

# **Conservation of Biodiversity through Integrated Collaborative Management in the Rekawa, Ussangoda and Kalametiya Coastal Ecosystems**

**Extent of Seashell Resources, Present level of Exploitation, and Recommendations for Sustainable Utilization within Rekawa, Ussangoda and Kalametiya (RUK) Areas**

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## **EXECUTIVE SUMMARY**

The Rekawa, Ussangoda, and Kalametiya (RUK) area is located along the Southeastern coastline in the Hambantota district and has a rich biodiversity and considerable socioeconomic significance. Coastal wetlands, lagoons, salt marshes, mangrove vegetation, scrub jungle, paddy lands, abandoned paddy lands, seashell deposits homesteads etc. are the major land use types in the RUK area.

Seashell mining is one of the major economic activities in the RUK area. At Present seashell deposits are mined mainly for the production of Chicken Grit, which is used as a supplementary food in the poultry industry. The present extraction system is highly unsystematic and unsustainable. It has created several environmental problems such as decline and loss of biodiversity, depletion and degradation of the environmental resources and several socioeconomic problems. The effectiveness of past government and non-government initiatives to combat this situation is sub-optimal and no action has been taken to rehabilitate the degraded environment.

The major objectives of this study are to investigate, and assess the nature of seashell mining within the project area, identify the environmental and socioeconomic problems, provide management guidelines for shell mining in suitable sites, back filling and inputs to develop alternative livelihood/skills development programmes. A literature survey and extensive field surveys appropriate for the existing physical, environmental, and social conditions, and analysis of data, and drafting recommendations were the methodological steps followed in this study.

The literature survey was aimed at reviewing the existing materials based on the physical, socioeconomic, legal and institutional aspects of seashell resources. Three field surveys were conducted. The first one reviewed the available maps relating to the distribution of seashell deposits in the study area, conducted field investigations and prepared digital maps indicating spatial distribution of seashell deposits. It also provided inputs to quantify the seashell resources in the RUK area, and to prepare guidelines and a new mining plan for the available seashell deposits for future mining. The second field survey was aimed at collecting, analyzing and putting together data and information on environmental problems associated with seashell mining. The socioeconomic survey covered the socioeconomic situation of the seashell miners, and their related activities, information on livelihood and skill development. Two participatory workshops were conducted to discuss the survey results and to obtain their feedback and views.

Individual permit holders, group permit holders, homestead illegal miners, and the state land illegal miners are the four categories of seashell mining. At present a total of 19 permit holders having 26 permits both individual and group are legally engaged in mining activities within the project area.. At the same time over 50 persons also engaged in illegal shell mining activities.

As regards spatial distribution of seashell mining, this activity is primarily concentrated in the Kalametiya-Lunama area. The mining activities are taking place largely on private lands outside the sanctuary area.

The illegal seashell mining within the project area is concentrated mostly on land within the sanctuary, coastal dunes, private lands and homesteads in Kalametiya, Hatagala and

Lunama. The study estimated that the total quantity of seashell deposits in the project area is 216.9 thousand metric tons. Of this 155.0 thousand metric tons of seashell deposits have been extracted in the past. The total available seashell deposits in the area is 61861 metric tons. However, considering the distribution of these deposits in different locations such as the sanctuary, sand dunes etc. the available quantity of seashell deposits for future extraction is in the range of 11,035 to 13,609 metric tons. The current annual extraction rate of seashell deposits in the southern region is 1240 and the estimated time period for future seashell deposit in the Kalametiya - Lunama area is 9 to 11 years.

The environmental impact associated with seashell mining was examined for ongoing, abandoned and potential shell mining areas. A field survey was carried out in the natural forests, sand dunes, mangroves, and flood zones falling within the reservations of the Department of Wildlife Conservation. The natural forest cover in the ongoing seashell mining area is confined to open spaces (grasses or herb patches), and a small number of large trees, small trees, thorny shrubs and bushes. The plant species diversity index (H') varies from 1.8431 to 1.31266. Dunes associated with the ongoing shell mine sites show a considerable damage to vegetation due to mining. Uprooted coconut trees and destruction of natural vegetation are common in these areas. With regard to homesteads, pits have been excavated for shell mining between coconut trees. Ongoing mines were observed in lagoon reservations belonging to the Department of Wildlife. Most of the Mangals in these sites have been cut off for mining operations. The plant species diversity in these sites is 1.0438. Species such as *Avecennia*, *marina*, *Sonneratia*, *caseolaris*, *Lumnitzera racemosa*, and *Brugeria* sp. and *Exoceria agollachi* exist as isolated clumps. The plant species diversity index in the old abandoned seashell mining area range from 0.89951-0.112566 while in the newly abandoned areas this index is 0.89951 to 1.6459.. The abandoned shell mining areas in homestead were replanted with coconut trees. The vegetation in future mining areas is similar to the general vegetation in the study area, and has a high plant species diversity ranging from 1.37586 to 2.11421.

The socioeconomic survey shows that the average family size in the study area is 4.1, which is smaller than the average rural family size in Sri Lanka. The potential labour force (18-55 years) in the project area is large (97 %). Among the seashell miners 90 percent have obtained primary/secondary education. Seashell mining, processing, transport and marketing are the major activities in relation to seashell mining. Over 60 percent of them are engaged in seashell mining and 16 percent of them are engaged in two or more activities. Although the number of working days per month ranges from 10-20 days per month the average household income is over Rs.3000/= month. The survey reveals that the average health and housing conditions are satisfactory. With regards to resources and skills owned, around 52 percent of the villagers do not own any type resources for income generation. Twenty two percent have seashell deposits while the remainder owns agriculture or fishery equipment.

The survey revealed that eighty percent of the seashell miners is willing to give up seashell mining if appropriate alternative sources of income are available. Agriculture, fisheries, industry/business enterprise, driving and foreign employment are the potential sources of livelihood indicated by them. A majority of persons stated that they require financial assistance and technical training for this change. The expected financial assistance ranges from Rs.50,000/= to Rs.200,000/= varying from livestock husbandry to salt production for the poultry industry.

The study revealed that the seashell deposits in the study area are spatially distributed in Hatagala, Hungama, Kiula South, Kiula North, Lunama South, Lunama North and Bata Atha South. Industrial mining license holders are not interested in getting reimbursement of the cash deposit retained by the GSMB by post mining operations without fulfilling the permit condition on rehabilitation.

Strengthening of legal and institutional procedures in relation to shell mining, the introduction of alternative livelihood/skill development procedures, the introduction of a new mining plan, creation of awareness among stakeholders, and the introduction of monitoring procedures, are the proposed mitigatory measures in the study.

