resources Assessment 2005, ¹⁰i.e., via unassisted clonal expansion, ¹¹Liu et al 2007, ¹²Duarte unpublished



You can see all the organic rich sediment that gets accumulated in the mangrove roots as the forest accretes vertically. This makes mangrove forests highly effective at capturing and storing carbon emitted into the atmosphere by humans. However, when mangrove forests are destroyed for development, vast amounts of carbon is released, intensifying global climate change.

Mangroves, tidal marshes and sea-grasses are critical along the world's coasts, supporting coastal water quality, healthy fisheries, and coastal protection against floods and storms. For example, mangroves are estimated to be worth at least US\$1.6 billion each year in ecosystem services that support coastal livelihoods and human populations around the world*.

GREEN IS BLUE

by James Hutchison

My colleagues and I have just worked out how much carbon there is in the [world's mangrove forests](#), give or take a bit. And we mapped it. And here's why these findings are tremendously important.

They quantify what some of us in marine conservation have been saying for a decade or more: that mangrove forests are among the most carbon rich habitats on the planet. That, although they occupy just a fraction of the world's surface, they pack a punch. Anyone concerned about preserving nature's value — carbon sequestration and all the other benefits mangroves provide us — needs to think hard about this.

Because **on average, mangroves have double the living bio mass of tropical forests overall**. This means that if you want to slow carbon emissions, one of the first places you could look would be in the mangroves. Stop an acre of loss here, and you will achieve a much bigger win than in many other areas.

As we make our increasingly bold statements about the importance of mangrove biomass — or indeed around any ecosystem services — it is so important that we have the numbers to back up our claims. Until this paper, the best we could in most places was provide a global average number. “A typical mangrove has 152 tonnes of aboveground biomass per hectare,” we might say.

That doesn't sound at all convincing whether you are standing at the foot of canopy giant in Berau, Indonesia, or indeed on the margins of straggly community of mangrove shrubs in the desert margins of the Middle East. To do this new paper, we stood on the shoulders of hundreds of others who have sweated and toiled in the tropical heat of the mangroves, doing the real work of assessing biomass. **We took numbers from 95 studies around the world and built a computer model** around the climatic factors that help to drive the variability in biomass from place to place.



Mangroves in Berau, Indonesia. These are being rapidly converted to aquaculture ponds.
Photo credit: Mark Spalding

It's a model, of course, and only captures part of reality, but it's a huge advance. We need this sort of work — both the hard data from the field scientists and the verifiable models of what's going on. It means so much more than average numbers. Without it, all our platitudes and pleadings about the value of nature run the risk of sounding hollow.

The map shows the real hotspots for mangrove biomass — the countries of the Coral Triangle lead the way, but the overlap with coral reefs isn't always neat — it's the wet muddy coasts of Sumatra, Borneo, and New Guinea that have the very high biomass. So too does an extraordinary stretch of coastline in on the Pacific coast of Columbia and Northern Ecuador. In all these places mangroves are truly breathtaking — gigantic trees with canopies reaching well over 30m high. These are found on wide, still growing deltas where they hold together sediments and add vast amounts of organic nutrients to the soils and the surrounding waters.

