Regreening and Environmental Enhancement at Akurala Sri Lanka

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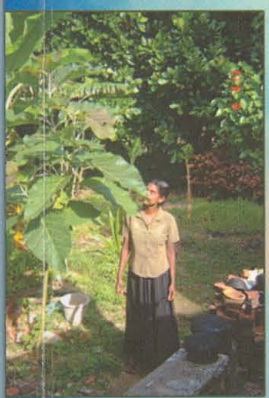
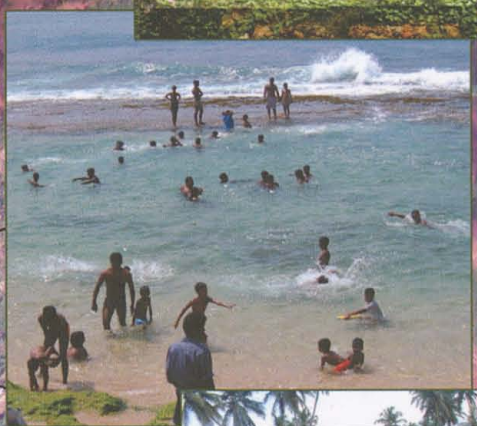
A Project Implemented with Community, University, Regulator Partnership (CURP)





Geoinformatics for Systematic Environmental Enhancement

Regreening and Environmental Enhancement at Akurala, Sri Lanka.

A Project Implemented with Community, University, Regulator Partnership (CURP)

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Regreening and Environmental Enhancement at Akurala, Sri Lanka

A Project Implemented with
Community, University, Regulator Partnership (CURP)

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Regreening and Environmental Enhancement at Akurala, Sri Lanka.

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Foreword

The Green Coast Programme funded by Oxfam/NOVIB and administered in Sri Lanka by The World Conservation Union (IUCN) has contributed immensely to the enhancement of coastal environment in Sri Lanka, post the Tsunami of December 2004. The Akurala Small Grant PP/071, A,B, is a project funded under this programme. The project which commenced in September 2006 and ended in December 2007, has successfully achieved it's objectives of rehabilitation of abandoned inland coral mines and in the re-greening of a selected coastal strip. Execution of the project by the International Center for Geoinformatics Applications and Training (ICGAT) of the University of Moratuwa has been excellent and has very clearly shown efficient leadership and management capabilities demonstrating effective working with concerned communities in achieving project objectives with limited time and resources.

The project from its inception has taken a systematic approach to plan and execute its activities and hence it is of extreme importance that these efforts are suitably documented. This publication which presents details of the project, its activities, achievements, adopted methodologies, merits and drawbacks is a very important document for anyone who is interested in small scale environmental rehabilitation projects and in their execution. This publication will no doubt lead the way to disseminate the details of successful application of such approaches.

We warmly congratulate the International Center for Geoinformatics Applications and Training of University of Moratuwa on this significant achievement.

Shiranee Yasaratne
Country Representative
The World Conservation Union (IUCN)

The International Centre for Geoinformatics Applications and Training is a Centre of Excellence at the University of Moratuwa which is in the forefront of Geoinformatics. The contributions made by the ICgat in capacity building and carrying out applications in the field of Geoinformatics are well known both nationally and internationally. ICgat which successfully completed the rehabilitation of abandoned coral mines and regreening of the associated coastal environment has shown the huge potential and capabilities which are associated with the Geoinformatics and this has been done through a real life application.

This supplementary book published by the ICgat demonstrates the successful execution of an environmental enhancement project. The project has made extensive use of GIS and other Geoinformatics tools to deal with many activities involved with the management of spatially distributed resources. This work completed by the ICgat is of extreme importance due to several reasons. It has shown the systematic approach taken to study, assess and complete a project in time and achieving excellent quality. The project has demonstrated the use of present day IT tools for practical applications. This project had been executed around the concept of CURP which is the Community, University and Regulator Partnership.

This partnership with the leadership of the University of Moratuwa has indicated its success in project execution and delivery. Finally the project has very elaborately documented the work done for wider stakeholder awareness and use. I am proud to present this publication from the ICgat as a significant contribution towards the nation's development activities.

Professor Malik Ranasinghe
Vice-Chancellor University of Moratuwa

Preface

Regreening and Environmental Enhancement at Akurala, Sri Lanka

A Project Implemented with Community, University Regulator Partnership (CURP)

Akurala Green Coast Project successfully completed the rehabilitation of abandoned coral mines and regreening in a coastal strip of approximately 3 km long and 100 meters wide. This project which achieved it's objectives in a very limited time of approximately 15 months required extremely careful planning and implementation. In situations where the resources that have to be utilised are spatially distributed, their planning and management can be easily done with the use of map based IT tools. In this regard, Geographic Information Systems (GIS) are becoming more and more popular among the decision makers. Today, GIS, GPS and Remote Sensing, commonly grouped as Geoinformatics, have become powerful tools which are indispensable for planners and managers who are in the forefront of resource utilization. Akurala Green Coast project made wide use of Geoinformatics tools and techniques in successful completion of the project.

International Center for Geoinformatics Applications and Training (ICGAT) of the University of Moratuwa, through training programs and application projects provides expert support in the utilisation of Geoinformatics for planning and management of spatially distributed resources. Akurala Green Coast Project is a Geoinformatics Application of Environmental Enhancement which had been completed with a unique Community, University and the Regulator Partnership (CURP).

The project achieved its targets by incorporating a scientific approach together with a good community and other stakeholder participation. GIS database facilitated mapping of resource assessment, mobilisation and utilisation in a quantitative manner. This capability enabled the evaluation of situations on a temporal scale. The spatial and temporal monitoring with GIS capability has been clearly displayed and documented in this publication.

This supplementary book published by the ICGAT has given an emphasis to present the details of the project and its activities. The project section descriptions in this publication are illustrated with flowcharts, maps and pictures. Contents include the process, efforts, achievements, experiences and recommendations. This publication will appeal to users who carryout regreening and rehabilitation of coral mines in the coastal belt, apply Geoinformatics for spatial and temporal management of real life projects, and execute environmental enhancement or rehabilitation works targeting the participation of stakeholders who are very poor and frustrated.

Editor is greatly indebted to the core resource personnel and other support staff of the ICGAT for their untiring contributions. Review and editorial assistance provided by the individuals of ICGAT is highly appreciated. Financial assistance provided for the Akurala Green Coast project by Oxfam/NOVIB is gratefully acknowledged. The excellent support extended by the IUCN and especially by Mrs Shiranee Yasaratne, Mr. Shamen Vidanage, and Mrs. Kumudeni Ekaratna, is highly appreciated. The Staff of Geological Survey and Mines Bureau are thanked for their willing contributions. Special thanks are for the support from the Vice Chancellor Prof. Malik Ranasinghe, Deputy Vice Chancellor Prof Niranjan Gunawardena, Dean Faculty of Engineering Prof. A. K. W. Jayawardane, Bursar Mr. Lionel Silva, and other staff of the University especially the staff of finance division and the library.

Professor N.T. Sohan Wijesekera

Introduction to Akurala Green Coast Project

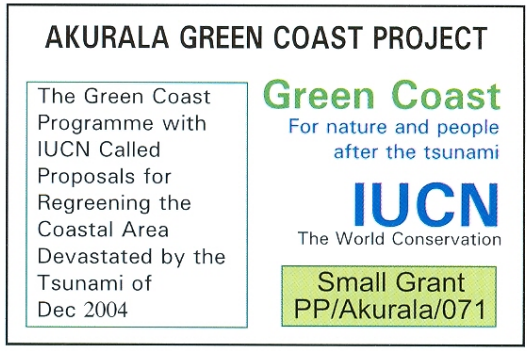
It's Achievements and Lessons

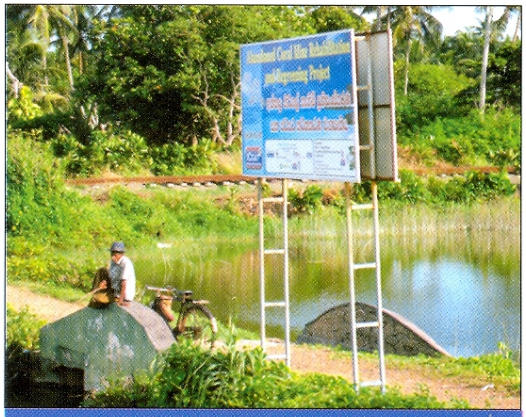
1. Background

Environmental degradation due to human activities has been on the increase and this has been a major complaint with regards to mining of earth resources. In most parts of the country mining for sand, clay, rock, earth and gravel has devastated the countryside creating water pollution, groundwater depletion, water stagnation, creating mosquito problems etc. Most of the sites are left as open pits filled with rainwater or pits that are filled with solid waste and water. Illegal sand & clay mining and coral mining are among the top that had caused severe environmental damage by way of lowering groundwater, removal of sand aquifers and increase of salinity etc. The southern coastal belt near the town of Hikkaduwa had been home to many people who carried out a living by means of inland and near shore coral mining.

Coral mining in the coastal belt had been banned by the Coast Conservation Act of 1981 and subsequent amendments. With the establishment of the Geological Survey and Mines Bureau (GSMB) under the Mines and Minerals Act of 1992, inland coral mining had been under strict control. The inland coral mining sites which had operated prior to these laws remain as abandoned and sometimes as deep, stagnant water ponds causing environmental problems.

The southern coastal area also has a large number of abandoned coral mines which creates many environmental problems due to the polluted water and solid waste dumped to them. These pits were further affected by the 2004 Tsunami which flooded debris and also salt water. The village





Akurala Green Coast Project Commenced in September 2006

personnel have gone on dumping solid waste into the pits worsening the environment. Vegetation of the coastal belt has also got affected by the power and the saltiness of Tsunami and as a result the greenery has been lost in most parts of the belt except for a few coconut trees and some vegetation patches near the houses. The main problem in these areas are the health hazard of abandoned coral mines due to mosquito breeding, domestic waste dumping, and the Tsunami defenceless status due to loss of vegetation. Any rehabilitation of these areas needs to include the environmental restoration of the abandoned coral pits with the planting of trees to suit the regreening of the environment. The GSMB had already identified the need and had been attempting to execute inland mine pit rehabilitation and re-vegetation. GSMB carried out a pilot mine pit rehabilitation on its own and had realised that the filling of pits can not be recommended as it is not the best option for environmental sustainability.

The solution identified during field visits to the project area was, to upgrade the water quality of the pits by cleaning and enabling a change of water and then to establish fish culture to ensure sustainability of the associated community. A common complain had been the mosquito problem. The poor pit status had been mostly due to environmental degradation as a result of solid waste dumping and zero maintenance.

2. The Project

The Green Coast Programme along with the World Conservation Union (IUCN), called for project proposals to carryout regreening of the coastal area devastated by the Tsunami of December 2004. A project proposal was submitted by the International Center for Geoinformatics Applications and Training (ICGAT) of the University of Moratuwa to rehabilitate the abandoned coral mines and to regreen the coastal stretch of 3 km along the coast to a width of 100 meters from the beach. The proposal submitted by the University of Moratuwa indicated a collaboration with GSMB of the Ministry of Environment which is the regulatory institution of the Government of Sri Lanka for Mining activities. The GSMB collaboration was considered very important for the project since it reflects the regulator's commitment towards the environment. Stakeholders also identified the GSMB involvement as an indication of the government's commitment towards environmental rehabilitation while performing the regulation of mining activities. Prior to the Tsunami, this coastal belt has had small houses and many other small scale manmade infrastructure. Main vegetation of the area was coconut trees in the home gardens and in the state lands. The washing away of housing, buildings and other infrastructure, and the movement of a massive water mass with debris due to Tsunami, had damaged and left the entire coastal region with only a few coconut trees and hence defenceless in a future Tsunami.

Selected project area spans across a stretch of 3 km at Akurala near Hikkaduwa. This area consists of 44 water holes which are abandoned coral mines that have been devastated by the Tsunami and further polluted by waste disposal. The terrain of the strip is flat, consists of sandy soil and has sparse vegetation. Most of the dwellers in the area have moved out of the near coast region after receiving lands towards the interior of the island. There are 80 families remaining in the area and most of them are fishing folk who live by

fishing in the sea. The Tsunami had taken 87 lives from Akurala. Those who have received land elsewhere are gradually returning to the coastal properties indicating their resistance to be settled in an unknown neighbourhood.

The project area within the buffer of 100m consists of both state and private lands. In the state lands, project directly carried out the environmental rehabilitation and regreening with community and GSMB participation. Private land owners were encouraged to carryout rehabilitation and regreening by facilitating and capacity building through provision of direct support for cleaning and water quality enhancement, the provision of fish stock for breeding and also provision of useful plants suitable for tsunami barrier re-vegetation. As the area is flood prone there is a threat to life during floods. It is because people cannot identify the difference between shallow normally dry lands and deep abandoned pits once they are inundated with water. This causes a threat to life as people tend to accidentally walk into pits injuring themselves. Lack of vegetation suitable for Tsunami defence support also makes the area very vulnerable.

Status of the abandoned coral mine pits have been deteriorating day by day and since the Tsunami of 2004, this situation had worsened. The public or the land owners had not taken attempts to do restoration of coral mines and regreening for livelihood enhancement mostly due to the lack of, 1) guidelines for selection of options & methods, 2) leadership from the state, 3) joint efforts by the community and government, 4) capacity with the community to ensure maintenance of rehabilitated systems etc. Project targeted the rehabilitation of abandoned coral mines and regreening the selected coastal environment to serve as a flagship project for influencing policy makers to embark upon larger national environmental rehabilitation projects. Project also reflects the strength of community, state, & academic partnership and it's ability to achieve satisfactory implementation.

3. Goal

Goal of the project is effective restoration of coastal ecosystems through proper management of resources with community, technical experts and state participation and thereby ensuring suitable disaster mitigation strategies and sustainable livelihoods for the surrounding environment.

4. Objectives

The project objectives are (i) to rehabilitate the abandoned coral mine pits, while improving water quality (ii) to ensure a sustainable livelihood for the maintenance of the water bodies and (iii) to revegetate the surroundings of the water bodies and the coastal belt, in the selected project area by joining hands with community, technical experts and regulating authorities.

4.1 Specific Objectives

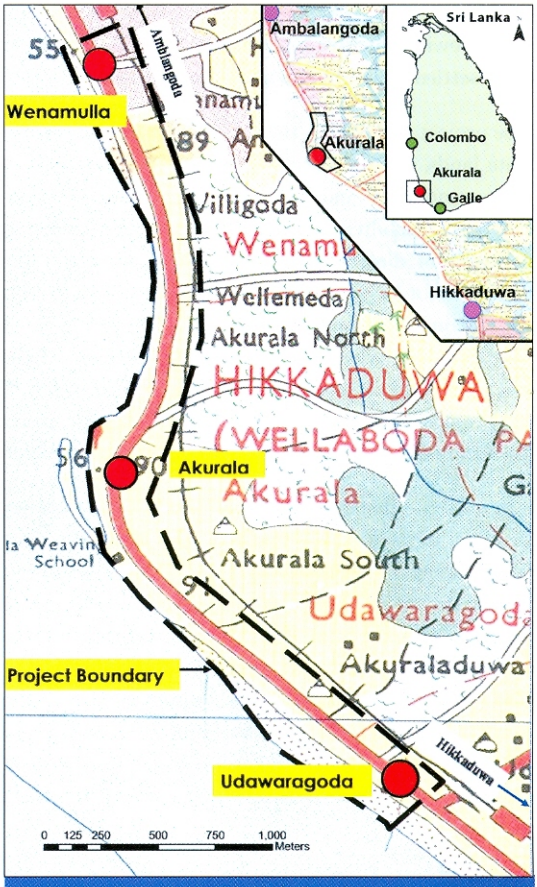
1. Execution of a coastal regreening and rehabilitation project with the cooperation of the community, the government and the technical experts to serve as a

flagship for large scale national environmental rehabilitation projects

2. Development of an environmentally sustainable coastal green belt having rehabilitated abandoned coral mines, a regreened surrounding and a protected coastal strip
3. Training of representative stakeholders/target groups in project activities
4. Awareness enhancement of stakeholders

5. Rationale and Challenges

The Inability of public to bear the costs associated with filling, cleaning or rehabilitation of mine pits on their own, the inability to select, acquire and plant suitable trees for coastal zone regreening, the lack of awareness on solid waste disposal and associated benefits and hazards, the lack of knowledge to make a livelihood from the coral mined pits and inability to identify the paths to environmental sustainability, lack of financial and technical support to identify the methods of cleaning and rehabilitation, acquiring plants and fish, the lack of capacity with the community to ensure maintenance of the rehabilitated systems, lack of heavy machinery and water pumps for cleaning and rehabilitation, the lack of coordination and supervision to

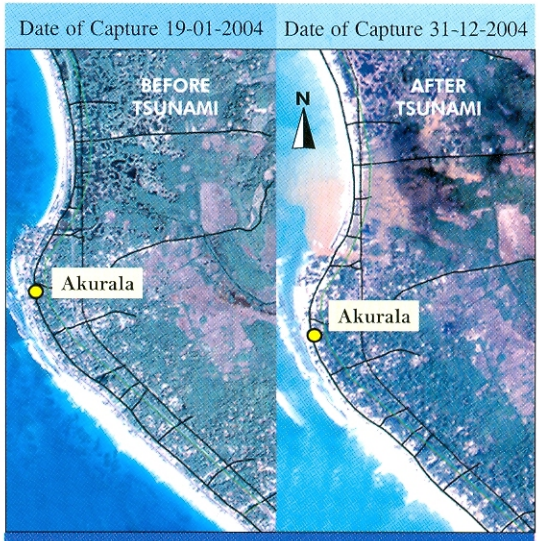


Location Map of Project Area

A Sample of Project Area at Comencement

ensure an integrated approach to rehabilitation and regreening, lack of guidelines, tools, knowledge & skills for spatial management, and the lack of example applications or situations of public, state and knowledge-center cooperation are considered as the main causes for the problem and hence the rationale for project support.