The major recommendations of the study are the implementation of the mining plan in collaboration with the stakeholders to control haphazard mining, the establishment of a committee to implement and monitor the mining and rehabilitation plan, monitoring under the guidance of the Central Coordinating Committee, an agreement on the proposed mining and rehabilitation plan as well as a monitoring mechanism with the Department of Wild Life Conservation, GSMB and the Divisional Secretary. Accommodating seashell miners, who could not be absorbed into the livelihood programmes within the industry in compliance with the mining guidelines, provision of suitable training and financial assistance to shell miners who are willing to accept alternative income generating opportunities, and proper skills development/alternative livelihood programmes for the school leavers and youths in the area to curtail the new entrants into the industry.

# CHAPTER 1 - INTRODUCTION

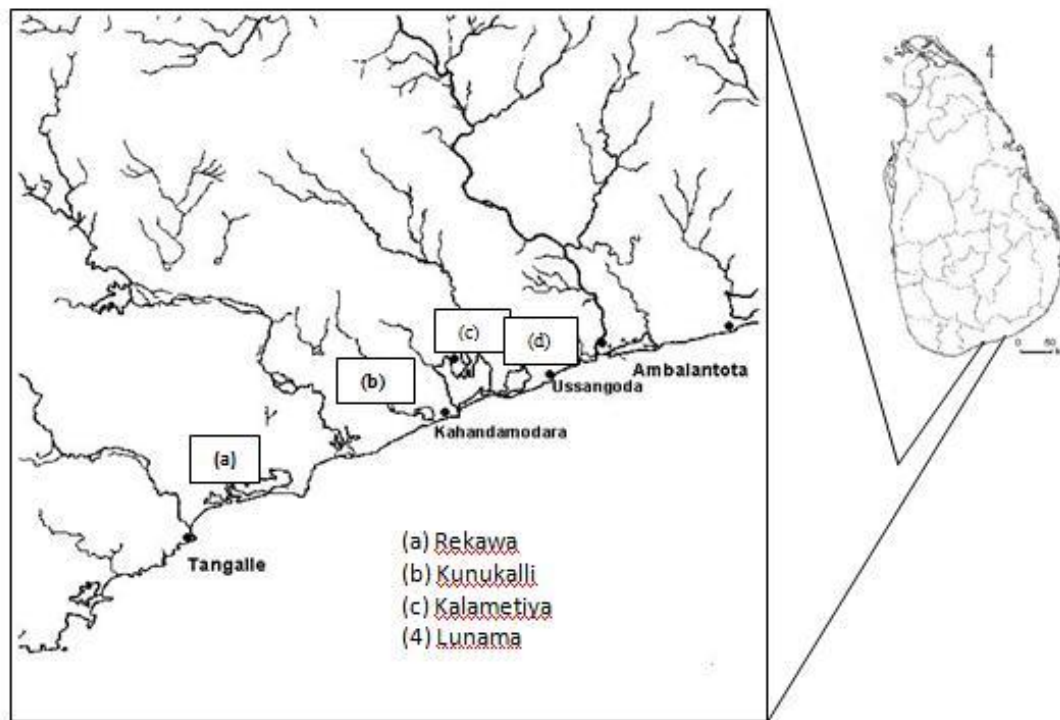
## 1.1 Background

The Rekawa, Ussangoda, and Kalametiya (RUK) area is located on the South -eastern coastline in the Hambantota District, which is about 200 kilometers from Colombo (Fig. 1.1). Administratively there are eleven Divisional Secretariat Divisions in the Hambantota District. Kalametiya and Ussangoda are located in the Ambalantota Divisional Secretariat Division while Rekawa is located in the Tangalle Divisional Secretariat Division.

The coastal area extending from Tangalle in the southern province to Potuvil in the Eastern Province has rich coastal biodiversity, which includes a variety of fauna and flora both in its terrestrial and marine habitats. A Major portion of the terrestrial area comes under Bundala, and Yala National Parks and Kalametiya sanctuary. The human influence on the coastal biodiversity in Yala and Bundala National parks is of a lesser magnitude due to their protected status and prevailing management systems. In contrast, the human influence on the coastal bio-diversity in Rekawa, Ussangoda and Kalametiya areas is comparatively high due to the fact that most parts of the ecosystems contain open resources with open access for which several groups of the local community compete. The submerged seashell deposits located in the coastal belt of Rekawa, Ussangoda and Kalametiya areas is one of the resources that has attracted the local community groups for their livelihood.

Coastal wetlands, lagoons, coral reefs, marsh and mangrove vegetation, scrub jungles, paddy lands, abandoned paddy fields, homesteads, salterns, deposits of seashell etc. are the major land and other resource types in the RUK area. The average diurnal temperature in RUK ranges from 26.6<sup>0</sup> C to 27.2<sup>0</sup> C while the average annual rainfall varies from 1000 to 1200 millimeters. According to the rainfall distribution, Kalametiya and Ussangoda are included in the Intermediate Zone while Rekawa is in the dry zone.





**Fig. 1.1 Location of the study (RUK) area**

Marine and brackish water deposits of coastal embayment contain high percentages of seashell & fragments and are therefore highly calcareous rather than siliceous. This calcareous material, which is used in the lime industry of Sri Lanka, has a long history that goes back to early times in Sri Lanka's history. But, in the recent times, the shell beds are extensively mined for chicken grit for production of lime and chemicals, by local people throughout the area along the southern coastal zone. The mining of shells continues with using family labour as well as outside labour on a daily paid or contract basis. Family members or neighbors continue the mining and cleaning operation from early morning till evening in their own lands as well as in the areas where mining is forbidden particularly scrub lands and marshy areas.

Assemblages of bivalve and univalve molluscs in these shell beds have accumulated due to eustatic changes as well as past coastal hazards. These shell beds are a "useful" geoscientific tool in the study of former sea-level strands that are significant for the industry. Along the southern coastal strip, seashell beds are concentrated mainly between Rekawa and Bundala.

The extent, composition, and thickness of these shell beds vary from location to location and some beds extend 4 - 6 km inland from the present coastline (Katupotha, 1994).

Deposits of seashell form an economically important natural resource in the RUK area. These deposits exist along the coastal belt from Gurupokuna to Bundala in the Hambantota District and are found below the surface of the earth. Spatially deposits of seashell are located largely in Rekawa, Ussangoda and Kalametiya (RUK) in the study area and small-scale mining has been carried out for the purpose of producing lime in the past.

The rate of mining in the recent past for the purpose of producing lime and supplementary food for livestock production has increased tremendously. The rapid growth of the construction industry and the demand created from the livestock sector are the major reasons for this situation. Strict law enforcement, a ban imposed on mining of sea coral and coral deposits in the coastal zone, and the absence of other sources of lime in this area have also contributed much to the increased rate of mining of seashells. This has led to the declining of quality and quantity of seashell deposits and at present only small scale mining is taking place for producing chicken grit which is used as an ingredient in chickenfeed.

