Restoring Mangrove Forests

Background:

Mangroves are a special kind of tree that can live only on tropical coasts where salt and fresh water meet. There are many creatures that live in Mangrove forests, and like the trees that offer them protection and food, they cannot live anywhere else. Mangroves are an irreplaceable and unique ecosystem, hosting incredible biodiversity and ranking among the most productive ecosystems in the world. Both sea and land creatures depend on mangrove forests.

Unfortunately for the mangroves and the millions of organisms that depend on them, the parts of the world where they grow are also areas that are perfect for shrimp farming. Shrimp, a bottom dwelling organism that is in high demand all over the world, is driving major destruction of this precious resource. Mangrove forests have been destroyed all over the world in order to create shrimp farms.

Other threats are agriculture, urban and industrial expansion, and tourism development.

This puts serious strain on the thousands of species that live in or depend on the forests for survival and reproduction. Also, destruction of mangrove forests negatively affects the local population who depends on the animals that live in the mangroves for their food and income. Mangroves provide support for unstable soils that helps them withstand currents and storms and also bring air into the ground through their roots. The world as a whole has already lost over 50% of its original mangrove forests. Although some countries have been able to reduce the mangrove destruction, there are still many countries in Asia and Africa without protective legislation.


Mangroves need to be protected and reforested. GIS is particularly useful when finding areas that are suitable for mangrove reforestation. Mangroves require large sizes of intertidal areas that are protected from heavy wave, wind, and ocean storms. They should be in tropical areas that are less populated. The Philippines is a great country to focus on rehabilitation of mangrove forests because it is located in an ideal place for mangroves.

Literature Review:

Prior rehabilitation projects have had varying degrees of success. One project based in the Philippines had over 50% of its seedlings die because of neglect or that they were planted in the wrong places. They did not use GIS in their research and picked the locations for reforestation rather arbitrarily. Other projects have people permanently stationed near the mangrove forest. The most useful literature was the “Assessment of a Mangrove Rehabilitation Programme Using Remote Sensing and GIS.” The Mangrove Rehabilitation Program was conducted in coastal regions of Thailand. It used GIS to focus on areas where mangrove forests currently occur or once existed. Their goals were to protect existing mangroves and promote forest extension and conservation awareness among local people.

The strengths of this research were that they had a three pronged approach. They protected existing mangrove forests, reforested new ones, and made sure to educate the local public about the benefits of conservation. The limitations are that they only used GIS to find places where there are currently and where there were mangrove

forests before. This project will find all areas where mangrove forests could possibly grow.

Hypotheses:

Where are the best areas in the Philippines where mangroves can most successfully be reforested? Using GIS, we will find areas that are not only suitable but ideal habitats for mangrove forests and use that data to repopulate the coastal Philippines with some of the most productive ecosystems in the world.

Data:

This project would use raster GIS data of:

- Land use raster
- DEMs and slope
- Watersheds
- Salt water/fresh water delineated bodies of water and river systems
- Fisheries information off the coast
- Rainfall data
- Climate and weather data
- Soil data
- Flood zones
- Mangrove data (Philippine Mangrove Forests)

PhilGIS has much of this data at philgis.org.

Methods:

The research will define areas where mangrove forests would be successful and the areas that would be most efficient to invest in for reforestation.

- The DEM, slope, rivers, soil, and weather data will be used to find areas on the coast in the Philippines that would be a suitable place to grow mangroves
- Land use raster will be used for identifying areas of high population/building, where there is no land use, and agricultural land use. It will be best to avoid

areas of high population and buildings. Areas that are already used for agriculture or not being used at all would be best for reforesting mangroves.

- The fisheries data will be used to help decide where the mangrove forests would be most economically beneficial because they significantly increase nearby fish stock and other biota in the water column.
- Once the areas are found, the best areas will be picked and assessed for their cost effectiveness and economic and natural benefits.

Once the 10 biggest cores possible are decided on, the employees and volunteers will be able to effectively work and reforest the mangroves.