An Example of a Polluted Coral Mine Pit



Before and After Tsunami Satellite Images of Project Area

Tsunami destruction drew significant pledges of assistance to Sri Lanka. Being an area devastated by the Tsunami, the Akurala area was also visited by many well wishers, both local and foreign donors, governmentandnon-governmental agencies, voluntary and paid workers etc. According to the people in the area there had been many offers for relief but most of them pending. Therefore the community had been losing faith on any kind of assistance offered to them. They were of the opinion that the implementers were receiving large sums of money from the donors but there was neither any delivery on ground nor have they received any funds as currency for their life support. This response of the community was a challenge to commence the regreening project. In the project area there were indications of previous regreening efforts near the coast but there were no activities other than sporadic building constructions and demolishing activities along the coast.

6. Planned Activities and Benefits

The project activities were planned as a partnership effort of the university, the regulator and the local community. Activities of the project and the benefits are as listed below.

6.1 Activities

1. Field data collection & assessment of the status and features of abandoned coral mine pits, land ownership and the status of revegetation
2. Acquire available maps, aerial photographs, and satellite imagery to identify the topographic features in combination with the mine pits
3. Water quality and other field testing, identification of water quality improvement options and drainage status in the surroundings
4. Community awareness building and identification of the most suitable alternatives with joint desk studies and community discussion workshops
5. Development of a Geographic Information System to plan, implement and monitor project activities
6. Rehabilitation of abandoned mine pit and surroundings of state and private lands through example implementations and participatory incentive schemes
7. Revegetation planning of the associated coastal belt and the pit environment with selected plant species
8. Development of fish life in the abandoned mine pits
9. Acquisition, distribution, planting, monitoring of plants and carrying out revegetation
10. Community Awareness and capacity building for successful implementation and sustenance
11. Maintenance and long term monitoring mechanism development with community and regulatory authority participation
12. Training and technology transfer visits and workshops, both in and outside project area, to enhance stakeholder knowledge and awareness

6.2 Benefits

1. Delivering outputs visible to the naked eye of the public over a significantly long stretch which has been devastated by the Tsunami and where there had been minimal environmental protective action
2. Providing implementation foresight and examples of regreening efforts in i) state lands and ii) in private lands, with academia and state agency participation and achieving sustainability through community involvement
3. Acting as a unique project with Knowledge-Centers taking the lead role with equally

major roles by the State and the Community to set guidelines for involving agencies and the government. Indicating a significant deviation from the approach of standard NGO-Community projects which incorporates minimum state involvement and little of Knowledge-Center inputs

4. Encouraging the state to be more environmentally friendly and not friendlier with development and short term economic prosperity. This project targets a deviation from the common syndrome of isolating (cornering) the state (as culprits of environmental damage and corruption) without giving opportunity at least for those state institutions who attempt to be in the main stream through simple but effective contributions

5. Inculcating the culture of environmental rehabilitation needs and methods (Repairing/ rehabilitation of the environment damaged due to economic and natural causes) in the minds of the state and public, thus leading to policy reform suggestions

6. Disseminating the project success to influence policy makers to embark on Nationwide Environmental Rehabilitation Projects utilising community cooperation and willingness to achieve sustainability

7. Inculcating the habit of waste disposal concepts and the importance of vegetation in the rural community as a part of recognising the role of environment

8. Facilitating the policy and decision-makers through example cases of i) ecosystem concepts, ii) drainage engineering, iii) water table engineering, iv) geographic information systems for project planning, implementation and monitoring, v) community education awareness and support, and vi) linking engineering options for sustenance through livelihood needs of the community

9. Displaying to nearby rail and road user community about a structured rehabilitation and regreening effort executed in both state and private lands

10. Disseminating the project related information to the visitors arriving at the project area; through the establishment of a Green Coast Visitor Center and development of related publicity material

7. Target Groups and Local Participation

Project encompasses both international and national target groups. Agencies in Tsunami affected countries that are carrying out regreening projects, funding agencies, local administrators and managers of such countries are the important international target groups. National level target groups of the project are the national political leadership, ministries of the central government, national progress and project monitoring units, non governmental organisations. At regional and local level, the divisional administration (DS division), village level administration (Grama Niladhari), and formal & informal community groups are treated as the target groups.

Participation aspects of local community groups envisaged during scoping and implementation are as listed below.

1. Definition of the problem that project will address was developed through project initiation and awareness building meetings for local community and administrators
2. Planning process of the project was carried out through discussions with local community and administrators
3. Project activities were identified with a situation assessment through field data collection programs supported by the community groups
4. Monitoring and evaluation of the project was done through progress review seminars and workshops with community participation
5. Training was carried out for technology and knowledge transfer between local community, decision makers, technical experts and administrators

Participation of Local Community was a very Important Factor

A Small Community Group Discussion in the Project Area

8. Gender

As the project is based on community, knowledge expertise, and state agency cooperation, project sustenance depends largely on the local community; hence a balanced involvement of males and females at household level was targeted. An emphasis was given to females and school going children by encouraging active participation and training in the practices of sustainable ecosystem rehabilitation, solid waste disposal, importance of the maintenance of water bodies and vegetation, methods of income generation etc. This approach was based on the assumption that the environmental safeguards need to be rooted in individual

homes and schools to ensure long term sustainability. These target groups were given special attention as they are the future generation who would be the core of the project. Females, especially the housewives of the area were given a significant prominence as they have a significant influence at a given household

9. Management Partnership

The project used a new approach for project planning, implementation, management, monitoring and evaluation. This involved Community of the project area (C), academia of the University (U), and the Regulator of core environmental concerns (R), as a strong Partnership (P). The CURP provided a strong support for the successful project completion within a very limited time period. Important roles played by each party to the partnership are as follows.

Community: Ensuring project sustainability, sense of ownership, function as beneficiaries and caretakers carrying out execution and to contribute with suggestions

University: Scientific approach and technical know-how, reputation and public image, flexibility to act

Regulator: Knowledge of the process, authority of mining, environmental responsibility, future activity control, sustainability, compelling to listen, better state collaboration

The project was managed by the International Center for Geoinformatics Applications and Training (ICGAT) of the University of Moratuwa. The Chairman of the center was the Chief Executive Officer of the project. Resource persons and geoinformatics support staff were responsible to the CEO. External support staff were hired as and when required. Project activities were monitored and evaluated via observation of activities and submission of reports at the end of such activity completion. The GIS database of the project area was the key instrument for spatial data management. Progress reports and detailed output monitoring were submitted to the IUCN in a periodical manner.

10. Team and Support

The team and support for the project consisted of persons representing three partners. They were (i) International Centre for Geoinformatics Applications and Training from the University of Moratuwa (ii) Geological Survey and Mines Bureau from the regulator and (iii) the direct community contributors from the neighbourhood. Other than the above, activity support was provided by the Ministry of Environment and Natural Resources, Mahaweli Authority, the Forest Department and the State Timber Corporation. The local government organisations extended support by providing the land and maintenance commitment for the visitor center. National and local political leadership provided their blessing for the project by providing the coordination between various communities. List of these project activity support personnel and agencies are listed below. Project received the major financial support from Green Coast Programme through the IUCN. GSMB and the ICGAT also supported with funding for limited inspection and other works.

University

- **Prof. N.T.S. Wijesekera**
  Chartered Civil Engineer, Team Leader, Water Resources, Geoinformatics and EIA Expert, Chairman ICGAT, Professor of Civil Engineering
- **Mr. S. Weerawarnakula**
  Environmental Geologist, Senior Lecturer in Earth Resources Engineering
- **Dr. K.M.P.S. Bandara**
  Chartered Civil Engineer, Geoinformatics Expert, Drainage Specialist
- **Dr. Yasantha Mapatuna**
  Bio Diversity and Community Awareness Expert
- **Mr. H.H. Leelananda**
  GIS Expert, Town Planner

Regulator

- **Prof.N.T.S. Wijesekera**
  Chairman
- **Mr. Sajjana De Silva**
  Chartered Mining Engineer, Community, Project Planning, Mining and Earth Resources Expert

Community

- **Rev. Akurala Gunananda**
  Community Advisor
- **Mr. Mohan Silva**
  Regional Community Leader
- **Mr. S Ariyawansa**
  Chairman Pradeshiya Sabha
- **Mr. C Ranjith de Silva**
  Grama Niladhari
- **Mr. B K Dharmadasa**
  Grama Niladhari
- **Mr. T Susil Nandana**
  Agriculture Research Assistant
- **Mr. A Kumudu De silva** Community Leader
- **Mr. M Bandupala De Silva**
  Community Leader
- **Mr. Ranjith Bandusena** Community Leader
- **Mrs. Nadeera Sandamali**
  Community Leader
- **Mrs Yashima Vijayangani De Silva**
  Community Leader

Activity Support

- Ministry of Environment and Natural Resources
- Mahaweli Authority
- Department of Forest Conservation
- State Timber Corporation

Financial, Material and Service Support

- Green Coast Programme funded by Oxfam/NOVIB
- The World Conservation Union (IUCN)
- Geological Survey and Mines Bureau, Ministry of Environment and Natural Resources
- International Center for Geoinfomatics Applications and Training, University of Moratuwa

11. Geoinformatics

The project for its application utilized Geoinformatics tools in a very prominent manner. Geoinformatics tools were initially used during project planning in order to select the site. A structured GIS database for the project was developed to carry out spatial resource planning in a rational manner ensuring that the project could be completed according to stipulated time targets. The GIS database incorporated site specific survey sheets as base data. GPS surveys were done from time to time to capture various other data pertaining to the project area. Use of Geoinformatics provided excellent support for the implementation and monitoring of drainage system improvement, coral pit environment rehabilitation and the execution of planting for regreening. Utilization of Geoinformatics for resource allocation and monitoring enabled the optimal use of resources both by means of finances and time.

12. Implementation

12.1 Stages

The Green Coast project for the Rehabilitation of Abandoned Coral Mines and regreening of the associated coastal strip at Akurala was granted approval in three stages. Initially project approval was granted for the rehabilitation and regreening in the project area. Subsequently with the availability of more time within the Green Coast programme, approval was granted for a second stage which included an evaluation of the previous work, identification of shortfalls and carrying out plant maintenance. The third stage approval which consisted of the awareness enhancement, publication etc., included the establishment of the Green Coast Visitor Center, conducting of a stakeholder awareness workshop, preparation of an information video and a publication on the project details.

12.2 Project Studies

Project work in all three stages were planned, commenced and executed in a systematic manner. Once the project contract was awarded, project team reassessed the plan and workloads. Work items were clearly identified, verified through site excursions and schedules were done for all activities. In order to carryout the work effectively, several studies were executed. Geological Survey and Mines Bureau carried out an engineering survey (GSMB 1) to the scale of 1:1000 for the project, along with a study of water and soil quality in the area

(GSMB 2) as an initial contribution to project planning. Contour survey included the bathymetry of coral pits as well. Detail survey also included a tenement list pertaining to the project area. A study of the surface drainage patterns done with the use of the maps and supplemented by field surveys (ICGAT 1) was used to identify poorly draining area and their problems. Surface drainage of the area and the adjoining project area were studied and the improvements required were identified (ICGAT 2). The stakeholder community and their status were surveyed to analyse the situation of the project area (ICGAT 3). Initially the status of the coral mines were studied using the available information (ICGAT 4) and then rehabilitation approach was established (ICGAT 5). Prior to regreening activities, it was necessary to identify the biodiversity of the area to establish the planting and fishery programs. A rapid biodiversity assessment was carried out in the project area to plan relevant activities (ICGAT 6). Based on the rapid biodiversity assessment and the available literature, the selection of plant material, planting details, fish life development, plant maintenance etc., were planned systematically with the use of field data and geoinformatics (ICGAT 7,8,9).

Regreening activity experienced severe dry weather conditions in the months of December 2006, January and February of 2007. As a result plants were protected from sunlight and dry winds by using coconut branches. Coconut branches were selected considering the availability, low prices, the easy biodegradability and environmentally friendliness. An assessment of the plants were done at the end of the Phase 1. Project being in a vulnerable area, plants experienced a significant salty sea breeze and sea water splashing due to the monsoonal windy weather in the months of June and July 2007. The plants covered with coconut leaves were not adequately protected from the salt water. A survey of plants was done in the project area to identify plant survival status and to make appropriate recommendations. This assessment through the GIS database enabled the identification of plants for gap filling and maintenance (ICGAT 10).

13. Execution

Key aspects for the successful execution could be attributed to several factors. The team made frequent site visits to support site engineers and workers, and also to assess the program of work in comparison with the project targets. The Project from time to time carried out map based progress monitoring in a quantitative manner by using GIS database and GIS techniques. Project staff contributed with committed inputs and whenever possible incorporated cost cutting methods, Plant nursery development, contributory plant supply arrangements with school children participation, were some of the examples. Short term project execution requires quick decision making supported by technical competency. In this aspect University involvement and leadership could be identified as a major advantage for the project. In the implementation of a project of this nature flexibility of the university was also an added advantage. It is commonly known that the project area communities do not positively commit to carryout rehabilitation works unless the government shows a noteworthy role in the concerned activity. In this regard, the present work received significant support from the regulator. This and the strong links of the univer-

sity with state institutions enabled the onschedule execution of project plans. Success of the project should also be contributed to the project team for their experience and technical competency.

14. Achievements

The major achievements of the project could be listed as follows.

1. Abandoned coral mines were rehabilitated and regreening was completed in the entire project area of 30 ha within the target duration.
2. An approximate area of 5200 square meters of land was cleaned of debris.
3. The road side strips, areas surrounding water ponds and home gardens were regreened with 4654 plants.
4. In the project area, 35 abandoned mines were rehabilitated by cleaning and removal of debris.
5. Six small polluted ponds were selected and were filled with the debris which were collected while cleaning surrounding area and other pits.
6. Rehabilitation of pits included the construction of 1150 meters of small

School Children were Involved at Various Stages

Soil Studies were carried out in the Project Area

Coconut Branches did not Provide Adequate Protection to the Plants

bunds of approximate height of 0.8 meters around the mine pits so that the surface runoff pollution could be controlled.

7. The regreening activities donated valuable trees such as Teak, Mahogany and Pihimbiya for 41 home gardens in the project area and many more households in the nearby area.

8. An approximate drainage length of 2500m within the project area was cleaned and developed using heavy machinery, while a drainage length of 900m outside the project area was also cleaned to ensure proper functioning of drainage within the project area.

9. Sixty seven compost bins were distributed free of charge among the takeholders to encourage environmentally friendly waste disposal.

10. Four identified special locations within the project area were developed for attraction of the passers by. Two were to be used as leisure area for stopping passing by vehicles to enjoy the natural environment. A coral pit by the side of the road was developed as an Eco Park where stop by personnel could take a peek at the green environment adjacent to a rehabilitated coral pit. A visitor center has been located by the road side and approximately at the middle of the project area. This center has been named as the "Green Coast Visitor Center". The local government administration has undertaken the maintenance of this center.

11. Twenty nine of the rehabilitated water bodies were identified and 34,500 fresh water fish fingerlings were introduced. These ponds are to be managed by the stakeholder groups identified from the adjacent neighbourhood.

12. Stakeholder awareness enhancement was done according to a systematic plan. Workshop programs targeted stakeholder audience ranging from direct beneficiaries to local and national political leadership. Ten awareness workshops were held. Out of these, 6 were held within the project area and 4 were done outside.

13. Plant maintenance including placement of a protective cover, watering and adding fertilizer was commenced immediately after planting was done in the Phase 1. This was continued and extended to the Phase 2. Plant protection was strengthened as gap filling and plant maintenance work was carried out in Phase 2.

14. The visitor center has been completed and would provide information about the project and the surrounding environment. A sample set of waste disposal compartments have been constructed including a sample composting facility. Local government administration has undertaken to supply fresh water and electricity for the center and the maintenance of center after the project period. Land for the visitor center was allocated by the local government.

15. Many publications were done during the project including study and planning documentation of the ICGAT. These publications include maps and reports. A documentary video of the project area called "Reawakening of Akurala" was

developed in English during the Phase 1 and a documentary video in Sinhala (Main local language) has been done as a part of the Phase 3 of the project.

16. A printed publication in a book form (this publication) and several publicity leaflets and posters to enhance public awareness has been completed.

15. Discussion

15.1 Completion and Influence

The present project which is an environmental status enhancement activity included rehabilitation of abandoned coral minepits and regreeining of the surrounding area, maintaining the plants and gap filling during a period of approximately fifteen months, development of a visitor center, conducting awareness enhancement, and dissemination of knowledge. The project has targeted to be a flagship for environmental enhancement, and rehabilitation projects of the nation and outside. Hence, the project has given a special emphasis to the methods and outputs. There had been many lessons learned during the project execution. Completion of a project within a limited time duration with substantial stakeholder participation, and having to work in an environment where the stakeholders had little or no faith in external support, was an immense challenge. It was experienced that initial lack of interest could be erased as the project progressed. Willingness of the public and the local government to support the project could be clearly identified by the enthusiastic participation of the community at home garden cleaning and tree enhancements, work contributions at common area development, and the extension of land, water, and electricity support by the local government. Local religious focal point which is the Buddhist temple expressed great support and provided excellent encouragement to the environmental enhancement through this project. Stakeholders living immediately outside of the project area were also appreciative of the efforts through the project. Such stakeholders who had shown voluntary efforts to enhance the environmental status in adjacent area were encouraged through the distribution of plants, fish, compost bins and other material. This provided great strength to the success of the project and to capture community appreciation.

Other than the project's core supervision and other expert services such as surveying, printing etc., the major labour inputs and material inputs were from the project area. This along with the maintenance of a project office, utilising resident project supervisors and village community leadership for awareness enhancement were the key factors for the success of activities in the project area. Involvement of village personnel for work did enhance the quality because of the sense of ownership developed among the workers after realizing that the project outputs are for the benefit of them and their future generations. The community participation during the project period were centered around the leadership provided by the CURP, A growing of self motivated local leadership was not clearly visible in the project area. Therefore in future, the Pradeshiya Sabha (Local Government) administration need to provide a strong leadership to achieve continued community participation and thereby sustenance of the project. The visitor center constructed by the

project is expected to facilitate this with respect to future activities.