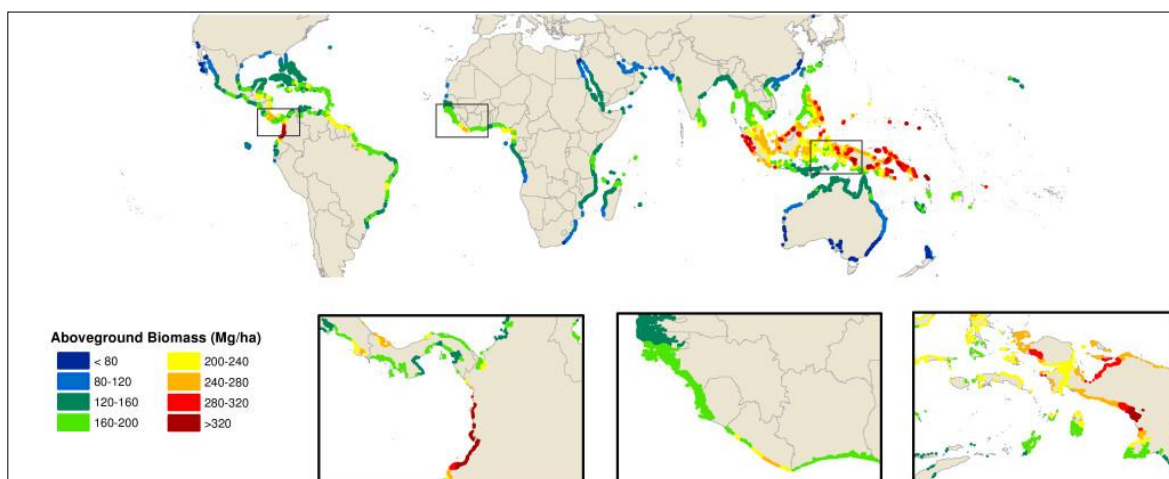


Figure caption: the mangrove carbon map from Hutchison et al (2013). Greatest biomass is concentrated in the wetter and more equatorial regions of the world, notably Southeast Asia and through to the Solomon Islands.

When it comes to soils, we're still struggling with the models a bit, but the story is equally compelling. Most mangrove forests lay down peat — thick, heavy layers of carbon-rich soil that stays waterlogged and doesn't rot. There are other important peat forests worldwide, but the microbial processes in those peat forests give off pretty substantial amounts of methane, which is a greenhouse gas in its own right. The saline soils of the mangroves generally prevent this methane production. That gives us **a huge extra carbon store in the soil.**

But it's not *just* a store. Mangroves are celebrated as one of the most productive ecosystems on the planet, and it is believed that about 10% of what they produce also gets sequestered away in the soil. **That word "sequestered" should be music to our ears.** In other words, mangroves are natural carbon-scrubbers, taking CO₂ out of the atmosphere and packing it away, for millennia or more, in their rich soils.

So if you had a dollar to invest in carbon futures, my strongest advice of all would be to invest in preventing mangrove loss, or even [restoration](#). There's no magic cure to the challenges of global change — warming, rising seas, worsening storms and ocean acidification — we'll only ever get there through a combination of interventions. Mangroves aren't sufficiently widespread to tip the scales, but they give a greater return on investment than many other mitigation efforts. On a unit area basis, it would be hard to think of a more important

ecosystem. And that's before you even start to add up the value of mangroves for fisheries, timber, tourism, water purification, coastal protection and so on.

This work was supervised by Dr Mark Spalding. The lead author, James Hutchison, is a researcher at the University of Cambridge now working with TNC on mangrove fisheries, and the other co-authors were other Cambridge conservation scientists: Andrea Manica, Ruth Swetnam (now at University of Staffordshire) and Andrew Balmford.

LIFE IN THE HIGH SEAS in perspective of Thor Heyerdahl's legacy



Figure 2. Global map showing the extent of EEZs and the high seas (Sumaila et al. In prep.)

A new study published 5 June 2014 has revealed the extent to which life in the [high seas](#) is mitigating climate change, taking up a staggering 500 million tonnes of carbon per year by storing one-and-a half billion tonnes of carbon dioxide away from the atmosphere.

Filling one of the gaps in knowledge identified by the last [Intergovernmental Panel on Climate Change \(IPCC\)](#) (the role of the deep ocean in carbon cycling), [The High Seas And Us: Understanding The Value Of High Seas Ecosystems](#) is the first study to assess the ecosystem services of the high seas and place an economic value on them.

The study, commissioned by the Global Ocean Commission, identifies 15 ecosystem services of direct value to humans ranging from 'provisioning' services such as genetic resources and raw materials, 'regulating' such as air purification and biological control, to 'habitat' services such as life cycle maintenance and gene pool protection.

The Global Ocean Commission commissioned the study to help inform its inquiry into the role of the high seas in the wider health of the ocean and the relative value of the many services provided. Co-chair of the Commission [Trevor Manuel](#) said: "This study makes that which used to be out of sight/out of mind visible and we can now more obviously see and assess what we stand to lose if we do not take measures to protect the high seas and govern them effectively to preserve vital ecosystem services. This new information has informed the Commission and on 24 June we will be releasing a report and proposals for action to reverse ocean decline and restore health".

Describing the major ways in which the ocean stores and fixes carbon away from the atmosphere, the study calculated an economic value for the role of high seas carbon sequestration as between US\$74 and US\$222 billion annually.



Thank You

from one of the beneficiaries of Worldview's project in Myanmar.