IT TAKES A MANGROVE VILLAGE

SUMMARY OF SOLUTION

This team proposes creation of a public-private business venture between a "green" commercial fishing company and individuals of the local native population with agreements from a politically-stable government in a tropical location, to create a series of community farms (with housing) that would protect existing mangrove stands and re-plant mangrove trees, in order to sustainably harvest seafood and other products, and provide living wages and partial ownership to the local population.

INTRODUCTION – THE AMAZING MANGROVE

A famous author once said looking at trees can reduce stress in a person. Trees can, in fact, do quite more than that, especially the highly adaptable and multi-faceted mangrove. The mangrove has evolved to inhabit intertidal salt-water and fresh-water zones along marine and riverine environments in many tropical and sub-tropical regions around the world. The tree provides significant habitat for many species of creatures- birds (over 230 species recorded in mangroves and nine species restricted to mangroves in the wet tropics), amphibians, birds, fish, and invertebrates, not to mention the more than 10 billion bacteria found in just one teaspoon of mud from a mangrove stand (AIMS 2003). Further, it is estimated that 75% of the commercially caught fish and prawns in Queensland, Australia spend at least some part of their life cycle living in mangroves (AIMS 2003).

Depending on the species and the geographic dispersion, the mangrove tree:

- Provides significant short and long-duration wildlife habitat for sea-faring creatures, avian, and land-based creatures for breeding, feeding, and living,
- Is the basis of a complex marine food chain- many other aspects related to this valuable ecosystem revolve around the health of this plant,
- Reduces storm flow, erosion, wave action, and protects shorelines,
- Sequesters carbon from the atmosphere in addition to processing atmospheric carbon through tree photosynthesis,
- Is a source of food, wood, charcoal, medicines, and other products for humans,
- Preserves water quality and filters pollutants,
- Reduces sedimentation into marine environment,
- Has an estimated value of between $200,000 – $900,000 US per hectare per year.

THREATS TO MANGROVE TREES– ANTHROPOGENIC IMPACTS AND GLOBAL WARMING

Since 1880, the Earth has warmed 0.6 – 0.8 degrees Celsius and it is projected to warm 2 - 6 degrees Celsius by 2100 mostly due to human activity (Houghton et al. 2001). Climate change components that effect mangroves include:

- changes in sea-level,
- increased frequency of high water events,
- increased storminess,
- fluctuations of precipitation (wet areas will be wetter, dry areas will be drier),
- increased average temperature,
- atmospheric CO_2 concentration, though increased CO_2 concentrations enhance mangrove photo synthesis and growth rate,
- changes in ocean circulation patterns,
- potentially decreased health of functionally linked neighboring ecosystems,
- human responses to climate change that affect mangroves directly or indirectly.

Of all the outcomes from changes in the atmosphere's composition and alterations to land surfaces, relative sea-level rise may be the greatest threat. During the 21st century, mean sea-level projections range from 0.09 to 0.88 meters (Hougton et al. 2001). Relative sea-level rise is a substantial cause of recent and predicted future reductions in the area and health of mangroves and other tidal wetlands.