16. Geoinformatics and Resource Persons

The project which was proposed by the International Center for Geoinformatics Applications and Training of University of Moratuwa incorporated map based information technology tools for the completion of the works as desired. The work which included planning, implementation, monitoring and evaluation was done with the use of a Geographic Information System (GIS). Initial work related to the justification of the project indicating vegetation status and polluted mine pit distribution, demarcation of the coastal strip, were done incorporating a GIS map based approach. The project area drainage, rehabilitation locations, vegetation and special area identifications, progress monitoring of gap filling, maintenance etc., were carried out using GIS, GPS and Remote Sensing. This project clearly demonstrated the use of Geoinformatics in the successfull execution of environmental quality enhancement projects and hence stands out as a practical application of recent information technology tools for the benefit of the common public. This would stand out as a great strength

Children Contributed to Collecting of Plants

Field Discussions by Resource Persons

House to House Field Visits

to the university to exhibit it's role in disseminating the use of technology in real life applications and through very recent map based technologies such as Geoinformatics.

Project completion required many inputs and one such input was the team of resource personnel. The ICGAT of University of Moratuwa through the CURP, identified learned and experienced personnel. This proved as one of the key factors for satisfactory completion of the project. Amount of work carried out, and documentation done for the project stands out as self explanatory material for the scientific methods and successful completion.

17. Awareness

Awareness enhancement workshops, household visits, demonstrations, field visits, material support, tokens of appreciations, etc., used by the core team members indicated as significant factors in the successful execution of the project. Participation of the school children and their contributions subsequent to the awareness campaigns was significant and commendable. Awareness workshops held outside the project area to provide exposure to the project's direct and associated beneficiaries, with respect to

Planting Along the Road Sides

Coral Mines were Cleaned with Machinery and Manual Labour

Fish were Introduced to the Rehabilitated Pits

the freshwater fish culturing, importance of biodiversity, waste disposal, home gardening etc., proved very helpful in making the project a success.

The Project launched a strong awareness campaign to disseminate the experiences through various methods such as dissemination workshops to policy makers, local stakeholder community and political leadership, publicity leaflets, formal descriptive documentation, a home page on web, posters and a visitor center. This is considered as a major component for encouraging the public and the state to embark upon similar projects. The project through it's awareness campaign provides additional support to the stakeholder community by attracting environmentally devoted attractive visitors to the region who would provide enhanced indirect support to such projects.

18. CURP

CURP displayed its potential as a major factor that should be noted by Government, the Non Government and the Donor community. This project indicated tremendous success in timely implementation adhering to desired quality in planning, documenting and monitoring. This credit should be directly attributed to the CURP which enabled many impossible actions possible through the formal connections as well as through the respect that the stakeholders expressed in CURP. During execution it was experienced that undoubtedly the leadership of the CURP should be given to the university for successful implementation of similar projects.

19. Attitudes and Obstacles

There are many lessons to be learnt from a project of this nature. It is important to highlight some such factors for the benefit of similar future activities. Stakeholder cooperation needs to be harnessed with great patience and should be is more in the case of stakeholders who have been given significant hope in the past but without delivery. Present work experienced great difficulty in convincing stakeholders of the benefits that would be achieved with time. Stakeholders were mostly cooperating only for their self benefits and in some cases, stakeholders were bold enough to selfishly challenge a neighbouring stakeholder claim for a benefit eventhough it may be legitimate. Project staff were required to exert significant energy through home visits and awareness workshops to overcome this problem.

Project area regreening and rehabilitation during the assigned period was done entirely by the Green Coast project. There was no evidence of another on going program for planting or any awareness programme to safeguard the planted trees in the project area. Neither the project resource persions, site supervisors nor the project area community were aware of the such a programme. However towards the end of the project's first phase, hoardings appeared in the project area and among the plants done under the Green Coast Project. The hoardings indicated an involvement of a different set of organisations including an international donor in tree planting activity. ICGAT project team is of the opinion that if one desires to take the component of regreening credit from the ICGAT,

then the team would opt not take any notice of such an activity, provided that the agency or agencies grabbing the credit had not deprived any donor funds intended for the stakeholders of the project area. The Project duration in total was approximately 15 months for all three phases. Project duration could be named as very short and especially for a regreening program. This is because for regreening it is necessary to have a proper timing arrangement so that planting coincides with rains. If otherwise, there should be a costly watering programme for regreening efforts to bear fruit. In case of short term projects any lethargy from the part of project team or a supporting agency would easily lead to an escalation of costs in the regreening efforts thereby increasing the risk of a failure. Such works include fund releases, work orders, fund disbursements, evaluations, and monitoring.

This project on several occasions underwent hardships due to inadequate experience and commitment of some personnel to act in time to propose suitable alternatives through identification of past experiences. Inbuilt communication methods commonly practised by state and donor agencies also did not facilitate quick responses that

The Eco-Park Near the Akurala Bridge

Green Coast Visitor Center was Constructed

Plant Watering During the Drought Period

were needed for the project which required to be completed in a very short time. This was a major concern especially in a project like the present one where significant outputs both in the form of reports and on ground were to be produced with limited resources. In this connection the agency cooperation to act out of the box and eliminate wake up time is extremely important. Project had to experience difficulties as a result of the above and overcoming of such problems was possible through significant efforts exerted by the team of resource personnel. In this project, overcoming of the problem was also facilitated by the use of a Geographic Information System which provided periodical indications of resource needs, utilization and the progress rates.

Gap Filled and Vulnerable Plants were Covered by Polythene

Geoinformatics was Used for Better Project Planning

20. Political and Community Leadership

Project targeted the involvement of a stakeholder community in a Tsunami affected area and the team realised the importance of receiving support of political leadership in the area. Efforts were launched to brief the political leadership through individual briefings, common workshops and also by participating in regional development committee meetings. Regional and local community leadership were convinced to work as a support group for the core resource personnel. A special effort was taken to make presentations indicating the benefits that could be reaped by the community. This enabled a very close collaboration from the community leadership to successfully complete the activities. Throughout the project this initiation and the continued rapport provided immense assistance and therefore it is important to realise that projects of this nature should target the blessings of the community and it's leadership. In this project the efforts were made easy because of the CURP which was warmly welcomed by the politicians both locally and nationally.

21. Conclusions

1. Rehabilitation of abandoned coral mines and regreening of the associated coastal strip was successfully completed within the stipulated time.

2. The project received satisfactory community participation during planning and implementation. A local community leadership is necessary for continued local participation. The assurance of local government to provide necessary leadership is a strong indication of commitment.

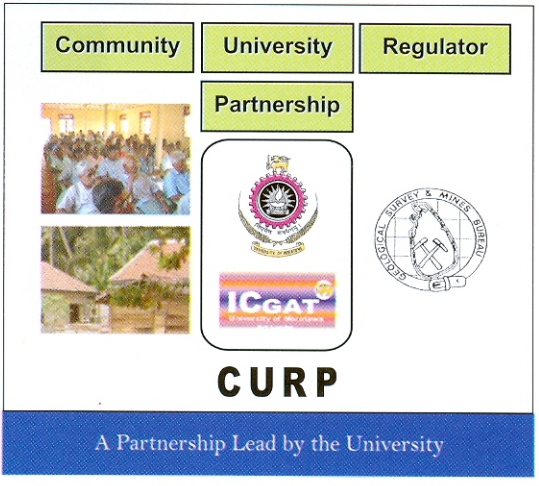
3. The project identified that the Community, University, Regulator, Partnership (CURP) played a vital role in the successful completion. This concept is recommended to be incorporated in future projects.

4. The map based resource allocation, use, monitoring and evaluation was a powerful aspect of this project. This work demonstrated the ability to develop and use a spatial database to support temporal needs of project management. Geoinformatics and spatial database systems should be embedded in similar environmental projects.

5. Project completion depends on the commitment and competence of the

Efforts of the Project is to Provide a Better Environment for the Future Generation

Support from Political Leadership;
Hon. Minister Maitriepala Sirisena Visited the Site



A Partnership Lead by the University

core team. When targeting similar projects, careful selections must be made with respect to the core team members.

Awareness Programme at Udawalawe Freshwater Fish Breeding Center

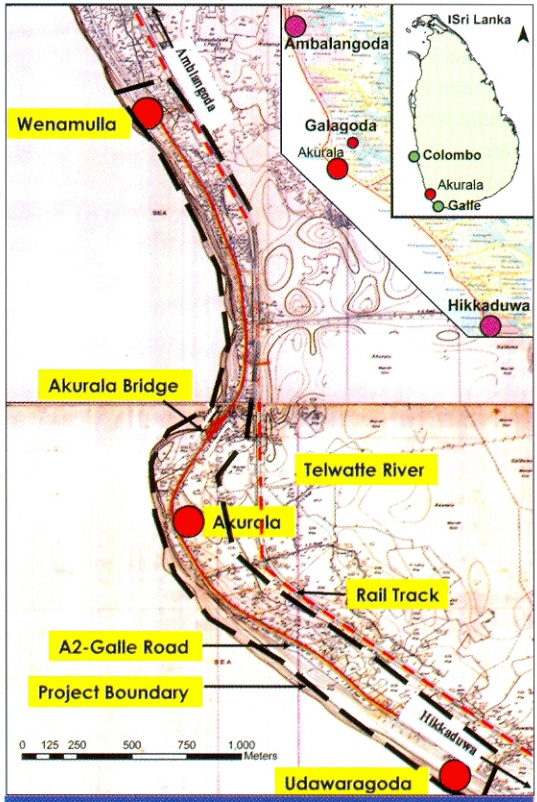
Field Data Collection

Plant Collection Programme

Planning and Rehabilitation of Abandoned Coral Mines and Establishing Plant Layouts for Regreening

1. Introduction

Unsustainable management of natural resources leads to environmental degradation of the land surface. In the southern coastal area of Sri Lanka, inland coral mining has been illegally carried out in a haphazard nature for a period of more than 50 years. Mined coral material, identified as Calcium Carbonate by its chemical composition, is burnt and used as a building construction material. There is a continuous demand for burnt coral material in the construction industry. The coral deposits appear under the thin top soil layer of the earth surface along the coastal region and extend upto approximate depths of 1m to 12 m. Having removed such coral deposits, the mines had been left alone without effecting any rehabilitation measures to mitigate the land degradation caused by mining activity. As a result of this unmanaged land degradation, density of trees has reduced drastically while forming stagnant water holes scattered over the land area. Though in the short term, inland coral mining appears as an income generating activity for the relatively poor community living in this area, in the long term, the same community and the entire nation are affected due to adverse effects of coral mining. With the introduction of Mines and Minerals Act No 33 of 1993, the legal framework for mining activities was implemented and through these legislations, restrictions on coral mining were imposed, thereby giving a stronger footing for environmental safeguards. Coastal zone between Akurala and Hikkaduwa of Southern



Project Location Map

Sri Lanka was seriously damaged by the Tsunami on 26th December 2004. At Wenamulla, the main road and rail track from Colombo to Galle comes closer to each other and diverges near Uduwaragoda. The number of Tsunami damaged lands and houses in this area are substantially high. It is said that lack of resistive vegetation in this area would have caused aggravated damage when compared with other vegetated areas. After the Tsunami, the community at Wenamulla were resettled at Galagoda area while the community at Uduwaragoda were settled at closeby places which are slightly inland when compared to Akurala. A reasonably large stream called Telwatta Ganga (Lanka Ganga) falls to the sea crossing the A2 Galle road approximately halfway between Wenamulla and Uduwaragoda.

Considering the conditions of coastal area between Wenamulla (121208.15 E,112440.23 N) and Uduwaragoda (22148.41 E, 109803.58 N) in connection with the Tsunami effects, abandoned coral mines, lack of vegetation, close proximity to rail and road, socio economic status of community etc., the approximately 3 km long coastal strip at Akurala having a width of 100 m was selected for the Green Coast Project (PP/Akurala/071, 071A, 071B). Forty-four abandoned coral mines are located within the project area. It was observed from a field survey that most coral mines were more than 4 m deep. Several coral mines were nearly 8 -10 m deep. Very few shallow coral mines were found where the depth was less than 3 m. If the available option for rehabilitation is to fill these polluted abandoned coral mines, then the provision of a huge volume of burrow material required to fill these abandoned coral mines would be an impossible, unfeasible and an environmentally costly exercise. Since a large quantity of earth burrowed and hauled from another location would be required, such an earth moving operation would undoubtedly create adverse environmental impacts in the vicinity of the burrow areas too. It was observed that in the project area, the bund which is constructed along the seashore to protect the land from sea water does obstruct surface drainage paths leading towards the sea coast. Surface runoff accumulates over a large extent of low-lying area in the Akurala region. Water stagnation also leads to health hazards in the project area. Surface runoff pattern and water stagnations were observed and studied in detail through field observations. Poor drainage system in the area was identified as a major problem. Water stagnation fell into two categories: (i) Stagnant water in the abandoned coral excavations and (ii) Stagnant water in low lying or poorly drained areas. Land areas having water stagnation are not conducive for plant growth and hence regreening. Soil suitability, characteristics of soil water, and depth to the water table, are parameters that were taken in to consideration with respect to the determination of plant suitability and their growth factors.

2. Objectives

The main objectives of the Akurala Green Coast project could be listed as follows.

- To rehabilitate the abandoned coral mines and carry out environmental quality enhancement
- To increase the vegetation density of the area through implementation of regreening

3. Methodology

The implementation of activities to achieve the project objectives was taken as three broad areas of field work. They are,

- Rehabilitation of coral mines
- Improving the drainage system and
- Regreening the surrounding environment

Methodology adapted from planning to completion stages and presented in a flow chart indicates the activity linkages.

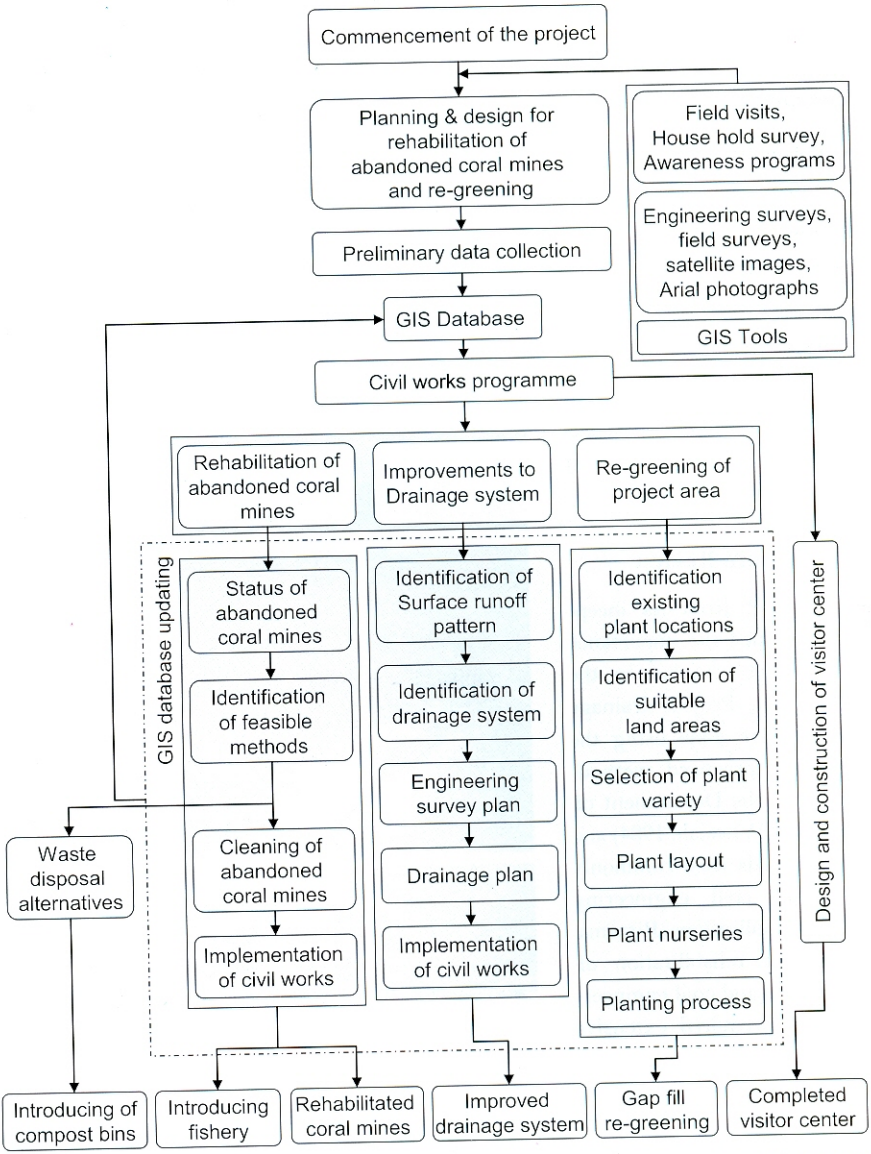
4. Literature Review

The project from its inception identified the importance of drainage concerns in the project area. Project drainage designs were done using the commonly practiced methodologies of the Department of Irrigation (Ponrajah, 1984) and the standards used commonly for other civil engineering drainage applications (Ritzema, 1994). The rehabilitation of coral mines and civil engineering works required extensive use of heavy machinery. In order to perform these tasks with a rational resource mobilization, it was necessary to carry out economical movement of the right type of machinery for selected tasks. Incorporation of drainage systems, quality

Waste Disposed into Coral Mines Leads to Health Hazards

Bund Along the Sea Coast Obstructs Natural Drainage

Field Data Collection to update the Geographic Information System



Flow Chart of Activiting Linkages

control in drainage construction, cost calculations etc., (Nijland et al., 2005) were studied in detail to ensure satisfactory extensions of the project. Regreening of the project area and associated plant identifications were based on the proposed IUCN ecosystem approach. The project carried out the five steps of implementation (Stephard, 2000). to develop a sustainable utilization and conservation strategy with regards to regreening and fish life development.

5. Planning and Design

Having identified the need for rehabilitation of abandoned coral mines without creating adverse environmental impacts to the surrounding area, and while adhering to the requirements of regreening, the following key activities were carried out by the project team.

1. Cleaning the periphery of coral mines through debris moving, earthwork and related civil works.
2. Cleaning the water area of coral mines by removal of debris, heavy and light material, and floating articles.
3. Providing waste disposal alternatives and introduction of fish for the sustainability of rehabilitated coral mines.
4. Improvements to the terrain such as landscaping, drainage improvements and related civil works.
5. Identification and preparation of lands for regreening through assessment of land suitability, location planning, and related civil works.
6. Regreening with proper selection of plant varieties, preparation of plant nurseries, preparation of seedlings, finding plants from other sources, planting on ground, watering, adding fertilizer, gap filling, and installation of plant covers.
7. Construction of visitor center and preparation of associated awareness enhancement material.