The strengths of this analysis are that we will be able to find the best and most cost-effective areas to reforest mangroves. Often times when reforestation is attempted, money and time is wasted because the areas that are picked have not been properly checked and floods or other weather issues kill the young mangroves. With full information those issues can be easily avoided and the projects will be more cost effective, therefore enabling more acres of mangrove forest to be re-instated on the coast.

Weaknesses are that there won't be people on the ground picking the sites. This choice was to save the money it takes to pay well-educated scientists to find the areas that would be best for reforestation. The GIS information may be outdated or incorrect, and it may not account for local population. Some locals might be more adverse to grow projects than others, depending on the local culture.

Anticipated Results:

We will find core areas that are best for mangrove reforestation with the GIS information. From that point we will find the most cost-effective way to reforest mangroves. Once the mangrove forests are up to full health and productivity, local economies will prosper.

Policy Applications:

Public policy applications of this problem would be:

- First we would ask the Philippines to double whatever we, the non-profit organization, will commit to this reforestation project.
- Local towns in the reforestation area will be asked to provide volunteers to help plant and maintain the forests because they will benefit from the increased biota and economic benefits from local tourism and fishing.
- Government subsidies/tax benefits needed to incentivize coastal dwellers to sell land or allow it to be reforested
- The mangrove forests will increase GDP in the Philippines from tourism, increase in profitable biota, and the selling of poles from harvested mangroves

Budget:

Planting costs in similar projects were $59–68/ha at 1.0x1.0 m spacing.

- Paid personnel:
    - 2 managers, full time for 2 years- $50k each, $100k total
    - One paid field manager for each of the 10 cores to manage volunteers and materials. Field Managers salaries: $300/week x8 weeks x10 managers = $24,000
- Travel expenses: flights, board, food and other travel = $50k each. = $100k travel costs
- Hardware: $60,000 for all planting needs including seedlings, soil, and tools
- Software: $2,500 for 5 users of ArcGIS for one year
- Subtotal: $286,500
- 40% for indirect costs: $91,600
- Total: $378,100

Timeframe:

- Research stage: 2 weeks

    - Two personnel (one manager and one researcher) use GIS to research and find out which areas are best for mangrove reforestation
- Intel stage: 2 weeks
    - Same two personnel travel to sites and see if they are suitable, call for volunteers and paid managers from the local population
- Clearing the areas: 1 year
    - Personnel work with government and locals to negotiate rehabilitation allowances and support.
- Implementation: 2 months
    - Five core areas are replanted with mangrove forests
- Maintenance: 9 months
    - Two original personnel stay on for the duration of the year and help manage a skeletal crew of volunteers to make sure mangroves are taking root and staying healthy
- Long term maintenance: 10 years
    - Volunteers are picked to be in charge of the mangrove forests and to keep an eye on them as they grow. They will give status reports.

Citations:

Dittmar, Thorsten, et al., 2006. “Mangroves, a major source of dissolved organic carbon to the Oceans,” Global Biogeochem. Cycles, Vol. 20, No. 1, GB101210, doi: 10.1029/2005GB002570, 2006

Manassrisuki, Korn, Michael Weir, and Yousif Ali Hussin, 2001. “Assessment of a Mangrove Rehabilitation Programme Using Remote Sensing and GIS: A Case Study of Amphur Khlung, Chantaburi Province, Eastern Thailand.” *Forest Resource Assessment Division, Royal Forest Department.*

Primavera, J.H. and J. M. A. Esteban, 2008. “A review of mangrove rehabilitation in the Philippines: successes, failures and future prospects.” *Wetlands Ecology Management*. DOI: 10.1007/s11273-008-9101-y

Quarto, Alfredo. July, 2010. Ecological Mangrove Restoration. *World Rainforest Movement.* Retrieved from http://www.wrm.org.uy/bulletin/156/Ecological_Mangrove_Restoration.html

"Mangrove Project." *The Red Mangrove Rehabilitation Project*. Web. 13 May 2013.