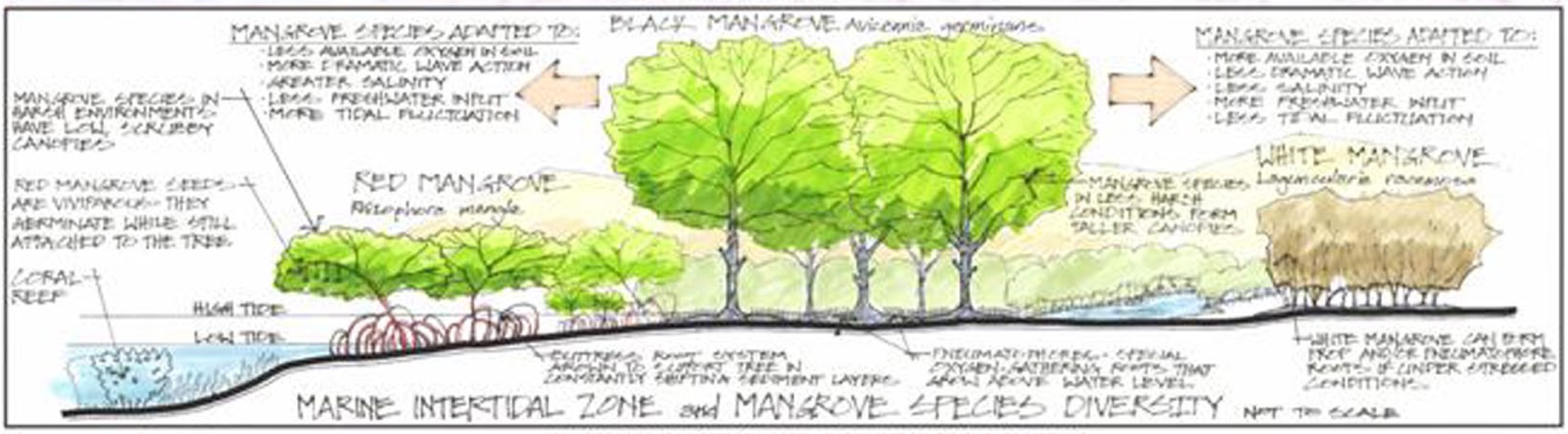
THE ENVIRONMENT – THE ADAPTABLE MANGROVE

Though rising sea levels create the most concern for mangrove survival, the mangrove has several ways to adapt to rising sea levels. Geological records indicate that previous sea-level fluctuations have created both crises and opportunities for mangrove communities, and they have survived or expanded in several refuges (Field 1995). Mangroves can adapt to sea-level rise if it occurs slowly enough (Ellison and Stoddart 1991), if adequate expansion space exists, and if other environmental conditions are met (Field 1995). Increased precipitation may also allow mangroves to migrate and outcompete salt marsh vegetation (Harty 2004).

Mangroves may adapt to changes in sea level by growing upward in place, or by expanding landward or seaward. Mangroves can expand their range despite sea-level rise if the rate of sediment accretion is sufficient to keep up with sea-level rise. However, their ability to migrate landward or seaward is also determined by local conditions, such as infrastructure (e.g., roads, agricultural fields, dikes, urbanization, seawalls, and shipping channels), topography (e.g., steep slopes) and precipitation (increase or decrease). If inland migration or growth cannot occur fast enough to account for the rise in sea level, then mangroves will become progressively smaller with each successive generation and may perish (UNEP 1994).

GLOBAL DISPERSION OF THE MANGROVE

Temperature is the driving factor in mangrove geographic distribution. Mangroves are found at low latitudes, where the environment is warm and humid. Most mangroves are found between the latitudes of 25 degrees North and 25 degrees South. Mangroves have shown a greater number of species in tropical regions as opposed to mangroves in subtropical and arid regions. More than 50% of the world's 100,000 square kilometers of mangrove forest are found in the eastern hemisphere.



MANGROVE SPECIES ADAPTED TO:
·LESS AVAILABLE OXYGEN IN SOIL
·MORE DRAMATIC WAVE ACTION
·GREATER SALINITY
·LESS FRESHWATER INPUT
·MORE TIDAL FLUCTUATION
BLACK MANGROVE Avicennia germinans
MANGROVE SPECIES ADAPTED TO:
·MORE AVAILABLE OXYGEN IN SOIL
·LESS DRAMATIC WAVE ACTION
·LESS SALINITY
·MORE FRESHWATER INPUT
·LESS TIDAL FLUCTUATION
MANGROVE SPECIES IN HARSH ENVIRONMENTS HAVE LOW, SCRUBBY CANOPIES
RED MANGROVE SEEDS ARE VIVIPAROUS- THEY GERMINATE WHILE STILL ATTACHED TO THE TREE
RED MANGROVE Rhizophora mangle
CORAL REEF
HIGH TIDE
LOW TIDE
MANGROVE SPECIES IN LESS HARSH CONDITIONS FORM TALLER CANOPIES
WHITE MANGROVE Laguncularia racemosa
BUTTRESS ROOT SYSTEM GROWN TO SUPPORT TREE IN CONSTANTLY SHIFTING SEDIMENT LAYERS
PNEUMATOPHORES- SPECIAL OXYGEN-GATHERING ROOTS THAT GROW ABOVE WATER LEVEL
WHITE MANGROVE CAN FORM PROP AND/OR PNEUMATOPHORE ROOTS IF UNDER STRESSED CONDITIONS
MARINE INTERTIDAL ZONE and MANGROVE SPECIES DIVERSITY NOT TO SCALE

LOW TIDE
HIGH TIDE
EXISTING RED MANGROVES
EXISTING BLACK MANGROVES
POTENTIAL FUTURE HIGH TIDE
FUTURE EXPANDED PLANTING AREA W/ BLACK AND WHITE MANGROVE SPECIES
ACCESS
CORAL REEF
OUTFLOW
WEIR
INFLOW
PIER
RIVER
LAGOON
WAVE ACTION
PLANTED BERM
INFLOW
OUTFLOW
ACCESS
TYPICAL HOUSING UNIT. NUMBER OF UNITS CAN INCREASE AS PROJECT EXPANDS
FUTURE EXPANDED PLANTING AREA
MANGROVE VILLAGE- CONCEPTUAL PLAN VIEW
NOT TO SCALE

IT TAKES A MANGROVE VILLAGE – DISCRIPTION OF OUR SOLUTION

The old way of doing business needs to be changed. Humans are realizing more and more that the short-term gains of working against nature only forces higher costs (environmental, human health, monetary) to be paid at some future date. For example, the continued clearing of mangroves and intertidal wetlands to farm a single species (shrimp) clearly does not work if the long term costs and impacts are factored into the equation. Environmental costs need to be part of the process of how products are created and brought to market, whether those products are food, incense, wood, or medicines.