6. Primary Data Collection

In order to study the physical features of abandoned coral mines and the land cover of the project area prior to and after Tsunami, collection of available data was considered as an important activity. Information was also gathered from the people living in this area. Aerial photographs, engineering survey sheets and satellite imagery were used to assess the situation before Tsunami. The last engineering survey of this area had been carried out in early 1960's and since then there had been many changes to the surface features and such changes were noted during field visits. This identification was taken into consideration at the project proposal preparation stage.

Therefore, at the commencement of project, a land survey was carried out in the area picking ownership boundaries, permanent structures, major land use features such as abandoned coral mines, roads, drainage lines, water bodies, streams etc. This survey included contour

and bathymetry measurements to identify surface undulations and also depths and shapes of the pits (GSMB 1). To overcome the time constraints for project completion, survey team was instructed to make map submissions on a part by part basis. This method enabled the project resource persons to check the completed maps while fieldwork was in progress. Process of map verifications enabled the identification of drainage and mine pit features which in turn helped (i) to design the project works in a systematic manner and (ii) to avoid missed out works. Any missed out works require additional finances and time for come-back executions when identified at later occasions. Therefore such early identifications were extremely important.

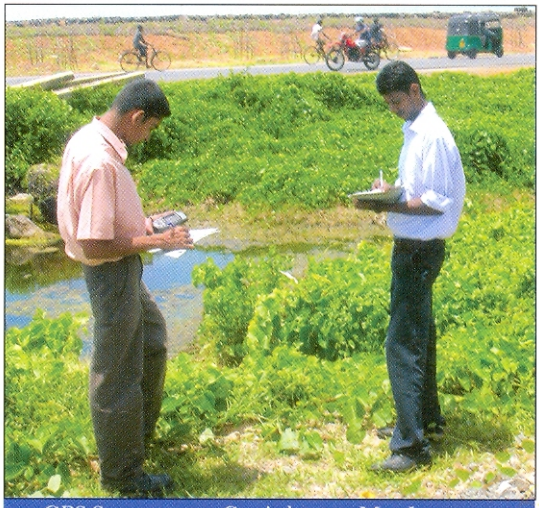
7. GIS Database

The project resource utilization is spread over an approximate land extent of 30 ha with varying features and therefore, any planning, implementation or monitoring would require a map based dataset. Project team having recognized the importance of this requirement developed a structured Geographic Information System (GIS). The GIS included data layers with details of coral mines and other key topographical features. GIS enabled computation of coral mine extents, volume of water in each coral mine, and make presentations of spatial and temporal variation. A GPS survey, which identified the locations of large trees, was mapped in the GIS. Satellite datasets dated 19th January 2004 and 31st December 2004 were available for the study. Satellite images were two important layers of the GIS representing the project area before and after the Tsunami. Drainage maps which were produced with the surveys done specifically for the project, the surface drainage direction maps, and engineering survey sheets of early 1960's were scanned, georeferenced and incorporated into the GIS data set. Data overlaying capability of GIS was used to identify the areas for drainage improvements and regreening. GIS also enabled the finalization of plant layouts including the incorporation of spatial variation of planting locations and type of plants. Suitable locations for visitors to stop by were identified, and to facilitate the same, vehicle parks were designed. The GIS helped engineers to plan civil works, biodiversity experts to identify and plan fauna and flora requirements, and mining experts to identify & map associated features. Progress of the regreening activity and management of plant nurseries, service needs such as transport, heavy machinery, fertilizer and watering, were monitored using GIS tools and techniques.

8. Community Awareness

Several community awareness enhancement programs in the form of small community groups were carried out with the assistance of the village headmen (Grama Niladhari). Project area consists of six Grama Niladhari administrative divisions. The project staff carried out a survey of individual households (ICGAT 3). First formal public awareness program was held on 29th October 2006 at the premises of village temple to explain the project objectives. Resource persons, the village headmen, local political leadership and approximately 70 community members participated in the program. Objectives of the project and key activities such as the project boundary, community participation, long-term and short-term benefits were explained. This awareness program was of significant

help to recognize and erase any gaps and to identify fresh requirements in order to achieve needs in relation to the project objectives while fulfilling the expectations of beneficiaries. Thus, appropriate modifications to the work program of the project could be carried out. The project resource personal encouraged the participant views, ideas, and suggestions of alternatives, even when the project activities were in progress. On 10th November 2006, an overview presentation was made at the District Development Committee (DDC) which is the regional planning and monitoring committee consisting of political leadership and public officials. Two awareness programs on important aspects of bio-diversity and solid waste disposal management were conducted for the school children on 3rd November 2006 and 26th November 2006 at Akurala Vidyalaya, and at Sunday school of village temple respectively. From time to time, Project resource persons made modifications to the work programs, work methodologies etc., in order to attract increased beneficiary participation. Work sequence pertaining to cleaning of pits and surroundings, filling of sites, establishing of nurseries, planting, introducing fish fingerlings etc., were programmed incorporating community suggestions and behav-



GPS Surveys were Carried out to Map Important Features

Seminar of the Awareness Enhancement for the Elders

Boats were Used to Clean the Abandoned Coral Mines

ior. School children were encouraged to support nursery programs and their participation was rewarded with school stationery as tokens of appreciation. Supporting community were given Green Coast T-shirts to enhance enthusiasm. Project team identified and appreciated the inputs of the community towards successful planning and implementation of the project through various techniques and this led to enhanced participation.

9. Coral Mine Rehabilitation

Considering the merits and demerits after a careful study of work loads, cost and environmental concerns, only 06 shallow mines out of a total of 44 abandoned coral mines were selected to be filled as they were highly polluted (ICGAT 4). Debris in the vicinity and those removed from the neighboring coral mines, were dumped into such mines. A soil layer scraped from the surrounding area was placed on the surface of filled mines to facilitate growth of vegetation (ICGAT 5). Looseness of material below the surface was purposely maintained to ensure water storage below the surface. Land owners of abandoned coral mines were informed to commence a cleaning program for their home gardens on a voluntary basis. Participants were informed that their enthusiasm and voluntary contributions would be treated as positive signs for the forthcoming contributory inputs by the project through its activities. Voluntary cleaning was promoted for approximately one and a half days. Home garden cleaning was conducted under direct supervision of the project resource personnel. This activity was an eye opener for the neighborhood community and the wide participation was an encouragement to the project resource persons. The program volunteers were provided with food and refreshments.

Thereafter commenced the abandoned coral mine rehabilitation which could be described as the most difficult and resource consuming component of project work. When manual labor employment was necessary for rehabilitation work, the project area labor was given priority. For some coral mines which were significantly deep, small boats were deployed to clean water areas. In case where such debris removal was not effective, barge mounted excavators were used to clean and remove heavy and bulky material. Debris removed from coral mines were dumped to the pits which were identified for filling. There were significant quantities of Tsunami debris scattered over the land area and in mine pits. All debris could not be accommodated in the pits selected for filling. Nor could they be economically transported to other pits by spending within the project's financial allocations. Having recognized the need to demarcate the boundaries of pits for easy identification during floods, and the need to prevent surface runoff easily carrying waste into rehabilitated ponds, project resource persons designed small bund formations around the pits while keeping sufficient openings to facilitate surface flows under gravity. These bunds were of approximate trapezoidal shape, and machine made using Tsunami created broken cement, brick, and concrete material. Such formations were topped with soil scraped from adjacent area without disturbing surface drainage flows. Manual labor was utilized for the finishing works of these machine made bunds. Dump trucks were used to transport debris. Heavy machines such as excavators, wheel loaders, track loaders etc., were used for civil works (ICGAT 5). In most of the coral mines, heavy solid blocks were found as debris, which were broken

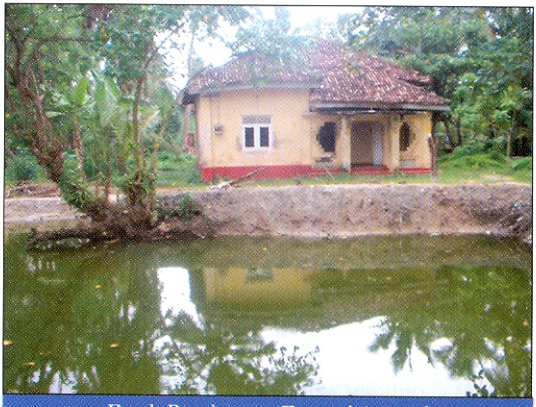
parts of houses and concrete posts swept and dropped in the pits as a result of the Tsunami. Such debris were removed with the use of heavy machinery, boats and manual labor. Some very heavy concrete pillars such as broken street lamp posts and telecommunication posts could not be removed because of their size, weight and as they were partly buried in mud. Three abandoned coral mine owners objected to carrying out any rehabilitation activity in their pits other than filling them. As filling was not the option identified by the project, these pits were left alone.

Use of Heavy Machines for Mine Pit Cleaning

Tsunamii Debris were Removed Using Machines

10. Introducing Fishery and Compost Bins

Project as it's objectives targeted the introduction of fish life in the rehabilitated abandoned coral mines. Biodiversity resource person after a study identified fish species that could be introduced (ICGAT 9). Community consultations were initiated to identify the ownership of the rehabilitated mines and also the fish life. Community in the neighborhood of each coral mine pit formed into groups and indicated the arrangements for maintenance of each mine pit. The community on a previous occasion were exposed to a demonstration field trip to Udawalawe Inland Fishery Center and therefore were well aware of the benefits from the



Earth Bunds were Formed Around Rehabilitated Coral Mines

growing of fish. Fish fingerlings were donated to each pond and a total of 34,500 fish were released. Rehabilitated coral mine environment requires to ensure the sustenance of environmental quality and this depends largely on the actions of stakeholder community. Project identified the solid waste disposal problem and to overcome this aspect community awareness programs were executed. To facilitate environmentally sustainable waste disposal, concrete compost bins were distributed. A total of 67 were distributed within the project area community. The project team arranged for the transport and assembly of the bins at the respective households. After completion of the phase I of the project a sample survey was carried out to assess the use of compost bins and it was revealed that approximately 52% of households were making the right use whereas 24% were making use, but not in the right way. However, 24% were still not making good use of the support given by the project.

11. Drainage Improvements

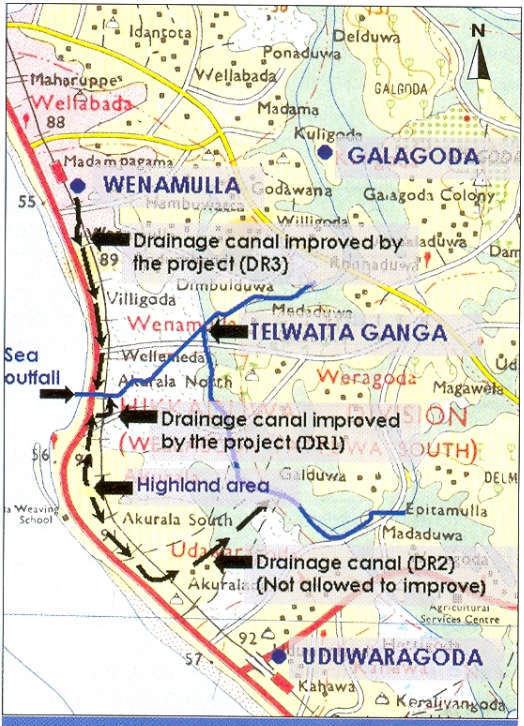
Identification of flooding experiences during field inspections carried out by resource persons and the desk studies with topographical and survey maps, revealed the need of surface drainage improvements in the project area. Project maps indicated that in general the terrain was undulating and at some places surface water naturally drained into mine pits whereas in some cases the community had diverted surface drainages into mine pits. Two main drainages were visible near the eastern boundary. One flowing along the Eastern boundary of the project area towards the northern direction and past the railway station (DR1). The other one was draining out of the Eastern boundary and flowing in the opposite direction of the station (DR2). Both drainages crossed the railway line to flow in the direction of low lands bordering Telwatta Ganga. The drainage flowing along the track towards the railway station consisted of a length of about 1 km, and required significant cleaning if the drainage problem of the project area is to be eased. Though this was a major expenditure item dealing with an area outside the project boundary the team executed the work considering the importance of project sustenance. The other drainage was purposely blocked at the railway line drainage crossing. This was because there were Tsunami relief houses built by blocking a natural drainage path at a down stream location. This blocking also needed clearing since drainage characteristics of the Akurala Project area were to be improved by the project to ensure community convenience along with the development of an environment suitable for regreening activities. Resistance from the owners of Tsunami relief housing resulted in abandoning the clearing of that drainage (DR2). Project team having designed the other drainages, suitably cleared a total of 2.5 kilometers of drain.

Another drainage canal which crossed the project at the Nothern boundary close to Wenamulla was flowing into the project area (DR3). Though the 1960 Engineering Survey Sheets (ES) indicated a clear drainage path leading to the Telwatta Ganga, the present field conditions did not indicate a flowing connection at this location. This drainage which brought significant surface water from watersheds in the Wenamulla area was draining into one large coral pit causing flood threats. This drainage had to be developed creating a

canal almost parallel to the rail track linking the Wenamulla drainage to Telwatta Ganga through large abandoned coral mines between the A2 Galle road and rail track. These two major drains and other less permanent drains were improved by using a combination of heavy machines and manual labour.

34,500 Fish Fingerlings were Released into 27 Pits

As previously indicated, small earth bunds were formed around the cleaned coral mines. The constructed bunds were compared with the drainage plan to identify locations where surface drainage under gravity should be facilitated into the pits through natural drainage paths. Such locations of bunds were opened for natural drainage with the use of either machinery or manual labor. Heavy machinery such as bulldozers and track mounted or wheel mounted backhoes were used along with manual labor to complete the drainage improvements required for the project area.



A Total of 2,500 meter of Main Drainage Canals were Improved with Machines

12. Regreening

Vegetation over landform is of immense importance for land stability and this is especially so in coastal areas. In area adjacent to coast, the plants perform as barriers that dissipate wave energy. Dune vegetation captures sand to support its vertical growth and enhances the protective function. Shorter trees and shrubs function as good wind shelterbelts. Other associated benefits that coastal vegetation offer include conservation of biodiversity, provision of

livelihood support for coastal communities through forestry crops, extending shade for humans and fauna, contributing to recreational activities and enhancing scenic beauty. The planning of regreening consisted of soil quality testing to identify soil types and textural quality to assess the regreening capability, drainage needs, and fertilizer requirement. Regreening activities needed the assessment of fauna and flora of the project area and its surrounding environment. A rapid biodiversity assessment was carried out to integrate the existing biodiversity into the project design, to select suitable plants for regreening, and to identify suitable species of fish while ensuring eco system stability (ICGAT 6). Based on the rapid biodiversity assessment a preliminary plant list was prepared. The surveys carried out revealed that the project area harbors a variety of natural, sub natural, and man made habitat types including both terrestrial and wetland systems. Based on the structure and compositions and human distribution gradient, four main habitat types were identified within the project area (ICGAT 7). They were the (i) open water and associated vegetation (ii) beach vegetation (iii) home garden and cultivated land and (iv) roadside vegetation. Biodiversity of these area was studied and due considerations were given when selecting plant and fish. Uses of multipurpose trees and shrubs, high adaptability to saline conditions, and the sea breeze resilience, resistance to wind, and growth rates were also taken into consideration while selecting plant species. For the phase one of the project, the plant species were proposed for the regrouped zones as indicated below.

Recommended Plant Species for Different Zones in Regreening the Area		
Item	Zones	Plants
01	Open water and associated vegetation habitat	Bamboo, Goda Kaduru, Lotus
02	Beach vegetation habitat	Pandanaus, Gan Suriya, Mudilla
03	Home garden and cultivated land habitat	Mudilla, Coconut, Kottamba, Mahogani, Teak,Pihimbiya, Arecanut, Domba
04	Roadside vegetation habitat	Mudilla, Kottamba, Lettakochchi, Domba

13. Layout

Regreening layout was prepared by considering existing land cover, land use and topographical features of the project area. Topographic maps of 1:1000 prepared for the project were utilized for layout generation. Satellite images acquired before and after the Tsunami were used for visual identification of areas vegetated, non vegetated and occupied by coral mines. A GPS survey was carried out to verify the details observed in the satellite images and to acquire new or missing details or details which were ambiguous in satellite imagery. In order to update the land cover and topographic information of the project area, a comprehensive field survey was carried out. GIS map layers were used to prepare

the plant layout. Project GIS enabled the comparison of many alternatives for plant layouts. At the initial stage, land use planners of the project targeted each 500 m of the road to be of a different plant variety. However due to restrictions of plant nurseries, the types were later restricted to Moodilla, Lettakochchi, Pihimbiya, Kottamba and Domba only. Plant spacing used during regreening of home gardens and unused private lands was at an approximate distance of 3 meters. The road side regreening layout planning needed careful consideration because the country did not have a guideline on such tree planting. Deficiency was both in the lack of guidelines for plant type selection and guidelines for the identification of spacing and distances. In this connection, the road authorities, local government authorities, the road users etc., were having different opinions. In order to arrive at a reasonable answer to the question of planting distance from the road edge, a survey of existing trees/plants were carried out. Based on the study results, the minimum distance of a plant from the road edge was established as 1.5 meters. The project in its first phase planted two rows of trees along the A2 road and the distance between two plants in the lateral direction was 1 m. The plants of a row fell into the center of the other row. In both plant rows the spacing in longitudinal direction of the road was taken as 3 m. Plants were placed in holes of 15 cm x 15cm x 23 cm and filled with earth. Coir dust was placed on the top surface to store and maintain moisture.

14. Planting

Planting activities commenced in mid November of 2006. Plants were from the Forest Department, the State Timber Corporation, Mahaweli Authority and from project specific nurseries. Mudilla, Pimbiya, Lettakochchi, Kottamba, and Domba were planted along the roadsides. Pendanaus were placed close to the seacoast. Mahogani, Teak, and Pihimbiya were distributed for home gardens. Bamboo and Goda Kaduru plants were placed around the rehabilitated coral mines. Domba, Coconut, Pandanaus, and Arecanut were planted in other open lands of the project area.