In terms of the nature of prevailing deposits of seashell in the area, the manner in which the extraction is done is highly unsustainable and unsystematic. In the absence of proper livelihood opportunities for the local communities, a large number of persons are engaged directly and indirectly in the seashell industry. Deposits of seashell are an exhaustible resource. The resource has a fixed stock unless new deposits are found. Rapid unsystematic exploitation creates several socio-economic and environmental problems.

As far as socio-economic aspects are concerned, the social and economic issues relating to risk and uncertainty of continued mining of seashells were observed within the study area. This situation will lead to the loss of employment opportunities, and lowering the living standards of persons directly and indirectly engaged in the seashell industry. With regards to environmental aspects, the loss of biodiversity in the RUK area can be viewed as the major issue. This occurs due to the destruction of vegetation for mining seashells. It has been revealed that this area has lost most of its prime natural vegetation. The scrubs, stunted trees and wetlands provide suitable breeding grounds for different kinds of birds and other animals.

Unsystematic land use practices relating to mining in these areas have created a negative impact on the existence of wildlife. In many places, stagnant water bodies and muddy water pools exist as in abandoned pits. These provide ideal breeding grounds for malaria and other vector borne diseases. Land degradation due to concentration of calcium carbonate is also observed in this area. Discarded fragments of shells, silt, pits and mounds are responsible for this situation. Loss of soil fertility, depletion of micro flora and fauna and barren land are the results of the land degradation.

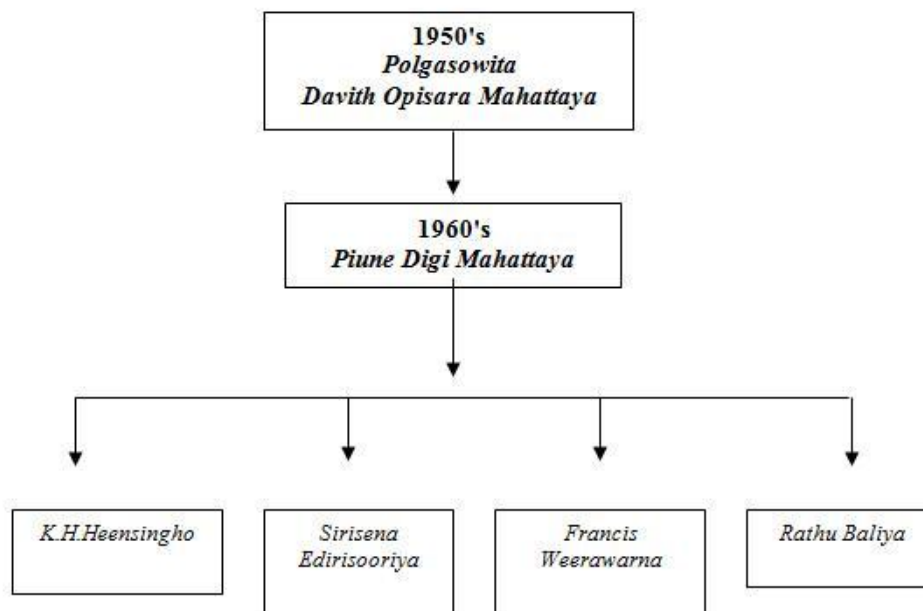
The illustrated facts show that several social, economic and environmental impacts have resulted from seashell mining in the RUK area and this calls for of an integrated approach to overcome these issues and to ensure sustainable use of the seashell resource within the Rekawa, Ussangoda and Kalametiya coastal areas.

## **1.2 Past and present situation of the seashell mining industry**

Historically the seashell mining and processing industry has been located in two prominent coastal districts viz. Hambantota and Batticaloa where buried deposits were in abundance. In terms of spatial distribution of the industry, Hungama, Lunama, Kalametiya, Bundala and Rekawa areas were significant in the Hambantota District. In the Batticaloa District, Passikudah Bay (Thannadi Bay area), Sallitiv and Kayankerni were the most important locations.

According to information provided by the local communities, the seashell mining industry in the Kalametiya area goes back to over 40 years. The industry commenced in late 1950's and was in operation as indicated in Fig. 1.2. A gentleman who came from Polgasowita (Horana) was the pioneer of the shell mining industry in the Kalametiya area in the Late 1950's. In the initial stages a person called *Heen Dingi Mahattaya* from Kalametiya village looked after the mining work on behalf of *Polgasowita Mahattaya*. According to the information provided by local communities, when Polgasowita Mahattaya started this activity, it was confined to mining and the mined shell resources were transported to outside areas as a raw material. He did not disclose details. All activities were kept secrete. Later Heen Dingi Mahattaya started mining activities on his own and four others too joined the mining activities in the area. In late seventies, it was expanded and many people entered the industry.

In the early years of this industry, almost all mining activities were carried out in state lands or crown reservations in the Kalametiya-Lunama area. However following the imposition of restrictions, introduction of mining licences and declaration of Lunama-Kalametiya areas as a sanctuary, people started mining in private lands. Subsequently the Ceylon Ceramic Corporation started a factory to produce lime along with the shell mining industry, which was developed in the area as a cottage industry.



**FIGURE 1.2 EVOLUTION OF SEASHELL MINING IN THE KALAMETIYA-LUNAMA**

### **1.3 Goals and objectives**

The objective of the project is to ensure conservation of biodiversity and sustainable use of this globally significant site through the development of a collaborative management system, actively involving local communities, NGOs and government agencies.

Globally significant environmental sites must ensure the conservation and sustainable use of their constituents and their biodiversity through development of a collaborative management system, actively involving local communities, NGOs and government agencies. Similarly, the main objective of this study is to formulate a sustainable management strategy in the RUK

area with a view to mitigating the social, economic and environmental impacts of shell mining and other associated activities. Therefore, this study intends to cover the following aspects:

- To investigate and assess the nature, extent and impacts of shell mining within the project area by reviewing secondary information.
- To determine the present status of sea shell mining in the project area
- To identify environmental and other related problems associated with shell mining in the area with special reference to the bio-diversity of the RUK ecosystem
- To provide management guidelines and recommendations for selecting suitable areas, method of mining and ways and means of back filling
- To develop landscape recovery methods in consultation with the relevant authorities
- To provide inputs to develop an alternative livelihood /skills development programme for the people who may have to give up mining
- To provide baseline information for future monitoring.

#### **1.4 Study outputs**

Formulating management guidelines for sustainable utilization of shell deposits, proposals for additional research and information on shell deposits available within the project area and a set of digital maps indicating spatial distribution of seashell deposits are the outputs of Task 1 & 2. Quantitative estimation on the present level of legal and illegal seashell extraction within the project area is the output of Task 3 & Task 4 concentrates on both quantitative and qualitative information on environmental problems associated with shell mining. Task 5 will produce information on adequacy, appropriateness, effectiveness and other impacts of ongoing intervention launched by government and the private and NGO sector institutions in arresting environmental degradation due to seashell mining.