The solution presented by this team is straightforward- we propose creating a business entity between a "green" fishing commercial company and groups of local native population to create, in essence, a farming village in order to harvest high-quality protein in the form of shellfish and shrimp.

Long-term leases or purchase agreements would be signed between the fishing company, interested parties of the local population, and a government located in a tropical south-east Asian country. Needless to say, the government would have to be a stable one with goals to create more environmentally-friendly jobs and protect its environment.

Individuals from the local population would be provided partial ownership for one very important reason: having a stake in the business endeavor will create an atmosphere of stewardship, and therefore, the project will have a greater likelihood of long-term viability.

The fishing company would set up the business side of the arrangement- business start up, management of the business operations, shipping, and distribution. Representatives of the local population would operate the day-to-day functions such as maintenance of the facilities, training, construction, farming, fishing, and replanting of mangroves and associated species.

Location of the farming village site would be in or adjacent to sheltered tropical marine intertidal coastal areas located in protected lagoons and bays to protect the farming village from storm surges and dramatic wave action. Also necessary will be a permanent freshwater river that empties into the marine environment. Continued sedimentation via a river will provide an environment suitable for continued and replanted mangrove forests, and therefore, seafood farming.

Because mangroves exist in such a harsh environment, tree growth is expected to be average. As such, the farming village should be located within an existing stand of high-quality mangrove trees. Existing trees will currently be supporting numerous species of seafood and shellfish. Replanting would take place over time as land became available for additional mangrove seedlings.

The farming village will require access to low-lying retreat areas which may provide suitable habitat for colonization and landward movement of mangroves as sea level rises. Geographically, the farming village would have to be in a tropical climate where the temperature never drops below 20 degrees Celsius. Although mangroves are highly adaptable, upstream human influences will have to be taken into account as part of the location (i.e. pollution, sediment load, etc). On a local climate scale, the farming village, and more specifically, the mangroves, will require high amounts of rainfall throughout the year.

This solution also introduces the idea of a planted berm at the inlet of the bay or lagoon where the Mangrove Village is to be located. The berm will perform two functions- 1) to protect as much as possible the Mangrove Village in the event of dramatic wave action, and 2) function as a dam to provide additional sediment levels behind the berm so that mangrove trees can adapt to rising sea levels. The mangrove is highly adaptable, especially to rising sea levels but the sediment level will have to rise with the sea level.

The berm will be planted with thick stands of red mangroves, which are normally prolific near shorelines. Mangrove trees, in thick stands, have shown themselves to be excellent energy dissipaters in regards to flooding. While the longevity of the berm is not expected to be permanent, the berm will be recreated as necessary to continue sustainable fishing/farming operations.

The berm will have several weirs to allow for continued flow of water and associated sea life into and out of the Mangrove Village area. The weirs and the berm will likely have to be armored with rock to provide additional protection from erosion.

This solution is not going to solve rising sea levels all by itself. Studies and research are showing that the amount of CO_2 currently in the atmosphere will cause rising sea levels today and also in the future. CO_2 emitted into the atmosphere in the future will continue to exacerbate the problem of rising sea levels for years to come. This solution is a new way of doing business and that can be an example for others to follow.

POTENTIAL FUTURE HIGH TIDE
POTENTIAL FUTURE LOW TIDE
FUTURE SEDIMENT LEVEL BEHIND PLANTED BERM
PROPOSED BERM TO PROTECT VILLAGE AGAINST WAVE ACTION. BERM PLANTED WITH RED MANGROVES
WEIR BEYOND ELEVATION LINE
HIGH TIDE
LOW TIDE
REEF
TYPICAL HOUSING UNIT. USE LOCAL MATERIALS, WHEN POSSIBLE. INTRODUCE MODERN TECHNOLOGIES TO REDUCE WASTE AND CARBON FOOTPRINT (I.E. SOLAR PANELS FOR ELECTRICITY)
DOCK AND PIER NOT SHOWN
VILLAGERS COLLECTING SHELLFISH AND SHRIMP
VILLAGERS EXPAND MANGROVE PLANTINGS AS SEA LEVELS RISE
MANGROVE VILLAGE- CONCEPTUAL ELEVATION NOT TO SCALE

GRAPHICS CREDITS

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REFERENCES

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