At the plant count, it was found that altogether 4654 plants had been in place at the end of Phase I in March 2006. Thereafter plant watering was continued and fertilizer was added from time to time. As the plants were to experience dry weather from January to April, all these plants needed shading from sun and wind to reduce moisture loss. Therefore, the plants were shaded and covered with the use of coconut branches. Coconut branches could be easily found and are environmentally friendly due to their biodegradability. During the drought weather, plant watering needed to be continued at a rate of twice a day. With the drought, a low-recharging rate was experienced in the dug well from which water was taken for the plants. Water had to be pumped from a rehabilitated coral mine using a fuel operated pump to ease the load on the dug well. A one thousand litre tank placed on a tractor trailer was used as a mobile watering truck.

15. Progress Monitoring of Plant Growth Rate

Growth of plants was monitored regularly. Since a maintenance program was forthcoming as the second phase, few persons were engaged to take care of the plants. This group

Improving DR3

was to attend miscellaneous work such as making arrangements for watering plants as and when necessary, cleaning around the plants, adding fertilizer etc. At regular intervals, project resource persons supervised the work and monitored the progress. It was observed that some varieties such as Pihimbiya and Domba did not show signs of survival along the roadsides and close to the coast line. Lettakochchi plants initially showed a rapid growth, but were destroyed in total due to the heavy sea breeze experienced in the period between June - July 2007.

As a result of rough seas and seawater splashes the regreened plants near the coast protection bund were damaged. However, it was a pleasure to note that Teak and Mahogani plants had shown a healthy growth in the home gardens where they received reasonable protection. All plants which received protection either from another tree or a man made structure had grown very well. Bamboo trees planted around pits which were in the middle of dwelling units survived the rough season. Mudilla plants which were planted in the designated Eco-Park grew well since this area was shaded by the coast protection embankment and also because these were at a lower elevation than the road embankment. Even in Mudilla leaves one could observe damage in places exposed to the sea breeze.

A plant count survey carried out by the project team after seven months identified that about 1900 plants (42%) survived by August 2007. Though the protection to the plants provided by coconut leaves was considered as an environmentally friendly and sufficient option, it could not provide sufficient protection from strong sea breeze. Consultation with people who had saved their valuable timber plants revealed that a plant cover of polythene would save plants and that once the plants reached a height of approximately 1 m then the plants would be out of danger.

16. Gap Filling and Maintenance

Phase II of project commenced with the evaluation of status of plants, status of rehabilitated coral mines, growth of fish, use of compost bins and status of waste disposal in the project area (ICGAT 13). Plant survival rate was 42% and the compost bin usage was only about 52%. Identifying the need for new plants for gap filling, plant nurseries were commenced in the month of August 2007. June and July being the rough weather months, this was the earliest possible time for commencement. Evaluation survey revealed that Mudilla

variety had survived the bad weather. Therefore, new plants for gapfilling were restricted to the most commonly found Mudilla variety. Gap fill planting process was started with the commencement of monsoon rains. At the start of the monsoon rains, new green leaves appeared in the Mudilla plants which appeared as dead during the rough period. Godakaduru was planted around the rehabilitated coral mines.

In order to protect new plants from direct sunlight, the plant cover was made out of black polythene. Cover was so designed that it enabled vertical direction air circulation from the bottom and from top of the cover. Protective cover for the reasonably established plants but yet to reach the level of surviving critical winds, were covered with transparent polythene. Color of the polythene protection was the only change made from transparent to black. The transparent polythene was expected to provide shade from sea breeze but enable sunlight to pass through thereby facilitating plant growth. A frame made out of tree branches was used to hold the polythene which was protecting the plants. A cylindrical polythene cover was fixed around the frame. Gap filling staff noted that stray cows had eaten the

DR1 after cleaning

Project Maintained Plant Nurseries

Regreening Activity

leaves of plants after damaging the the transparent polythene cover protection. It was also noted that that cows did not eat the same plant variety which was not covered, but had only eaten the ones which were covered with transparent polythene. This was not observed in the case of black polythene. Therefore as a remedy, black polythene was used to cover the remaining plants and the plants that required repair. Black protection cover obstructs sunlight entering the plant through the sides. Vertical growth rate of plants covered in black was noted much higher than the plants covered with transparent sheets. Only difference was that in the black polythene cover sunlight reached the plant only from the top. By growing at a rapid rate, the plants covered with black polythene very positively contributed to the project expectations.

Plants were cleaned of weeds during the maintenance period. Fertilizer and coir dust were added to each plant. Matured plants or the new gap-fill plants did not require watering during the monsoonal rains. However, during the inbetween dry periods, all new plants were watered by the maintenance crew. Gap filling was successfully completed except in places where the community restricted. Some such places were, the new playing areas identified after land clearing, new dwelling unit construction sites, and at some road side boutiques which encourage car parking by the side of the road. Approximately 560 plants which were destroyed due to such actions could not be gap filled.

17. Visitor Center

Pradeshiya Sabha Hikkaduwa which is the local government administration responsible for the project area, agreed to provide land, water and electricity for the Green Coast Visitor Center. Pradeshiya Sabha also agreed to carry out maintenance work of the center after the project duration. The project team having visited the land and vicinity designed the center to suit the objectives and financial allocations. Having recognized the importance of a reasonably strong structure, the project team after detailed discussions agreed on cost cutting methods to enable a strong masonry built structure having an asbestos roof on steel columns. Civil engineers of the project team designed foundation and other components including the roof. The visitor center consists of an open verandah and a room which can be kept under lock and key. Room and it's walls are to display the details of project implementation and about the surrounding environment. The center is provided with water-sealed toilet facilities. Benches are constructed in the verandah by elevating the side walls and tiling to enable easy usage. In the visitor center there are 10 benches. Two of similar benches were constructed on the sea side of the visitor center. The center consists of 50 sq. meters. A display hoarding in front of the visitor center displays the project area map overlaid on pre and post Tsunami satellite imagery. The hording also shows pictures of key environmental interrests and locations.

Green Coast Visitor Center was designed based on several key considerations. The center was provided with adequate area (i) for viewing the surrounding environment and also (ii) for displaying awareness documentation in the center. A room was provided to keep awareness enhancement material whereas the verandah with seating arrangements were built for visitors to appreciate the surrounding environment. Visitor Centre floor level

was designed to be at a significantly higher elevation than the natural ground. This was to enable the visitors to have a good view of the beautiful beach of Akurala. Roof shape and slope directions were determined to manage the wind effects during rains. Positioning of the building was adjusted to enable vehicle parking and to build a sample waste disposal facility. The surrounding area was also regreened with an adequate number of plants to facilitate the visitors to experience the project area objectives of regreening and environmental waste disposal.

18. Conclusions

1. Abandoned coral mine rehabilitation programme was completed according to the targets of the work plan. The scientific approach incorporated through available data, field surveys, and systematic quantifications enabled rational planning and implementation of the project. Work was successfully completed with the available finances while adhering to the stipulated time targets.

2. Drainage planning was very important for successful regreening and achieving desired quality of mine pit environment. Drainage designs need to look at the surface undulations both on map and in the field. This project through systematic design and careful planning, developed a suitable drainage network for the project area. Drainage improvement work required in the South-Eastern boundary was protested by the Tsunami housing occupants downstream of the project area. This was a critical issue as it was later noted that the regreening in the affected area was not quite successful due to the unsolved drainage problem.

3. Project implementation activities identified that it is extremely important for a project to carry out detailed drainage studies prior to implementation in order to satisfactorily achieve project objectives.

4. Regreening of project area was completed with suitable plant layouts. Layout preparation was carried out after detailed considerations by team members. Project team identified that layout preparation needs guidelines and there is a strong requirment to establish such documentation. The project work through a scientific approach determined the regreening layouts and these could be used as initial values for similar applications.

5. Regreening activities should be coincided with rains for increased effectiveness of achievements. Project in its Phase I encountered the difficulty of working through a dry season which required watering of plants. This was a very expensive activity. This was unavoidable because of the time targets of the project. Phase II of the project was planned to coincide with the rains and therefore watering works could be reduced to a minimum. Regreening project planning requires work scheduling according to weather patterns and this was clearly identified during the Akurala Green Coast Project implementation.

6. Visitor Center construction should incorporate important factors such as information dissemination space, space for experiencing the environment, facilities for visitor

convenience, and visitor acceptability during bad weather. The Green Coast Visitor Centre was designed and constructed incorporating user friendly layouts that are suited to achieve the project objectives.

A Hand Tractor with a Tank and a Pump was Used for Watering

(i) Affected Young Mudilla Leaves Near the Coast
(ii) Eco-Park Plants Received Protection

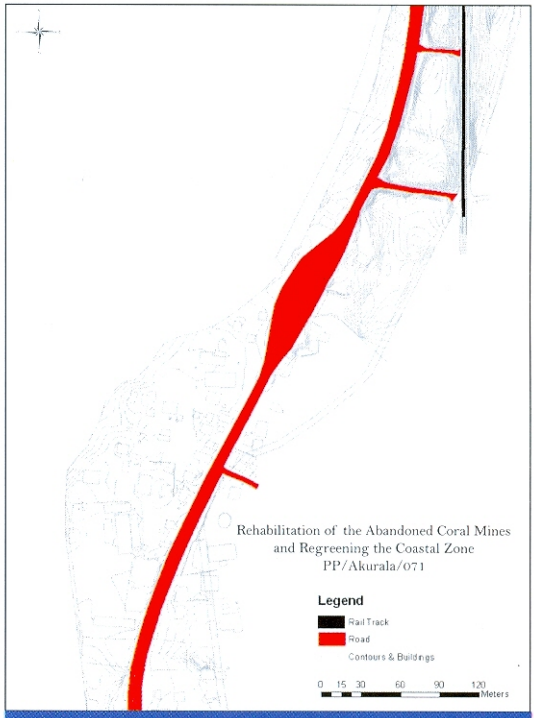
Polythene Covers were used for Plant Protection

Chapter 3

Geoinformatics for Planning, Implementation and Monitoring of the Akurala Green Coast Project

1. Introduction

Environmental degradation due to human activities is on the increase and among these, mining of earth resources is in the top of the list. Mining of earth resources without control would cause major environmental problems to both natural features as well as man made structures. Therefore, rehabilitation of natural environments where such problems have occurred is an urgent need in order to secure the environment for the benefit of future generations. Rehabilitation of abandoned coral mines and regreening the Tsunami affected coastal belt at Akurala in Galle District aimed environmental enhancement at a place which had got deteriorated due to mining and also due to the Tsunami of 2004. Akurala Green Coast Project area is a coastal strip of 3km long and having a width of 100 meters. The project which had its initial phase of rehabilitation of abandoned mines and regreening, spanned from September 2006 to March 2007. Duration of the second phase and the third phase of plant maintenance, gap filling, establishment of an information center and developing public awareness material was from April 2006 until December 2007.



GIS Maps of Project Area

The project consisted of a large number of activities that had to be executed at different time points. Locations of activity execution was spatially scattered over the project area. Project required the tasks to be completed within a very limited time. Therefore, the project activities needed to be planned, executed and monitored with the use of a suitable information system. Present day information technology tools such as Geographic

Information Systems (GIS), Global Positioning Systems (GPS), and Remote Sensing (RS) are considered as powerful spatial resource management instruments having the capacity to overlay spatial information for easy and rational decision making.

Akurala environmental enhancement project was implemented with Community, University and Regulator Partnership (CURP), as a flagship project for larger environmental enhancement projects. Therefore since the inception it was of immense importance that the project be well planned and managed to ensure timely completion to the desired quality. As such, the Abandoned Coral Mine Area Rehabilitation and Regreening the Associated Coastal Strip project at Akurala incorporated and integrated Geoinformatics for Planning, Implementation and Monitoring activities. Geographic Information System (GIS) developed for the project played a key role in the selection of project area according to the objectives, project planning, its implementation and monitoring of activities.

2. Objective

The objective pertaining to the utilization of Geoinformatics was to facilitate the project leadership and resource personnel with the required data capturing, storage, analysis and retrieval for the identification of project status and its implementation alternatives thereby leading to rational decision making.

3. Literature Review

Use of Geoinformatics for project planning and implementation requires the planning of database with a suitable assessment of its desired outputs and thereafter identifying the requisite inputs to arrive at the database structure and format (Longley et al 2001, Load Yeung 2005). GIS database creation requires a logical design approach. The design guideline of the Manual on GIS for Planners and Decision makers was taken as a reference for organizing the GIS Database (UN 1996). The project which covers a low lying coastal area susceptible to flooding, requires suitable inputs for the creation of terrain maps incorporating remote sensing, GPS and GIS. Identification of current mapping technologies and technologies that are appropriate was carried out with the consideration of needs and accuracies (NAS 2007 – 1). As the project involved planning and implementation activities, the following were considered in the development of Geographic Information System. Information access and dissemination needs, supporting the integration of data from multiple sources, aspects of developing data models and knowledge organization systems are some such considerations that are of great importance in laying out the foundations for geoinformatics use (NAS 2007-2).

There are many challenges to overcome when developing a land parcel database and these fall into two main categories called Technical and Data challenges. The Dynamic nature of records, external distribution of parcel data, quality of existing data, reconciliation and matching of different agency data, multiple coordinate systems, inconsistent practices and inconsistent data standards etc., (NAS 2007-3) are necessary to be dealt with when developing land information systems. Though the objective of the Geographic

Information System was not to carryout any environmental modeling, it was necessary to look into such aspects since in future this database used for the project may also be used for such purposes. Aspects of GIS for modeling of ecological/ biological systems (Morain 1999) and applications of GIS for natural resource management (Good Child, Parks and Steyaert 1993) should be considered for such needs.

4. Methodology

4.1 General

Satellite images, topographic sheets, and land survey maps were used for extraction of spatial data such as terrain conditions, vegetation pattern, administrative boundaries, abandoned coral mines, and natural drainage network pertaining to the project area.

4.2 Database Creation

GIS Database was developed using the ArcGIS software. Data layers to be incorporated were both in raster and vector formats. All data were georeferenced using the Kandawala Datum which is the standard of the Survey Department of Sri Lanka. The GIS was developed according to the Geodatabase technology of ArcGIS. Data were grouped as scanned maps, satellite remote sensing data, and vector data. Vector data were further categorized as the base data and temporal data. Temporal data contained time to time information of various project activities.

GIS database extensively used the hot linking feature to facilitate decision making from the ICGAT office at the University premises. Hot linking included separate layers to link photographs and movie clips. The project resource persons developed a standard layout format by specifying the scale for planning of progress maps. Survey data were in CAD format and therefore needed careful checking and corrections that are compatible with ArcGIS computational facilities. Attribute tables and site data collection sheets were so designed that the project progress data from field office could be directly imported to the GIS Database. Base data set of the project consisted of seven layers.

Field data collection by project staff utilized Magellon Platinum handheld GPS equipment, and Olympus and Cannon digital still camera and Sony video camera for data capture. Field data layers which were collected and prepared by project staff consisted of 11 main data layers.

The progress monitoring map layers mainly consisted of implementation details of the regreening activity. GIS enabled the visualization of work progress with the use of it's map interface while providing the resource persons with quantitative values for decision making.

4.3 Proposal Development

At the project proposal development stage, the Green Coast Programme had identified priority locations for Grant-Support which indicated Hikkaduwa as a priority area.

Base Data Consisted of Seven Layers.	
Item	Data Layer Description
1	1:50,000 Topo Maps of Survey Department
2	1:1000 Contour and Detailed Survey Maps from GSMB
3	Quickbird Multispectaral Images Pre and Post Tsunami
4	Engineering Survey Sheets of Irrigation Department
5	Administrative Division Map with Grama Niladari Boundaries
6	Project Area Boundaries
7	Road Map

Therefore, available Tsunami effect information and maps pertaining to locations around Hikkaduwa were assessed on a GIS. Based on these Information it was identified that Akurala area was a probable location to provide assistance. Field visits and GPS measurements confirmed that Akurala area had only little vegetation. Most vegetation in the area were damaged by the Tsunami. Rates for typical work execution were compared to calculate project cost for a specific spatial extent. Trial areas were identified and with the use of GIS tools, feasible extents that fitted the grant allocations were calculated. Alternatives were costed with already identified rates and compared in order to identify the optimum values. After careful consideration, the proposal for regreening and rehabilitation of a 3km coastal strip having a width of 100m at Akurala was submitted to the Green Coast Programme.

Field Data in the GIS were in Eleven Layers	
Item	Data Layer Description
1	Existing Vegetation
2	Coral Mine Pit Status
3	Plant Layout Design
4	Eco-Park and Car park Layout
5	Biodiversity Zoning Map
6	Houses and Key Features
7	Main Drainages
8	Spot Heights
9	Contour Map
10	Soil Sample Survey
11	Water Sample Survey

4.4 Project Planning

Along with the award of project implementation task to ICGAT, collection of GIS data layers commenced. The project resourse personnel started detailed planning to strengthen

activities that were identified at the proposal development stage. Data collection including the collection of already available data and newly identified data was commenced. The following were the actions which were executed with the incorporation of Geoinformatics at the planning stage.

GPS Surveys were Carried out to Map Spatial Information

4.5 Drainage System

Contour map of the area, topographic maps, and engineering survey sheets were compared and a drainage direction map was prepared on the GIS. This drainage direction map overlaid with existing drainage structures was used to assess the problems of flooding which ware expressed by the project area community. Lengths of drainage that needed to be cleared or excavated with heavy machinery were computed using the GIS. Minor drainage improvement requirements were also assessed and estimated.

4.6 Coral Mines

A data layer named Coral Mines incorporating the spatial coverage of each mine, pollution levels, average depths etc., was prepared. Surface area of each pit was computed in the GIS to assess work quantities. Based on coral pit locations, a machinery deployment plan was drawn. The attribute information such as mine pit area, perimeter, average depth and status/condition were incorporated in GIS maps.

4.7 Soil

Initial investigations identified soil types and soil quality pertaining to the project area and vicinity. These data were utilized in the assessment of plant type, watering and

Photographs and Videos were Hot Linked in the GIS

fertilizer needs etc. Attribute data incorporated in the GIS pertaining to soils were (i) pH (ii) Salinity (iii) NO_3^- (iv) Mg (v) K (vi) CO_3^- and (vii) P.

4.8 Social Survey

A house-to-house social survey dataset was incorporated in the GIS Database. Collected data were spatially viewed to identify community clusters in comparison with land ownership and distance from coast. Attribute entries of address and photographs enabled easy access and such details were very helpful when organizing awareness programs.