The relevant legislation, their interrelationship, and the institutional mechanism based on adequacy, effectiveness and appropriateness are the output of Task 6. The socio-economic situation of seashell miners and their related activities, information on alternative livelihood/skill development opportunities and information on community preference for

identified livelihood/skill development are the main output of Task 7. The output of Task 8 is to recommend suitable areas for shell mining, the volume and methods, and a vulnerability assessment.

## 1.5 Tasks and methodology

The Table 1.1 shows the Task are Methods, which are related to this study.

**TABLE 2.1 TASKS AND METHODS**

<b>TASKS</b>	<b>METHODS</b>
<i>(1) Assessment of shell resource availability, current status of mining and environmental impact by reviewing existing secondary information</i>	A survey of literature and review of existing material based on physical, socio-economic, legal and institutional aspects of seashell resources and mining activities were carried out.
<i>(2) Assessment of the extent of seashell deposits available and then spatial distribution within the project area</i>	Reviewed available resource maps pertaining to distribution of seashell deposits within the project area and conducted field investigations to determine the amount of shell resources available within the project area. In this exercise, ground coverage of the resource, variations of depth of deposits and the percentage, and composition of deposits were investigated on a sample basis. After completion of the assessment, information on spatial distribution in the shell deposits were incorporated into 1:10,000 digital maps using GIS (Fig. 1.3). Annex 3 shows the variation of 46 mining sites, which were indicated in the map.
<i>(3) Assessment of present level of legal and illegal exploitation of seashells</i>	<p>The present level of legal shell mining within the project area was estimated by reviewing the permit information. In this process the following information was collected from GSMB.</p> <ul style="list-style-type: none"> <li>• The number of valid permits issued for removing seashell deposits within the project area.</li> <li>• The quantities allowed on each permit.</li> <li>• The number of permissible locations.</li> </ul> <p>The actual level of legal exploitation was assessed through official estimates derived from permits and on site field investigations.</p> <ul style="list-style-type: none"> <li>• Indirect research tools such as the observatory method were employed to estimate the level of illegal mining and the number of persons engaged in such illegal mining within the project area.</li> </ul>

<p>(4) <i>Assessment of environmental problems occurring from seashell mining within the project area</i></p>	<p>This study was carried out in two steps as follows</p> <ol style="list-style-type: none"> <li>1. Study of the general biodiversity of the study area.</li> <li>2. Identification and assessment of environmental and other related problems arising from current shell mining practices with special reference to any adverse impacts on the biodiversity of ecosystems in the project area.</li> </ol> <p>The field survey covered the following ecosystems</p> <ol style="list-style-type: none"> <li>a) Forest cover</li> <li>b) Mangrove areas</li> <li>c) Sand dunes</li> <li>d) Salt marshes and adjacent aquatic ecosystems</li> <li>e) Homesteads</li> <li>f) Agricultural areas</li> </ol> <p>Identification and a qualitative assessment of the faunal and floral biodiversity of these ecosystems were done through visual observations and interviews with the local communities.</p> <p>Following the preliminary investigations, types of vegetation and associated faunal distribution were studied in detail in selected sites based on the level of mining. The study area was divided into three categories and sampling was done under each category. These three categories were,</p> <ol style="list-style-type: none"> <li>a) Ongoing shell mining areas</li> <li>b) Abandoned shell mining areas</li> <li>c) Potential shell mining areas</li> </ol> <p>Sampling sites under the above categories were selected after studying the site map and the sampling of the vegetation and fauna was carried out during the daytime from 8.00- 18.00hr. Line transects of 5m x 25m were used for sampling. 21 samplings were carried out within the study area (Annex 1). The locations are given in Map 1. In addition to the sampling, the local communities were interviewed to obtain an idea of the original faunal and floral distribution of the area and to assess the adverse impacts of shell mining on the biodiversity, well - being of the environment and the public health of the community.</p> <p>The species diversity of plants under each category was calculated using Shannon's Diversity Index <math>(H') = P_i \ln P_i</math> where <math>P_i</math> is the proportional abundance of the species.</p>
<p>(5) <i>Evaluation of effectiveness of government, private and NGO sector initiatives in arresting environmental degradation caused due to seashell mining</i></p>	<p>Interviews were conducted to obtain necessary information from the relevant government and private sector institutions and NGOs, within the project area. Public education and awareness, legal and institutional development and other conservation measures were the major interventions considered for fulfilling this task.</p>

<p><i>(6) Evaluation of relevant legislation their interrelationships and institutional mechanism for implementation</i></p>	<p><b>(Step 1)</b> Prepared existing legal provisions and/or regulations, their interrelationships pertaining to seashell mining, processing, and transportation by reviewing all relevant legislation.</p> <p><b>(Step 2)</b> Evaluated the existing legal provisions and/or regulations pertaining to seashell mining, processing and transportation using certain criteria and formulated recommendations to improve of legal framework for sustainable management. Criteria used:</p> <ul style="list-style-type: none"> <li>• Degree of adequacy</li> <li>• Degree of effectiveness</li> <li>• Degree of appropriateness</li> </ul> <p><b>(Step 3)</b> Assessment of the existing institutional mechanism in implementing legislation related to seashell mining and related areas was carried out in the following manner</p> <ul style="list-style-type: none"> <li>• The type of institution involved in implementing legal provisions and /or regulations</li> <li>• Institutional capabilities in implementing such provisions</li> <li>• Constraints and weakness in implementing legislation</li> <li>• Identification of areas to be improved in relation to implementing legislation</li> </ul>
<p><i>(7) Assessment of socio-economic status of people involved in seashell mining, processing and marketing and identification of potential alternative livelihood/skill development for those who are willing to give up shell mining</i></p>	<p><b>(Step 1)</b> A pre-tested structured questionnaire was administered to the related total population within the project area to assess the socio-economic status of people involved in lime production and marketing, Data and information were collected during the socio-economic survey emphasizing the following:  Population and age distribution  Level of education  Housing conditions and amenities  Nature of activities  Level of income  Resources and skills</p> <p><b>(Step 2)</b> Identification of alternative livelihood and skills development opportunities for shell miners was carried out based on the findings of the socioeconomic status of the target population by matching their preference with the available opportunities.</p> <p><b>(Step 3)</b> Based on the socio-economic information collected from step1 of the above task, an attitude survey was carried out on a sample basis to identify the community preference for alternative livelihood/skills development. In this respect pre identified alternative livelihood/skills development opportunities were offered in the form of an incentive package.</p>
<p>8. Identification of suitable areas, allowable volumes, methods for mining and back-filling</p>	<p>A vulnerability assessment was conducted to identify suitable areas for back filling and rehabilitation.</p>



## **1.6 Limitations**

The following environmental, social and administrative constraints were encountered during the assignment period, which caused delays and some difficulties in the study process.