4.9 Satellite Imagery

Two remote sensing multi-spectral optical imagery pertaining to Quickbird satellite having 0.6 m resolution and belonging to before (19/01/2004) and after (31/12/2004) Tsunami were acquired and incorporated in the database. These were used to assess vegetation loss after the Tsunami. Vegetation polygons pertaining to the said points of time were created on GIS and the spatial area differences were used to compute loss of greenery. This layer was very useful to identify physical features such as low lying area, and man made constructions such as the bridge, temples, school, main road and rail road in the project area. Overlaying of these two temporal images was carried out. GIS software capability to make one-georeferenced layer transparent over the other, was used to compare one with another to carryout an assessment of the spatial extents that are to be regreened and the location of mines that are to be rehabilitated.

4.10 Land Survey

Close contour data of detail survey which had been done to a scale of 1:1000 were in CAD format. These data were imported to the GIS dataset and georeferenced. Elevation data were taken to the GIS as attributes of contour line features. This data layer assisted the identification of drainage directions leading to the finalization of drainage improvement needs.

4.11 Plant Survey

A handheld GPS survey was done in order to map large well grown trees in the project area. In the GIS, survey data were overlaid with satellite imagery to improve plant cluster maps and to carryout other assessments needed for regreening work. Plant survey GIS layer mapped approximately 3,500 well grown trees. The tree types and growth were indicated in the attribute tables of GIS.

5. Project Implementation

5.1 General

Project implementation is the execution of project plan. In case of project implementation it is necessary for a manager to isolate an activity or a few activities and then to identify resource requirements. A GIS ena-

bles easy implementation because spatial needs can be assessed on a map interface while attributes enable the recording of work execution on a temporal basis. Thus a GIS supports a manager with resource planning and utilization incorporating spatial-temporal variations. In this project each activity was implemented with the use of dedicated GIS layers which stored temporal implementation data in layer attribute tables.

5.2 Regreening Area

Regreening location selection and determination of plant types according to spatial zoning was done by overlaying the biodiversity-zones layer, the existing vegetation layer, and the project boundary layer. Once the broad outlines were determined, buffering tool was used to identify zones adjacent to the main road where planting of trees was not possible. Also the areas of coral pits where rehabilitation was done and their adjacent zones were identified through a GIS buffer. A two-line green layouts for regreening along the A2 road was demarcated on the GIS and this enabled easy identification of spatial locations where two layer planting was not possible. In the GIS, plant locations were incorporated as a point theme with the variety, height, date of planting etc., incorporated as attributes.

5.3 Coral Mines

Abandoned coral mine pits were identified either for rehabilitation or for filling. Map of coral mines was studied with field observations and selections were made based on the degree of pollution, surface area and volume to be filled, haulage of debris in the surroundings, drainage direction etc. These identifications were carried out with simple GIS computations and overlay comparisons. GIS enabled the graphical presentation of coral pit distribution in the project area. GIS layer indicating the 44 mine pits in the area was used to map the temporal achievements made with rehabilitation activities. The GIS maps enabled visualization of mine pits that were not permitted to be cleaned by the community due to land ownership disputes. Such locations were studied on the GIS maps along with other information such as land ownership and drainage directions to identify alternatives that would minimize damage to other areas. GIS based computations indicated that the 35 rehabilitated mine pits covered a surface area of 54,000 square meters which is 93% of the total abandoned mine pit area within the project boundary.

5.4 Car park/Leisure Area

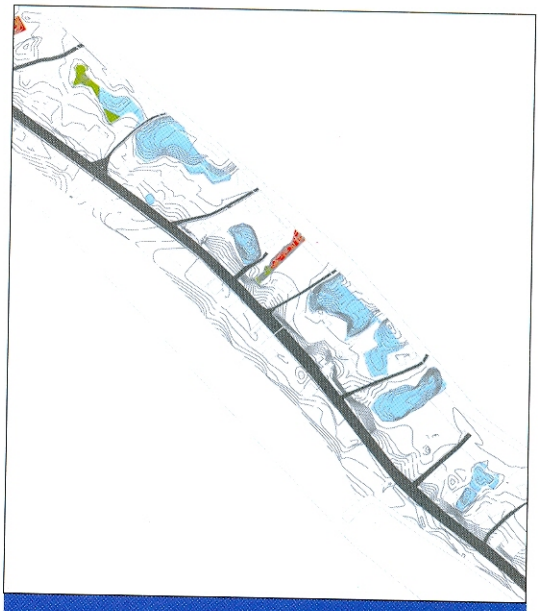
Project resource personnel identified that due to the advantage of Akurala being located approximately at the mid point between Colombo and Matara, it would be suitable to establish car parking & break journey locations for the passing by road travelers to enjoy the environmental strengths of the Akurala area. Plant layouts were modified on GIS to enable easy vehicle parking.

A leisure area was developed adjacent to the car park near the bridge and was named as the Eco-Park. The Eco-Park location by the side of the road, and between the road and the rail track, facilitates a visitor to take a stroll through a cross section of the regreened area

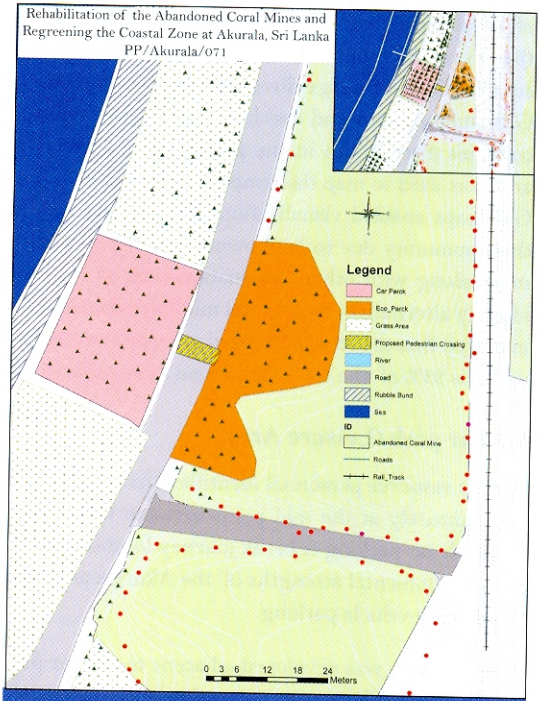
and to appreciate the surrounding environment which has been enhanced by mine pit rehabilitation work and regreening work. Earth filling and tree planting layouts were suitably designed and the implementation activities with close supervision were carried out with the facilitations by the GIS.

5.5 Drainage System

After field observations, the main drainage paths that were blocked as a result of the Tsunami were identified on GIS maps. Implementation of necessary excavation works to clear the drains were supervised using GIS. This was extremely useful as the GIS enabled mapping of heavy machine movement from one place to another. It is important that such machine movements are made in a least cost manner. When heavy machinery are deployed in areas where the works are spatially scattered, it is always possible for machine idle times to exceed the working times due to delays in moving machines from one place to another. Since project work was spatially scattered, and not easily measurable, machine owners did not operate for quantity of work but only hired the machinery. As hiring included a charge for idling time as well, it was important to reduce unproductive time periods. The GIS visualization and the identification of time variations of machine stations on



Maps of Coral Pit Rehabilitation Status were Prepared

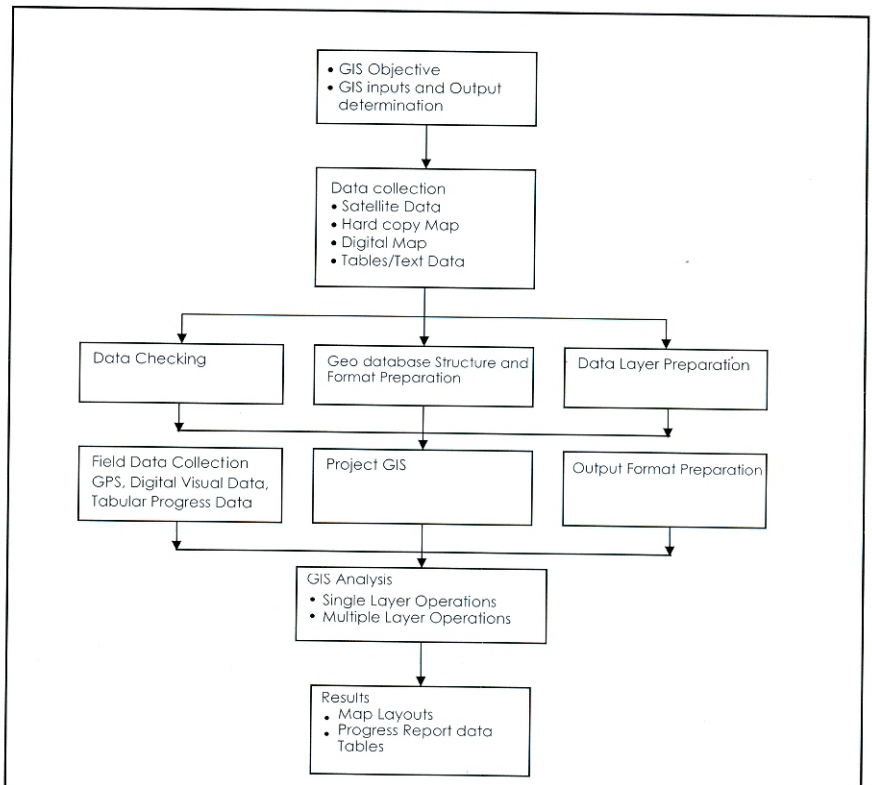


GIS Assisted the Planning and Regreening of Eco-Park

map enabled cost effective implementation of the drainage cleaning work. The GIS also facilitated the calculation of excavation workload pertaining to each main drain that was cleared with machinery. Such calculations enabled the assessment of periodical resource requirements thereby identifying the efficiency of implementation. Once the generation of drainage layer was done in the GIS with the use of satellite images, survey plans and field survey spot heights, then the GPS field measurements were incorporated to locate critical locations which required either widening, digging or construction of bunds.

6. Monitoring

Monitoring of project progress is an aspect as important as the preparation of workplans either prior to or during implementation. Actions of implementation would require resource allocations and mobilization, whereas monitoring is to comparatively assess the implementation against a plan or a target. Monitoring would enable the assessment of resource utilization efficiency. Such a comparison on a temporal scale would facilitate identifying the degree of achievements targeted by a project.



Geoinformatics Played an Important Role in Executing the Project

GIS and GPS together performed as excellent monitoring tools. Field data collected from time to time were incorporated in the GIS to assess the progress of work against project targets. GPS field measurements, digital photographs and video clips were extensively used in the GIS as hotlinks of work at site. The regreening activities were marked as point features incorporating monthly progress on plant counts, while plant variety information were included as attributes in the GIS data tables. Monitoring of progress was carried out for machine deployment, regreening, cleaning of coral mines, construction of visitor center, completion of Eco-Park etc., through periodical field office reports containing quantity of associated work, GPS locations and digital photographs. Monitoring also included the comparison of progress in gap filling and placement of polythene covers. An evaluation survey was done immediately after the 2007 June-July period to identify the status of rehabilitated coral mines, use of compost bins, and efficiency of plant establishment with covering as a part of regreening activities.

Such details mapped in the GIS along with hotlinked photographs and movie clips, were utilized to assess the situation and then to programme future activities. GIS maps prepared using evaluation results clearly showed that the plants which had received a reasonable cover from the sea breeze & splashes had survived the rough season period while those which did not receive protection had failed. Also the resource persons could identify the plant varieties that had survived along with the respective locations. Such evaluations enabled appropriate gap fill planning, which was executed as the Phase of the project. During the evaluation and gap filling period it was noted that planting could not be done in some places where plants had been established during Phase I. These locations were marked and reasons were identified. It was noted that in these places human activities had caused such inability whereas in other places the reason was bad weather. Geoinformatics use in association with project activities as identified in a flowchart expressed the significant role played by these tools.

7. Results

7.1 General

The results of Geoinformatics application were the maps and tabular data pertaining to project objectives. Results delivered the spatial distribution information on GIS mapping interface while detailed information of each spatial entity were in layer attribute tables.

7.2 Planning Stage

As a typical result of the planning stage, the sample maps as indicated below could be shown.

1. Abandoned coral mines overlaid on the contour data set
2. Drainage directions prepared on 1:1000 survey maps overlaid on engineering survey sheets

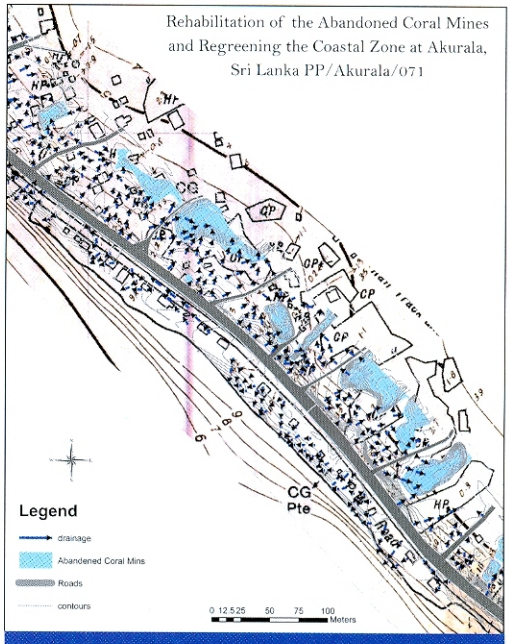
7.3 Implementation Stage

As it had been described previously, various inputs and outputs pertaining to project activities were supervised and monitored for executing the project to achieve the desired quality while adhering to the time targets. Typical outputs indicating the following could be presented as GIS application examples.

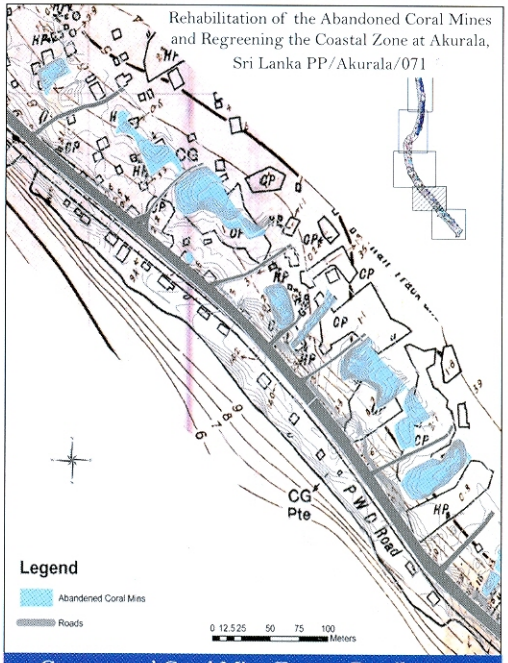
1. An intermediate progress map of regreening and
2. Final regreened area of a project section
3. Implemented status of coral pit rehabilitation
4. Layout of the Eco-Pack area
5. Spatial Distribution of Ecological Zoning

7.4 Publicity Material

GIS maps either with or without a combination of hot-linked visual imagery were effectively used as informative material for stakeholder awareness. Preparation of the Green Coast Visitor Center hoarding could be cited as an example. Georeferenced satellite images were used for the background of the hoardings. Road and rail road GIS map layers together with feature details incorporated as point information were overlaid on the satellite image. Project boundary map layer was also overlaid to achieve more clarity. A hoarding was designed to be erected perpendicular to the Galle (A2) road and in front of the Green Coast visitor center.



Drainage Direction Maps were Prepared



Contour and Coral Mine Feature Details were Included in the GIS

To facilitate easy understanding by the readers, maps on the hoarding were aligned in the viewing direction. As such the usual map alignment which has North pointing towards the top of the map is satisfactory for the hoarding to explain a travellar when moving from Galle to Colombo. However when the traveller is facing the direction of Galle, the South should be pointing towards the top of the map for easy reading and positioning. Once these alignments are placed, then irrespective of the side from which the hoarding is viewed, a reader identifies that the location of the sea coincides with the actual position and so is the land. This layout was done to the desired accuracy by using GIS tools.

8. Discussion

1. The use of Geoinformatics for project planning and implementation is immense. However, data collection and data checking requires a substantial effort. At the commencement itself, the project carried out sufficient planning of such activities and action was initiated to obtain maps and other data from available sources. When the project resource personnel identified that some important data sets such as close contour data were not available, early efforts were exerted to receive such data on time.

2. Use of Geoinformatics requires field data collection to be done with reference to a geographic coordinate. Field staff were not used to such data collection and hence, staff training was carried out at the commencement in order to familiarize the staff in the use of GPS equipment, data storage and retrieval. Digital photographs and video clips were necessary to visualize work execution and progress from a central monitoring location. Training for such activity was also given to the field staff. Data transfer to a central location required methodologies having data security along with a transfer time saving. The field staff always maintained backup data systems as a precaution against data losses.

3. Layout preparation and output data formats were standardized for the project. Such arrangements provided significant time and other resource savings.

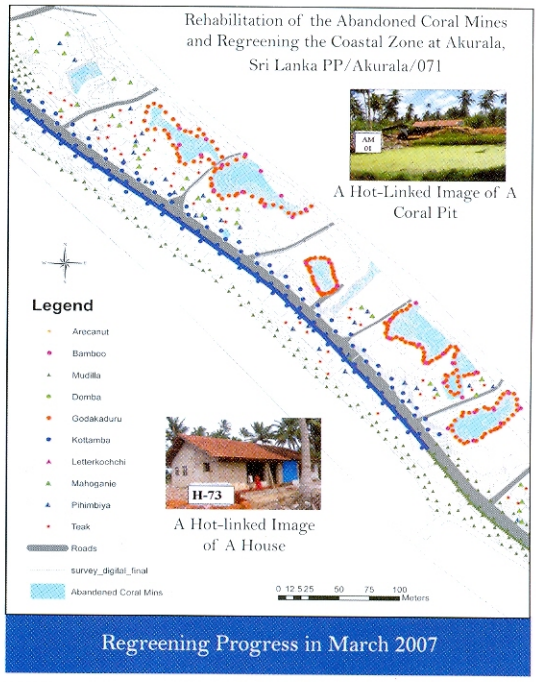
4. Progress meetings revealed that discussions held with resource persons were lively and were with many alternative suggestions. This was because the project's geoinformatics database provided a semi dynamic data set of project activities loaded with information that could be used for lively technical discussions. Data for discussions were presented on scaled maps incorporating GIS functional capabilities such as query and display, classification, reclassification etc.