- The incidence of severe floods in the Hambantota area during the early stages of the survey caused difficulties in field investigations and obtaining support of the GSND in the study area. In consideration of the situation caused by floods, the field investigations were postponed until the situation achieved to normal.
- Lack of accurate secondary information on the availability of resources, and the number of legal and illegal seashell miners posed difficulties in estimating the amount of past resource extraction and evaluating the trends.
- It was difficult to conduct focus group discussions with the illegal shell miners in the RUK area at the early stages of the survey. However, with the help of a few villagers an effective relationship was build up with the illegal miners at a latter stage.
- The poor relationship between the seashell miners and the field officers of the donor funded projects within the study area showed negative attitudes in the ongoing surveys. Hence, the overall goals, objectives and suggested strategies had to be explained to the stakeholders to prove transparency.

## CHAPTER 2 - GEOGRAPHICAL SETTING

### 2.1 Physical Environment

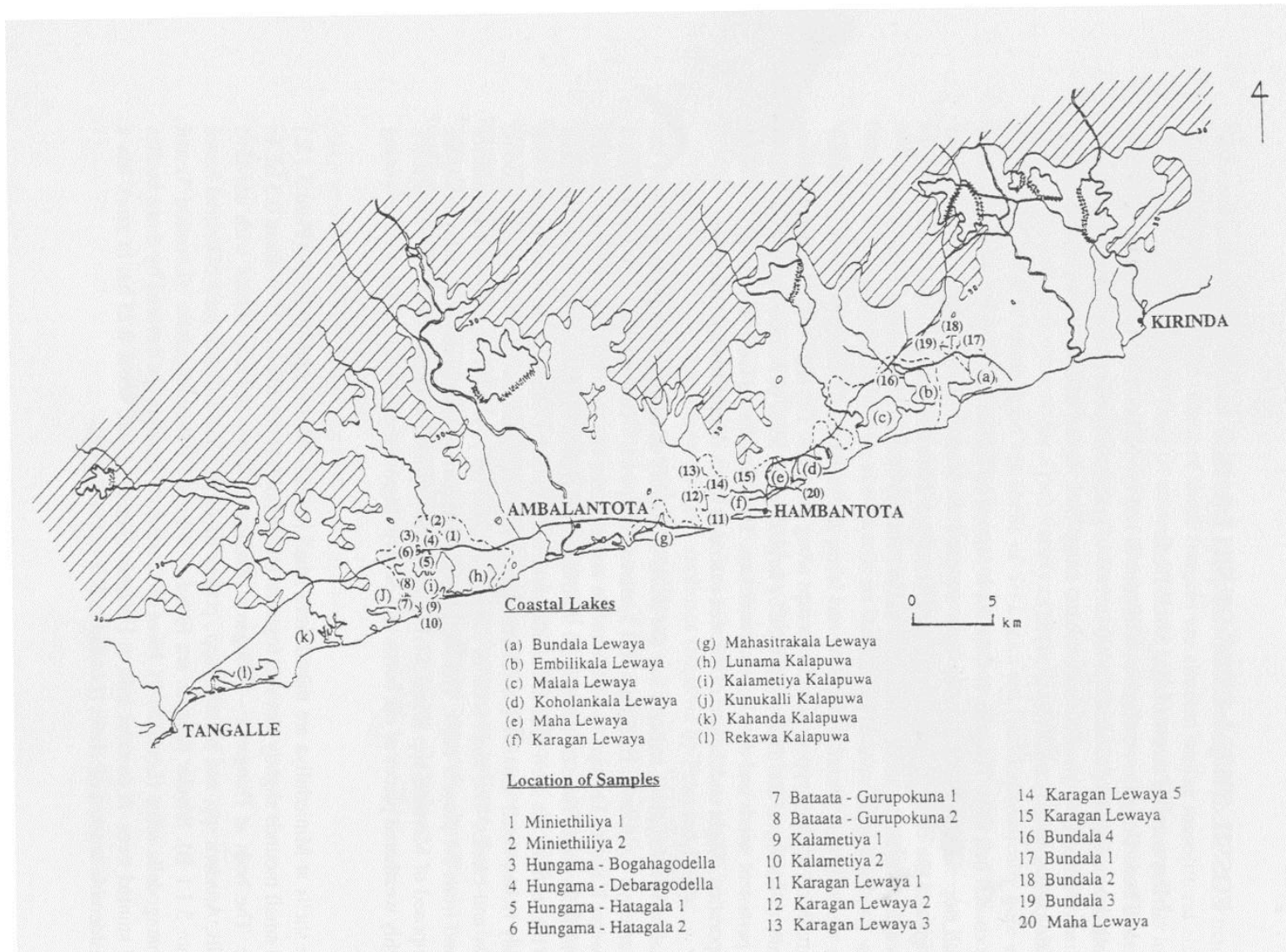
Extensive shell beds have been located between Rekawa Lagoon and Bundala Lewaya (from Hungama to Pallemalla) area on the southern coast (within longitude  $80^{\circ} 48' - 81^{\circ} 16'$  and latitude  $6^{\circ} 02' - 6^{\circ} 12'$ ). The study area, described here is situated within longitude  $80^{\circ} 48' - 81^{\circ} 00'$  and latitude  $6^{\circ} 02' - 6^{\circ} 12'$  (Fig. 2.1). Physical features and their characteristics including geological structure, landforms, climate, natural vegetation and soil have been responsible for extension of seashell beds in the Kalametiya–Lunama area (Fig. 2.2). Land use in the area shows that mining of seashells is one of the economic activities.

#### 2.1.1 Geology

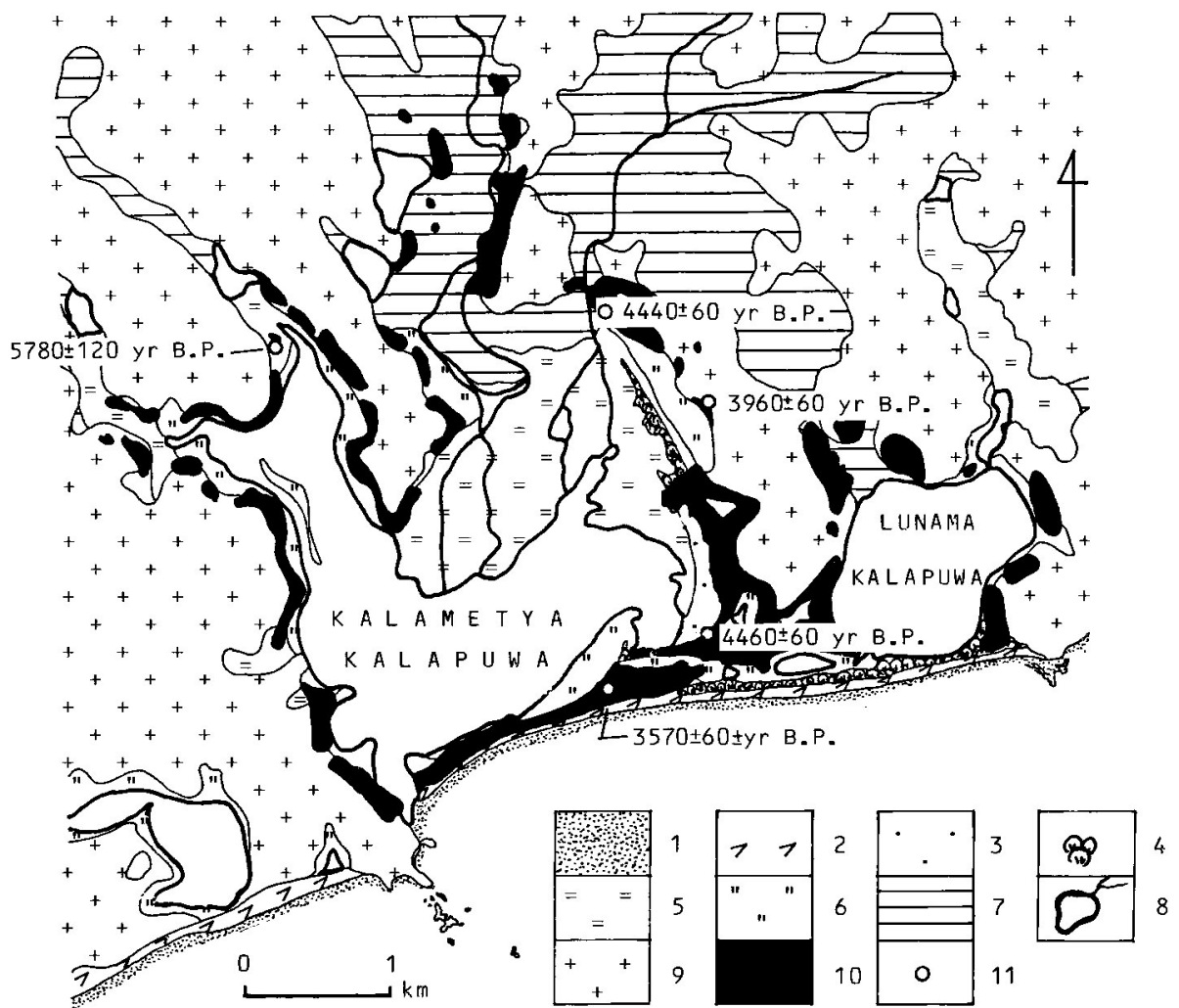
The right bank of the Walawe Ganga, which is the study area, is located underlain predominately by Highland Complex rocks (predominately granulate facies rocks) of Precambrian age, whilst the left bank consists of biotitic gneiss, hornblende-biotitic gneiss, magnetic and granitic in parts of the Vijayan Complex (Hapuarachchi, 1967 & 1968; Balendran, 1968; Geological Map of Sri Lanka, 1983; Cooray 1984). According to the Canada - Ceylon Colombo Plan Project (Resource of the Walawe Ganga Basin, 1980), the study sites consist of two types of rocks;

- (a) Hornblende and biotitic gneisses with associated pegmatite and migmatite (Vijayan Series rocks).
- (b) Quartz-feldspathic gneiss and granulite (Khondalite Series rocks).

These rock types have evoked a different morphological response. Due to this response headlands are spaced far apart and long barrier beaches, lagoons, estuarine deltas and ill-drained land have formed behind them (Swan, 1983). The zone of Quaternary deposits here is somewhat narrow due to the extension of low hills and ridges close to the sea and lie on the Highland Complex and Vijayan Complex. In the study area, shell beds have extended on this narrow coastal strip as Holocene deposits.



**Fig. 2.1 Extension of seashell beds along the southern coastal zone (Katupotha, 1994)**



- |                               |                                 |
|-------------------------------|---------------------------------|
| (1) Foreshore                 | (2) Sand dune                   |
| (3) Beach ridge               | (4) Mangrove swamp              |
| (5) Wasteland                 | (6) Marsh                       |
| (7) Food and valley plain     | (8) Water hole, lake and stream |
| (9) Residual hills and ridges | (10) Emerged seashell beds      |
| (11) Sample locations         |                                 |

**Figure 2.2 Map showing the extension of seashell beds in the Kalametiya-Lumana area**

### **2.1.2 Geomorphology**

Based on elevation, micro reliefs and the composition of the deposits, the southern coastal zone of Sri Lanka can be divided broadly into three regions (Katupotha, 1992) -

- (a) Flat terrain (Lowland I, <30 m)
- (b) Flat to slightly undulating terrain (Lowland II, <30 m)
- (c) Undulating terrain (Lowland III, 30-150 m).

Out of these three, the Flat Terrain (Lowland 1) is significant, because the extension of all the seashell deposits are concentrated in and limited to this terrain. Lowland 1 is a completely flat terrain whose slope is  $1/2^{\circ}$  or  $1^{\circ}$  (1:100 or 1:60 in gradient). The coastal belt, which borders the seaside to the east of Tangalla is formed of narrow and long beaches, beach ridges with medium and somewhat high dunes. In some places of the study area the dunes reach heights of 5 to 12 m, and have developed on bedrock or in some places on beach rock. Salterns, salt marshes and mangrove swamps and mound topography (a hummock relief) lie behind them. These features also reflect the configuration of the underlying bedrock surface. The bedrock outcrops, which are too small and too low, appear as erosional remnants. Sand spits are common features at the estuaries of the Walawe Ganga and the lagoons of the study area. Both well drained and imperfectly drained mixed Aeolian, residual and alluvial soils occupy these areas.

### **2.1.3 Soils**

Main soil types in the study area have a close relationship with the geological characteristics, micro relief and climatic conditions. Based on the Soil Map of Sri Lanka, Four main Soil Groups in the study area along the southern coastal zone are identified as follows:

- (a) Reddish Brown Earths with a high content of gravel in subsoil & Low Humid Gley Soils
- (b) Reddish Brown Earths & Solodized Solonetz (both (a) and (b) types lie on the undulating terrain)
- (c) Alluvial Soils of variable drainage and texture cover flat valley bottoms, water logged areas etc.

- (d) Regosols on recent beach and dune sand form barrier beaches, beach ridges, sand spits and dunes along the coast.

Granitic gneiss, quartzite, hornblende gneiss and hornblende-biotitic gneissic rocks form rock-knob plains and Erosional remnants in the coastal plain. The seashell beds in the study area are widely covered and mixed with the Reddish Brown Earths with high amount of gravel in the sub soil, low Humid Clay Soils and Solodized Solonetz in undulating and flat terrain.