5. Project utilized the remote sensing data only to a very limited capacity. Remote sensing digital signatures could have been effectively used to assess the vegetation changes after the Tsunami to achieve a better accuracy for the value of vegetation losses. However, since the project was done in a very short time period, with limited financial resources, remote sensing data calibration and verification was not carried out. Alternative methods such as field mapping with GPS etc., were used to supplement the detailed calculations using remote sensing. It may be appropriate to commence a research project with another temporal satellite dataset pertaining to after regreening period,

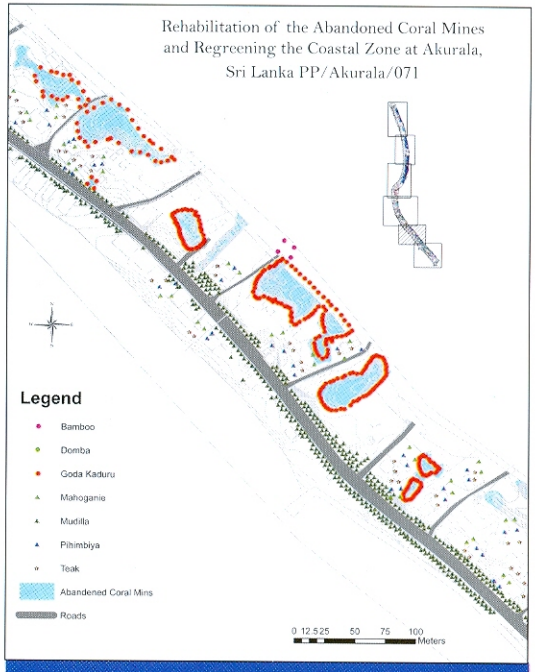
so that an assessment of the vegetation changes and the effectiveness of the project could be carried out.

9. Conclusions

1. Use of Remote Sensing Satellite data enabled, (a) The identification of temporal variation of land cover in the region, and (b) Verification of feature data pertaining to the project area. Remote sensing measurements were a powerful Geoinformatics input with regards to this project.
2. GIS database proved as an indispensable tool for a project that involves in the utilization of resources which have a high spatial variation and a short implementation period.
3. Field data collection with GPS and other digital devices such as digital camera is very helpful for monitoring of project activities. For successful utilization of geoinformatics it is necessary to have trained staff who could capture accurate and detailed field data using GPS and other digital devices. Competent field staff and training programmes of the project were a major reason for successful completion.
4. The Akurala Green Coast Project used Geoinformatics tools very effectively for the



Regreening Progress in March 2007



Progress of Regreening upto 15th December 2007

successful completion of the work and this can be cited as a practical application of GIS, GPS and Remote Sensing for project planning, implementation, monitoring and evaluation.

Maintained by Pradeshiyasaba Rathgama

Green Coast Visitor Center Hording View from Colombo Direction

Maintained by Pradeshiyasaba Hikkaduwa

Green Coast Visitor Center Hording View from Galle Direction

Stakeholder Community Awareness and Participation Enhancement; Tools, Techniques and Methods

1. Introduction

Akurala Green Coast project carried out the environmental enhancement of a coastal strip 3 km long and having a width of 100m. The project completed regreening of the area including home gardens and cleaning of abandoned coral mines that had deteriorated in environmental quality due to the Tsunami and human activities. Most of the pits had been in use for garbage disposal. In residential area the common practice was to dump waste to nearby water bodies. Though disposals were somewhat controlled in some areas, the pits by the side of the road and near the Akurala bridge were often used as dumping grounds for fish waste. The Green Coast regreening and abandoned coral mine rehabilitation project was developed targeting strong community participation because of the need for the project to sustain over the long run. Therefore building community participation was essential to ensure community ownership of the project.

Political Leadership Created a Strong Influence on the Success of Project: Galle DDC Meeting

2. Objective

Objective of the fulfilment of community participation in the Green Coast project at Akurala was to enhance the awareness of the community about the importance of environmental conservation & quality enhancement and then to establish a sense of ownership for the Project thereby achieving long term environmental sustainability.

3. Approach

In order to achieve this objective the project team systematically worked towards the enhancement of community involvement at various stages of the project. In the

Akurala Green Coast Project community involvement was targeted through different activities carried out from planning stage to implementation and monitoring stages. The community involvement was also achieved through strengthened partnerships, capacity building, training and education. Community participation was targeted through many ways (Munt 2002) described in literature. They are participation at project proposal development, being a member of work groups, reference groups and focus groups. The project divided stakeholder community in to three major groups. First was the direct beneficiaries who are residents of the project and nearby area, the second was local politicians and the state agency officials who would be interested in project activities. The third group consisted of the general public, donors, government decision makers, non governmental agencies, and national level political leadership. In the group one, school children were given a special emphasis while housewives were encouraged to participate in the awareness enhancement programmes. Community involvement was aimed by way of different described avenues (GWP 2000). They were through awareness enhancement, investing in people, promoting demonstration, and through information generation & sharing. The methods and tools for effective participation were carefully planned using the commonly incorporated methods (IBRD 1996) and such methods were utilized while ensuring the quality in preparation of material for awareness enhancement.

4. Community Participation

4.1 Proposal Development

Project area stakeholder participation commenced very early when the project proposal was being prepared. Project resource persons visited the project area to hold consultations with the community and their leaders to identify issues that need to be addressed through the project. Community groups were consulted and it was identified that since the Tsunami debris were still scattered in the area, any regreening would require clearing of land and inland water areas as well. With regards to the abandoned mine pits which were significantly polluted, the community were of the opinion that such pits need to be filled and regreened.

Project team had already identified that the pits had small surface area but many were approximately 10 - 12 meters deep. Team were also aware that the GSMB in an effort to fill the pits had made a previous attempt in the project area and had indicated to the community that filling the abandoned pits would require large quantities of earth thereby exerting severe environmental pressure on another ecosystem from which earth has to be burrowed. Discussions with stakeholders identified the most suited alternative as, cleaning the pits while enabling environmentally friendly waste disposal, along with the development of freshwater fish culture in selected water bodies to ensure the sustainability of rehabilitated coral pit environment. Community of the area had already formed into a group which indicated the need to carryout capacity building both in terms of knowledge and material in order to ensure that environmentally sound practices are carried out. Project proposal to rehabilitate abandoned coral mines and to regreen the area which

was developed with stakeholder consultation received acceptance from the Green Coast Project evaluators.

4.2 Implementation

Community of the area were considered as the main stakeholders of the project and a significant participation of this group was desired. Project area was sparsely inhabited after the Tsunami. Majority of the survivors had received lands interior to the coast and had moved out of the area. Only those who had refused to leave their properties were left in the area. However with the relaxation of state regulations, more stakeholders were indicating their plans to commence activities in the project area. Initial surveys revealed that the direct project area beneficiaries consisted of 80 families. A house to house survey of the project area was carried out (ICGAT 3) and it was identified that these families were low income families mostly belong to the fishing community who earn a living by fishing in the ocean. These families were undergoing severe hardships and this has aggravated with the loss of life and property as a result of the 2004 Tsunami. Therefore the living standards of these beneficiaries were extremely low.

A Community Group Consultation

House to House Stakeholder Consultation

Mature Community Discussions at the Temple

The team targeted community involvement through various methods. Conduct of stakeholder meetings, knowledge transfer seminars and workshops for children and the elders, educational field visits, investing in people by providing material benefits, participatory plant nursery programs, voluntary support mechanisms, recruiting and hiring to maintain involvement, providing tokens of appreciation, periodical dissemination of information were some of the methods utilised to ensure community participation within and nearby area of the project.

4.3 Meetings

Project team conducted fifteen main meetings where direct contact and discussions were made to enhance the community involvement. The participants were given opportunity to interact and discuss freely about their concerns with respect to the project and its implementation. These meetings were of immense value and were conducted at regular intervals to maintain the community interest and to enable adjustment of project activities wherever and whenever necessary. Meeting at Galle District Secretary's office for awareness enhancement of political leadership and government officials was the foundation for confidence building of project area community. Awareness and participation at project activities by political and community leadership paved way to the acquisition of a suitable land for the Green Coast Visitor Center and receiving a commitment for maintenance after the project period. Community interactive mechanisms through meetings included large group meetings, small informal gatherings and also house to house visits. Large group meetings were helpful in targeting the conveying of concerns, obtaining consensus for options, and systematic delivery of messages through structured presentations. Facilitations at such discussion times were often made use of by the community leaders while rest of the personnel were mostly silent. Small group meetings with interest groups provided better opportunities to identify available alternative options to execute a project activity. Also small group meetings encouraged significant participation in the project activities through collective contributions of material, equipment and human resource inputs. House to house surveys and evaluations enabled the capturing of personal issues and suggestions with regards to the project mechanisms. These meetings provided a sense of importance to each family due to the project's willingness to engage in discussions with individual families in order to identify methods or tools.

The following is the list of fifteen meetings carried out during the project period.

1. 30th September, 1st, 2nd October 2006: House to house awareness campaign on the commencement of the project, explanation of project, project donors, implementers, and project objectives, while making an assessment of contributing capacity of direct beneficiaries.

2. 10th October 2006: Small group meetings to discuss the objectives of engineering surveys and the tenement survey carried out in the area and provide solutions with regards to questions on land ownership

Sunday School Seminar and Demonstration of Compost Bins use

3. 29th October 2006: Community awareness meeting held at the village temple to formally introduce resource personnel of the team and to discuss the implementation procedure and identify issues and alternatives.

4. 10th November 2006: Awareness seminar presentation for the regional political leadership and public officials explaining about the project, project contributors, methods and duration at the District Development Committee Meeting, which was held at the Galle District Secretariat building.

5. 8th January 2007: Awareness and discussion meeting held at Galagoda to educate the fishing community on activities such as freshwater fish culturing in the rehabilitated coral pits, need to form community groups for management, project plan to distribute fish fingerlings, fish variety to be introduced and harvesting needs etc.

6. 24th February 2007: Awareness enhancement meeting held at the Akurala project office on the need of voluntary community groups and formation of community groups

7. 25th February 2007: House to House discussion and feed back on the execution of the project conducted by the core team and voluntary community support groups, explanation of the needs of project sustenance, the need to strengthen vegetation and continued maintenance of home gardens. Receiving comments on the distribution of plants with timber value, practice of waste disposal and locating the distributed waste bins.

An Awareness Programme at Village School

8. 27th, 28th, 29th September 2007: Small group discussion meetings at the Tharuna Seva Sabha premises (Youth Center) of project area on the plant survival after the seasonal sea water splashing, and to identify methods to control the destruction of wayside plants. Identification of drainage status, fish life development in the rehabilitated ponds etc., were evaluated through discussions.

9. 10th, 11th and 12th October 2007: House to House visits to discuss and assess the plant maintenance, garbage disposal methods, maintenance of cleaned coral pits while assessing the survival rate and factors associated with loss of plants after the planting, and estimating the watering needs prior to the rains.

10. 9th October 2007: Small community group discussions at the project area to identify available land for the construction of the Green Coast Visitor Center and to assess the benefits and shortcomings.

11. 12th and 20th October 2007: Small community group discussions on the plant maintenance, sustainability concerns and receiving community ideas on gap filling, fish pond and plant management activity.

12. 24th, 25th October 2007: Survey of fish culture, survival and management of the coral pits that were cleaned as part of the project activities. Discussions with community groups who undertook to manage the coral pits.

13. 28th October 2007: House to house awareness campaign by participatory community for the identification of a person who is willing to provide a land for the visitor center.

14. 1st November 2007: Project team meeting with the chairman of local government administration which is the Pradeheeya Sabha, to discuss the options available for construction of the Green Coast Visitor Center and the possibilities available to ensure sustainability.

15. 21st January 2008: Meeting to enhance awareness of project achievements, aspirations and community contributions in future. Handing over the project area and Green Coast Visitor Center to the community and the local Government administration, with the participation of local and regional community and national political leadership.

4.4 Seminars and Workshops

The seminars and workshops conducted are as follows.

1. 6th November 2006: Awareness seminar for school children to introduce project consepts; held at the Akurala Vidyalaya (Village School). Introducing the project, explaining the effects and causes of Tsunami, importance of drainage and biodiversity, awareness on the needs of proper waste disposal and regreening.

2. 30th March 2007: Seminar and poster exhibition at Colombo for the community leaders, donor community, state planning officials, and academia to disseminate project experiences, discuss the way forward in connection with the continuation of plant maintenance, detailed presentations on project execution, screening of a documentary video on the project.

3. 21st January 2008: Dissemination seminar at Hikkaduwa on the project achievements, handing over of visitor center to the local political leadership and neighbourhood community, participation of state and community officials of the region, religious leadership etc.

Seminar for Policy Makers and Donor Community

4.5 Field visits and Demonstrations

Strengthening of community involvement was targeted through several field visits and demonstrations in connection with the project activities. Project as one of its main objectives, concentrated on cleaning and maintaining the environmental quality of abandoned pits through environmentally friendly solidwaste disposal, and achieving sustainability through the introduction of fishery in the rehabilitated ponds. The project distributed fish fingerlings to the community who had formed groups to function as caretakers of individual ponds. Since growing of fresh water fish and harvesting them as a business or a living was new to most of the project area community, special demonstration and training programs were incorporated. The community quite enthusiastically participated in the field visits and were of the opinion that these programs provided immense knowledge through actual exposure and experience. Such field visits also helped the project staff and the community to establish friendly relationships which were found very fruitful not only in the dissemination of knowledge but also in executing the project activities with a stronger sense of ownership.

Awareness Enhancement Siminar in the Project Area

Field Visit to Uda Walawe Fish Breeding Center

4.6 Plant Nursery

Regreening effort required a large quantity of plants. Most of the plants selected for regreening were available in the nearby area. Community discussions revealed the need to establish plant nurseries. Project resource persons having trained the community to extract seedlings from vegetation clusters in the neighbourhood, commenced a potted plant nursery. Nurseries were looked after with service personnel obtained from the area. Three such nurseries were commenced. In order to further enhance the awareness, school children were encouraged to participate by supporting the nursery with plants. At the workshops held by resource persons, the plant acquisition and maintenance aspects were explained.

5. Material Benefits and Tokens of Appreciation

Community participation was encouraged by providing material benefits and by extending tokens of appreciation. These tools were effective in making the stakeholders participating in discussion and problem solving forums. Material benefits from the project were extended to the stakeholders identified as part of a critical reference group.

5.1 Green Coast T-shirts

Voluntary groups of community who supported the team members at house to house survey and meeting activities were donated with a durable white T-shirt bearing the Green Coast label in the pocket. Participating community were pleased with this token of appreciation.

5.2 School Stationery

School children who participated at the workshops were donated a small pack of stationery which could be used in their day to day school activities. School children were enthusiastic about the project and engaged actively in question and answer sessions with the resource persons. Teachers and villagers were also very appreciative of the efforts extended by the university to carryout environmental enhancement in the project area. Children were encouraged to commence and carryout environmentally friendly activities at their homes with their parents. At house to house surveys it was noted that messages delivered by the project had been conveyed to the elders by these children. From the inception, the team recognised that participation of small children was essential for the success of the project. Children were encouraged to identify the value of greenery and the support given by greenery for the sustenance of communities. The project initiated a program to strengthen the plant nurseries through children's participation and in this connection children were requested to participate by providing the project with potted plants and then to receive a token gift of stationery. Training for the children to collect plants from suitable locations and to pot them in polythene bags was given by the biodiversity resource person of the project team. The continued participation of small children to maintain plant nurseries for the project can be considered as a significant achievement in establishing the sense of ownership in the minds of our future generation.

Awareness Program at Colombo Zoological Gardens

Community Contributions for Plant Nurseries were Significant

5.3 Meals and Refreshments

Commencement of project was amidst scepticism shown by most of the community and hence community participation had to be strongly encouraged through various strategies. At the initial stage, clearing of Tsunami debris from abandoned mine pits and home gardens required the attraction of a larger community participation. The project provided voluntary participants with meals and refreshments during the initial stage works of cleaning, and planting activities. These efforts of project enabled the cultivation of a sense of ownership which was noted in the enhanced involvement

Compost Bins were Transported and Installed at Each Stakeholder Household

observed closer to the completion of first phase and while carrying out the second phase activities.

5.4 Certificates of Appreciation

Community who participated in the seminars and good-practice sessions of home garden planting & waste disposal programs were given certificates of appreciation. The participated community indicated a very positive attitude towards the certificate as they understood that their effort to ensure good practices were appreciated by the project and that they were identified as a special group among the rest of the community. As a result, the project achieved a very positive participation from this stakeholder community.

5.5 Valuable Timber

The project while using common trees for regreening of roadside and other common areas, donated plants of high value to be grown in home gardens. Teak, Mahogany, and Pihimbiya were the plants which were given for home gardens. Community were quite enthusiastic about the planting of valuable plants in their home gardens. Project team also encouraged the community to grow commonly available plants in their home gardens and those who participated effectively were donated an additional quota of valuable timber plants. The valuable tree planting was noted as a highly participated event which indicated very good results. Since the plants were in their home gardens, participants had been able to cover the plants from the salty breeze and hence a good growth could be observed. Valuable timber plants were also donated to the participating community who were from out side the project area. This activity improved the community image on the project.

6. Voluntary Support

Participation by the village headmen (the Grama Sevaka), the president and some committee members of local government administration (Pradeshiya Sabha) on a voluntary capacity was a great strength to the project. This indicated the recognition of project by community leaders for its contributions to the selected area as well as the region. There were several voluntary personnel who from time to time participated in the project activities by way of discussions and voluntary labour on field works or as facilitators. These voluntary personnel were elderly persons, who had retired from permanent employment and settled either in the area or in the neighbourhood. Their main concern was safeguarding the green environment and achieving the environmental enhancement of abandoned coral mine pits. This involvement was a great support for the project because such personnel facilitated the promotion of the project among younger folk who were mostly interested only in the short term benefits. There was significant community participation in the construction and establishment of the Green Coast Visitor center. Local administration voluntarily agreed to support the maintenance of center by means of personnel, water andd electricity supply etc. During construction of the visitor center, the nearby community provided tools, planks and scaffolding etc., on a sharing basis. Several stakeholders provided assistance by allowing storage of valuable material in their houses.