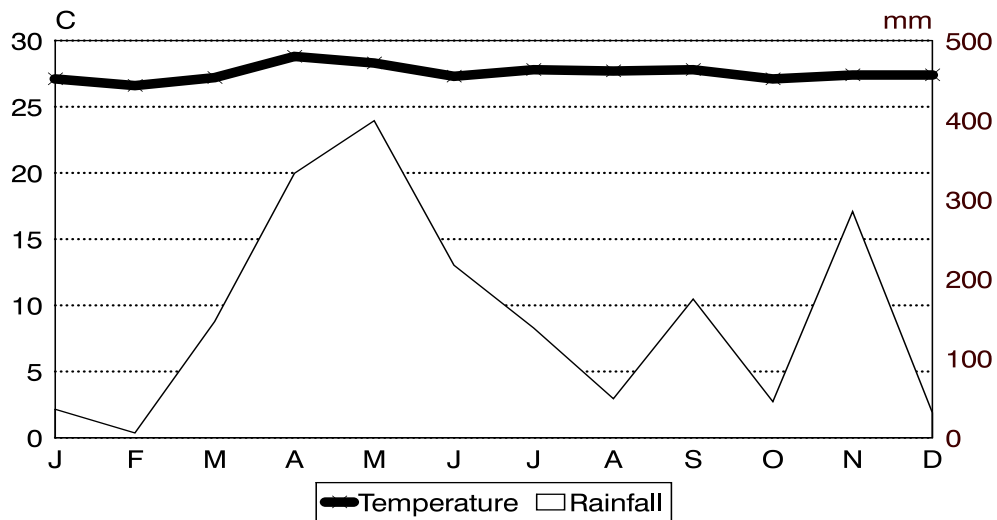
#### **2.1.4 Climate**

According to the Köppen classification, the southern coastal zone, from Matara to Bundala is classified as 'Afw''i, Amw''i, 'Asi' and 'Bsh' climates (Thambyapillai, 1960). Kalametiya and Lunama Lagoon areas are located in the Dry Zone, and also within the agro-ecological region DL<sub>5</sub> (Dry Zone low country).

The nearest stations are Nalagama (Tangalle), Hambantota and Mamadola. Within this triangle area, during a period of fifteen years (1979 - 1994), the rainfall has varied between 725 mm and 1300 mm. The mean air temperature has varied between 27.0 °C and 27.5 °C. This shows diurnal and seasonal variation, and the highest figures vary between 27.5 °C and 28.8 °C (Nakagawa et al., 1995). It is evident that there have been no drastic changes of rainfall and air temperature during the past ten years.

The selected rainfall stations in the southern coastal zone show two maximum seasons ((Fig. 2.3) during the Southwest monsoon (May to September) and the convectional-cyclonic-depression (October to November).

The ecosystems in the area under study consist of several habitat types, namely, natural forest cover, mangroves, sand dunes, salt marshes and adjacent aquatic ecosystems, homesteads and agricultural plots and show different vegetation patterns. The distribution and extent of these habitat types on the southern coast have a close relationship with geological structure, local relief, climate, soil and drainage. There are somewhat different from those on western and southwestern coasts.



**Figure 2.3 Monthly variations in temperature and rainfall in the Hambantota area**

## 2.1.5 Natural vegetation and land use

### Natural forest cover

Natural forest cover is sparse. Nevertheless scattered pockets can be seen. These consist of typical arid vegetation of thorny, bushes shrubs and small trees that are well adapted to xerophytes conditions. In most areas Prickly Pear (*Opuntia delenii*) seems to dominate together with species such as *Euphorbia antiquorum* (S: Daluk) and *E. tirucalli* (S: Navahandi), *Zizypus mauritiana* (S: Masan), *Carissa spinarum* (S: Karamba), *Z. oenoplia* (S: Heen earminiya), *Z. rugosa* (S: Maha Eraminiya) and *Dichrostachys cinerea* (S: Andara). Annex 2 gives the types of forest vegetation observed in the study area.

### Mangroves

Small fringes of mangrove are seen along the lagoon edge of the study area. They are highly degraded. Mangals are dominated by *Avecennia marina* (S: Manda, mada gas), *Sonneratia caseolaris* (S: Kirala), *Lumnitzera racemosa* (S: Beriya), *Brugiera sp.* (S:

*Kadol*), *Ceriops tagal* (S: *Punkanda*, *Rathu gas*) and *Excoecaria agallocha* (S: *Thela*). Mangrove associates such as *Clerodendrum inerme* (S: *Wal gurenda*) are also common. Annex 2 gives the types of mangrove vegetation observed in the study area.

## **Sand Dunes**

There are coastal sand dune ridges with a width extending upto 25m in certain places bordering the sea. These dunes have been largely transformed into homesteads, coconut plantations and shell mines. Fringes of very tall *Pandanus* (S: *muhdukeiya*) (*Pandanus tectorius*) grown in clumps in a few places was a special feature observed. Among the natural vegetation in the dunes, a typical xerophytic bush, Prickly Pear (*Opuntia delenii* – S: *Pathok*) seems to have invaded the dunes. The same species is seen growing successfully in dune areas that have been abandoned after mining. Other common xerophytes included species such as *Euphorbia antiquorum* (S: *Daluk*) and *E. tirucalli* (S: *Navahandi*). Annex 2 gives the types of sand dune vegetation observed in the study area.

## **Salt marshes and adjacent aquatic ecosystems**

Lagoon vegetation is dominated by marsh vegetation of *Typha latifolia* with sedges and floating macrophytes such as *Salvinia* sp and Water Hyacinth (*Eichornia crassipes*). Flood zones of the lagoon are predominated by grasses and heavily used for cattle/goat grazing. Annex 2 gives the types of aquatic vegetation observed in the study area.

## **Homestead vegetation**

Homestead vegetation is predominated by coconut cultivation and undergrowth that consist of species such as Citrus varieties ( e.g. *Citrus aurantifolia* – S. *Dehi* and *Memecylon* sp. S. *Dodam* ), *Punica granatum* (S: *Delum*) and *Ananas comosus* (S: *Annasi*). Annex 2 gives the types of vegetation observed in the study area.