7. Communication

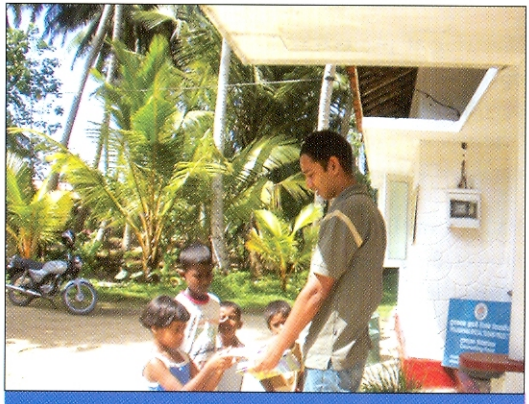
Communication was a strong tool which the project frequently used to target wider stakeholder participation. Project utilised several tools to enhance the community participation through enhanced awareness.

7.1 Banners, Hoardings and Labels

Project with the use of detailed hoardings demarcated the commencement and the end of the 3 km long coastal strip of the Colombo – Galle (A2) road. Project office location was also indicated with an additional roadside hoarding. Site office notices displayed project details and other agency material on clean environment, waste disposal, composting, value of Sri Lankan biodiversity etc.

A large hoarding was erected in the middle of rehabilitated coral pit environment at a location visible to both the road and rail travellers. All the boards displayed the project title with the key words such as "regreening" "rehabilitation of coral pits", and a slogan indicating the desire to harness the benefits of natural resources while safeguarding the environment. Hoardings also communicated the details of donors and the implementation agencies. These project area displays were targeting the enhancement of local area community awareness and

T-Shirts for the Volunteers



Children were Given Token Gifts of Stationary

Appreciation of Environmental Waste Disposal Efforts

Community were Given Teak, Pihimbiya and Mahogany Plants for Home Gardens

participation along with the awareness enhancement of a wider community passing through the project area.

Watering of plants was carried out using a hand tractor and a water tank for twice a day operation during non rainy periods. This was utilised as a tool to attract wider community participation through awareness enhancement and the cultivation of sense of belonging. The tractor carried a banner displaying the regreening target of the project and the names of supporting agencies.

Plants established through the project intervention were flagged with a message to protect the plants. The flag carried a message in Sinhala language meaning "Let's safe guard this plant for the sake of our children". The flag also indicated the project and the implementers. An enhanced community participation was sought by these flags to ensure the care and protection of the plants and especially road side plants which remain vulnerable to damage.

The Hoarding at the Green Coast visitor center carries a location Information map displaying the project area and the key locations. The hoarding prominently displays the donor, implementer and the maintenance agency which is the Pradeshiya Sabha. This would not only enhance stakeholder community awareness but also targets a continued commitment of the donor, implementer and most importantly the maintenance agency.

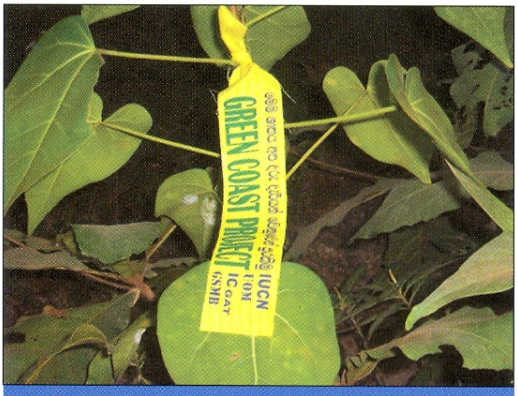
7.2 Notices and Leaflets

Written notices were utilised at the site office to deliver messages to the community on various issues such as awareness programs, civil work activities, plant nursery needs etc. The project noted that some villagers had commenced fishing in the ponds even prior to a satisfactory growth of fish. This was noted by the neighbourhood community and requests were made to the project to erect sign boards at the ponds so that more community participation could be obtained for the satisfactory management of the fresh water fishery activity initiated by the project. Notices put up by the project requesting limits on fishing while fish were not ready for harvesting, was well taken by the community.

Several leaflets were prepared by the project staff for circulation and to make available at the Green Coast visitor center. Posters displaying a photo gallery pertaining to the project activities and project participation were made to ensure continued stakeholder interest and maintenance activities of the project through adequate participation. A sticker was placed on the donated compost bins and another on the dockets given at awareness seminar aiming enhanced awareness and there by cultivating a sense of belonging. At the visitor center a notice was carved on a stone slate indicatng the project and the handing over of information center to the local community.

Banner on the Water Truck Displayed Project Ownership


Hoarding Indicating the Galle-End of the Project Area



Flags to Achieve Enhanced Community Participation

7.3 Study Reports, Video and Web Page

To achieve enhanced participation of the stakeholders, detailed reports on project activities were prepared. These efforts were exerted to encourage the increased participation of scientific community to contribute to the project, obtain lessons from the project to carryout similar environmental quality enhancement activities and also to enhance the awareness of the policy makers. The reports contain technical details such as data, methods and results.

One video was prepared at the end of the Phase 1 and another

one as a part of Phase III indicating the project details and key points. These details are incorporated in a web page to enable access to stakeholders of all communities with internet access, so that the participation on environmental quality enhancement could be made widespread.

8. Recruitments and Hiring

8.1 Services and Equipment

The resource needs of the project for various services such as the use of three wheelers, vans, water pumps, boats etc., were fulfilled through the village community. Whenever the village community were in possession of resources or willing to provide services, such supports were hired based on the project needs. The common expectation and the tendency of community projects is to obtain available services as a donation from the participating community. This prevents many people voluntarily participating in projects as they feel that those who participate would have to extend their resources for common good and at no charge whereas those who do not participate would reap project benefits without foregoing their resources. In this project, the act of receiving such services on a hire basis encouraged participation as the participants were comfortable with the knowledge that the common community contributions and services were not burdened on few persons who closely participated in the project. Community having recognized the contributions to the village by the project were for most of the time reasonable in the pricing of such services. This effort of the project made the community participation very effective as the community clearly understood that their routine living was not affected by joining in the common activities or by making efforts to provide services.

Recruitments for project activities were either directly from the identified coastal strip or from adjacent areas. The recruitments provided an opportunity for the community to participate in the work programmes while earning their living. Community indicated their strong participation by working for long hours without additional payments. The community also contributed with their experiences and this in turn enabled the project staff to make the most appropriate choices in terms of methods or activities.

9. Discussion

9.1 Leadership and Sustenance

The community participation aspects of the project was a very critical factor for the success of project. The community enthusiasm was not very encouraging probably because the benefits of the project was more on the long term. The team used different approaches and techniques to ensure stakeholder participation at all levels and it was observed that the community participation was heavily dependent on the leadership and on the benefits received. This is mostly because the very low income community are on a much critical struggle to make ends meet in the short run rather than opting to engage in environmental enhancement projects which would enable them or their children to reap benefits only

in the long term. This is a major factor that needs to be considered in the community participation projects. Project resource personnel noted that since the environmental enhancement projects are more of long term benefit generating actions, it is necessary to assess the capabilities of the community for any successful participation. It was also identified that a leadership built around the community should be in place to attract sufficient participation. There was no indication of an emerging leadership from 'within the project area community' and this most probably could be due to the economic status of the beneficiaries. The project planning and implementation period was taken care of by the leadership of project resource personnel. It is necessary to identify and enable a suitable leadership for the period after the project execution. The local government administration has shown interest and made several commitments. Therefore it is understood that there would be sufficient leadership to attract of community participation once the project period ends. The Green Coast visitor center for which the local government has shown their commitment to carry out maintenance, would enable the post project leadership to grow around the functionalities of the center.

Project Documentary Videos in English and Sinhala were Produced

Hoardings for Enhanced Community Participation

9.2 Attitudes

Material issues made to the community for the encouragement of participation was well appreciated by the community. It is important that such benefits are transferred to the community who actually contribute to the project objectives. There were instances where some personnel through their known frequent participants attempted to obtain such benefits. Therefore the project resource personnel exercised strict monitoring of material issues.

The selection of personnel for awareness programmes and field visits was carried out very carefully. Resource persons associated with each activity were entrusted to identify the personnel and target relevant awareness campaigns. This approach enabled easy and rational selection of correct target personnel for respective awareness programmes. Whenever possible the requisite services for the project was obtained from the neighbourhood community. At certain instances it was observed that the rates of such services were higher than that outside of the project area. Project resource personnel checked the prevailing rates and whenever it was found necessary, negotiations were carried out to avoid any attempts of exploitation.

The hoardings of the project were made using galvanised iron frames. Several hoardings were erected by the project to demarcate project boundaries along the road, to indicate the location of project office, provide details of project area, contributors etc. At the commencement of the Phase II of project it was noted that except for one hoarding all others were removed. Upon inquiry it was indicated that hoardings may have been stolen for the value of their iron sections which can be sold to scrapped iron yards.

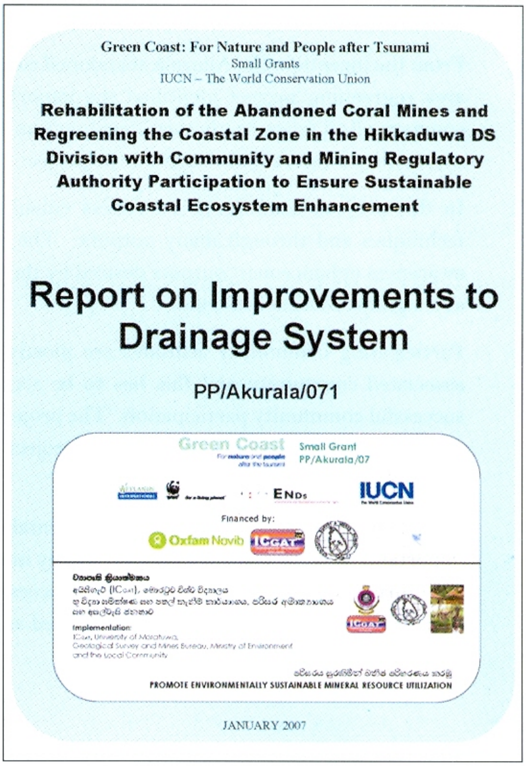
9.3 Small Groups

At the initial stages the plan of the project resource persons were to hold a series of awareness enhancement seminars and workshops. After a few field visits done in order to carryout detailed planning of activities, and immediately after the first awareness program introducing the project, the team converted most of the awareness programmes to small group discussions. This change proved very fruitful since the participants provided enthusiastic interaction during such small group conversations. In the small group meetings too, the traditional meeting format, which is to meet at a common place was identified as a barrier for active participation. Instead, road side meetings in small group were carried out.

9.4 Benefits

Community were always concerned about direct benefits they would receive from the project. It appeared that most of the community were not keen on benefits they would reap only after exercising a significant input from their side. Some community members showed very little enthusiasm to participate in actions which would lead to common benefits. Reason for the community always seeking direct benefits could be attributed to the very poor income level of beneficiary community which had turned from bad to worse

due to the Tsunami in 2004. The project through tokens of appreciation and through school children participation made a reasonably successful attempt in overcoming this problem.


Green Coast: For Nature and People after Tsunami
Small Grants
IUCN – The World Conservation Union

Rehabilitation of the Abandoned Coral Mines and Regreening the Coastal Zone in the Hikkaduwa DS Division with Community and Mining Regulatory Authority Participation to Ensure Sustainable Coastal Ecosystem Enhancement

Report on Improvements to Drainage System

PP/Akurala/071

JANUARY 2007

9.5 Other

most community awareness activities of the project were done in collaboration with the religious center of the village which is the Buddhist temple. The community were first informed about the project, its strategies, and targets. The community awareness programs were designed in a systematic manner to facilitate different stakeholder types to provide their inputs. Project team treated this as a very important consideration. The house to house meetings of the project were arranged in the form of "meet and greet" gatherings to ascertain a better user friendly environment for exchange of ideas. Project team carefully determined the most suited time for community participation discussions as it was an important issue for the fishermen who had a specific time for their job while it was different for the persons who made a living as casual labourers.

Considering the living status of community participants, the project provided transport and food during out of the area field visits. Language for awareness program explanations had to be changed to Sinhala as the community were not familiar with English to communicate freely. This change also benefited in the capture of local knowledge available with the community and especially with regards to the plants and mine pits.

In the case of achieving community awareness through communication material, the project made use of several tools. Project while targeting local community awareness enhancement, also made a special effort to educate the community in other parts of the country and the world as well. The targets of out of project area awareness campaign through the leaflets, posters, visitor center and the web page are, (i) to ensure that this flagship project becomes an example project for others to carryout similar projects nationwide, (ii) to attract more donor assistance for similar projects in needy areas, and also (iii) to support the scientific community with better awareness on real life applications.

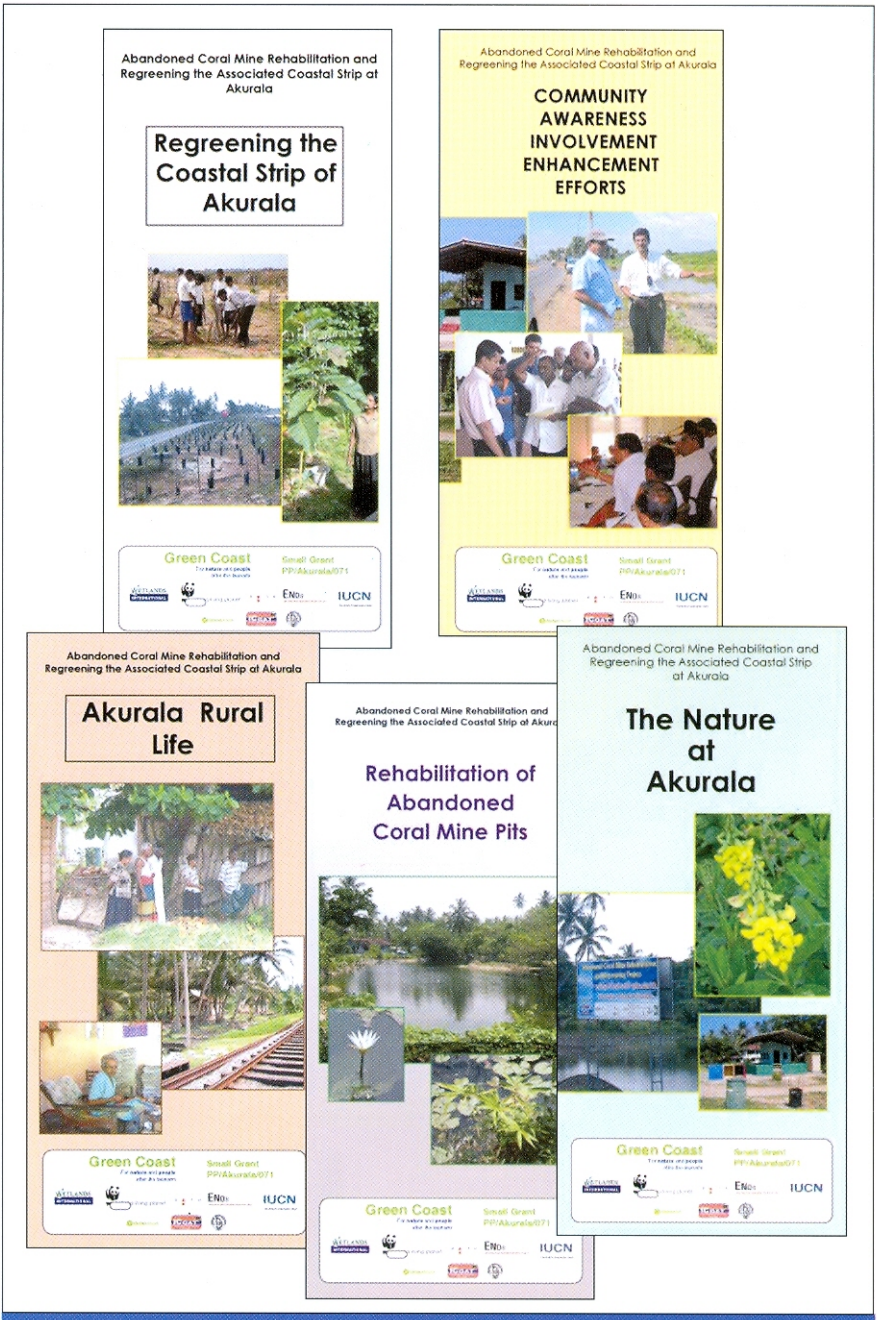
10. Conclusions

1. From the inception, the Akurala abandoned coral mine rehabilitation and associated area regreening project identified the importance of community awareness and commenced all related activities. Timely action enabled the achievement of adequate community awareness throughout the project.

2. In this project, community awareness enhancement was targeted using various techniques and through many outputs. The project successfully carried out the awareness enhancement outputs desired by the project and this could be considered as a significant achievement.

3. Participating community attitudes are mostly influenced by the income level of associated community and this has to be accommodated for the achievement of successful community participation. The project team using various techniques and with careful consideration achieved the project objectives to a very high degree of satisfaction.

4. School children participation in environmental enhancement projects is of extreme importance because such projects are mostly intended to safeguard the environment for future generations. The project made successful school children participation and awareness enhancement. This can be treated as a great strength of the project.



Five Leaflets were Prepared for Project Awareness Enhancement

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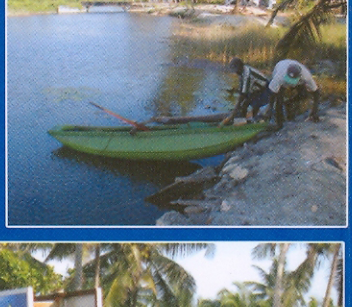
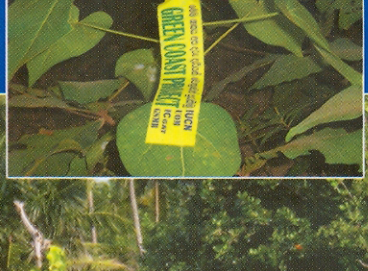
- An application of Geoinformatics for planning, implementation and monitoring of community based environmental enhancement and rehabilitation projects
- A scientific approach for the implementation of environmental enhancement projects with the concept of Community, University, Regulator and Partnership (CURP)





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ICGAT, University of Moratuwa,
Geological Survey and Mines Bureau,
Ministry of Environment and the Local Community

Green Coast
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