### **2.1.6 Faunal distribution of the area**

As the study area contains both freshwater and brackishwater habitats (i.e the Kalametiya lagoon and the freshwater hole), fauna associated with these two aquatic habitats is the most prominent. A rich bird life is seen in the study area mainly around the water hole and



the lagoon. Nearly 50 species of birds were observed in this survey. However, around 151 species of birds of which 54 are migrants have been recorded previously (CEA, 1995). Lapwings (*Vanellus* sp.- S: Kirala), coots (*Pophyrrio* sp. S: Kithala) and White breasted waterhens (*Amaurornis phoenicurus*- S: Laya sudu korawakka) were seen among reeds and herons of several genera (eg.: *Ardea* sp., *Ardeola* sp. *Egretta* sp. *Ixobrychus* sp.) spoonbills and cormorants (*Phalacrocorax* sp.- S: Diyakawa) were seen in the freshwater hole. A peacock (*Pavo cristatus*- S: Monara) and a hen (S: sebada) were seen in the open grass area. People of the area reported the sightings of the endemic Sri Lanka Jungle Fowl (*Gallus lafayetti* –S: Lanka vali kukula). Fish catches among the local fishermen consisted of *Tilapia* sp., stinging cat fish (*Heteropneustes fossilis* – S; Hunga), Brown snakehead (*Channa gachua* - S: paradal kanaya) and Pearl Spot (*Etroplus suratensis* – S: Koraliya). Among the reptiles observed in the area were, Green garden lizard (calotes calotes – S: Pala katussa), Water monitor (*varanus salvator*- S; Kabaragoya), Land monitor (*Varanus cepedianus*- S: thalagoya) Sand skink (*Mabuya bibronii*- S: Le hikanala). Among mammals, prominent species were the Toque monkey (*Macaca sinica* –S: Rilawa) and Grey langur (*Presbytis entellus*- S: Alu wandura). Grey mongoose (*Herpestes edwardsi* - S: Alu mugatiya) is another common mammal observed. There were reports of wild boar (*Sus scrofa*) killings from the area. Palm squirrel (*Funambulus palmarum*- S; Iri lena) was a common sight. Annex 2 gives the list of fauna observed in the study area.

## **2.2 General Social and Economic Conditions**

### **2.2.1 Demography**

The total population of the Hambantota District is estimated at 525,370 (Census and Statistics Department, 2002). The average annual population growth rate during 1981 to 2001 is 1.1 percent, which is slightly lower than the national average. The Hambantota district has 11 Divisional Secretariat (DS) divisions. As regards population, Ambalantota and Tangalle are the largest DS divisions. Rekawa, Ussangoda and Kalametiya (RUK) are located in Ambalantota and Tangalle Divisional Secretariat (DS) divisions. The total population in the RUK area is 9375, which is about 7 % of the total population in these two DS divisions. In terms of male and female ratio, the percentage of males in Hambantota is 51% while in Tangalle it is 49%.

### **2.2.2 Social stratification**

Hambantota District has the largest Sinhalese population in Sri Lanka (97.1 %) (Census & Statistics Department, 2002). The Sri Lanka Moors are only 1.2 percent. The Ambalantota and Tangalle DS divisions are predominantly Sinhalese areas and 96 percent of them are Buddhist. This situation prevails also in the RUK area. The average literacy rate in the Hambantota district is 91.1 percent and the survey also revealed that the average literacy rate in the RUK area is relatively high.

### **2.2.3 Economic status**

The active labour force in the Ambalantota DS division is over 50 percent of its population and the unemployment rate is around 17 percent. Agriculture, trade & related services and fisheries are the major sectors that provide employment opportunities. However, due to the existence of sea shell deposits, sea shell mining and related activities have become the major economic activities in the RUK area.

The average level of monthly income of the people in Hambantota is relatively low. For instance, the total number of "Samurdhi" household in 2001 was 78574 representing 58 percent to the total number of household. In regards to Tangalle and Ambalantota these numbers were 53 and 50 percent respectively (The Department of Poor Relief, 2002). The absence of a regular monthly income, frequent price fluctuations in agricultural and fisheries products, and risk and uncertainty in the mining sector have contributed much to the fluctuation of income.

## **CHAPTER 3 - ASSESSMENT OF SEASHELL RESOURCES AND LEVEL OF MINING IN THE RUK AREA**

### **3.1 Spatial Distribution and Quantity**

#### **3.1.1 Extent, composition and the total quantity**

The following steps were used to examine the composition and to calculate the extent and the quantity of seashell resources in the study area.

##### **Step1: Preparation of facts/assumptions**

- 80% of the total seashell production in the southern region is generated from the study area. This was based on the existence of extensive shell deposits and the number of permits issued for the shell mining industry.
- The extent of Kalametiya and Lunama lagoonal water bodies were excluded in estimating the total quantity of seashells
- In terms of lengthwise, the distribution of seashells in the RUK area was 20% of the total seashell belt along the southern coast
- The commercial scale seashell mining is being done for 30 years in the study area
- Weights were introduced to estimate the total quantity of seashell deposits
- The composition ratio of seashells and the soil in the mining materials is 1:3
- One cubic meter of seashell is equal to one metric ton of seashell
- 80% of the land in the study area is located within the sanctuary and environmentally sensitive areas such as sand dunes, lagoonal edges and state land.
- 10% sensitivity range has been used to estimate the seashell deposits available for future extraction in the private lands
- The current annual extraction rate of seashell deposit in the southern region is 1240 metric tons (Source: GSMB Annual Report 2003)
- The current seashell stock in Kalmetiya-Lunama is estimated by adapting the following equation.

$$S_t = S_0 - \sum_{=0} (H_t - R_t) \text{ where}$$

$S_t =$  initial stock  
 $S_0 =$  current stock  
 $H_t =$  amount extracted  
 $R_t =$  amount recycled

## **Step 2: Identification of the sample points in the study area**

- The methodology adopted to identify sample points was based on quasi random selection of open pits and soil auger investigations.
- Exact locations of the sample points were determined by using GPS
- The total number of sample points identified in the study was 67, and of these 46 points were open pits while 21 were soil auger observations (Annexes 3).

## **Step 3: The measurement of the thickness of seashell layers in the sample points**

- The soil auger was used to collect the soil logs in the identified locations and thickness was measured using a measuring scale
- With regard to open pits the thickness of the seashell layer was measured using a measuring tape

## **Step 4: Determination of the distribution of seashell deposits in the study area. This involved following two sub steps**

- a) Determination of the total area (land and water bodies) using the topographic map (1:50,000) prepared by the Survey Department, and
- b) Determination of the total land calculated by using the following equation

$$\text{Total land area} = \text{Total area} - \text{Extent of water bodies}$$

### Step 5: Computation the total quantity of seashell deposits in the study area

- The number of grids in the total land area, weights and the thickness of layers were used to calculate the total quantity
- Weights were calculated based on the average thickness of different categories and their distribution in the study area

### Step 6: Estimation of the quantity of seashell deposits extracted in the past

- Secondary data and information published by the GSMB were used. According to GSMB the average annual extraction of seashell deposits in the southern region over period of eight years is 6460 metric tons.
- The above figure was used to calculate the total seashell deposits extracted in the past

### Step 7: Estimate the available seashell deposits at present in the study area

Available Shell deposits = Total quantity of sea shell deposits – quantity of deposits already extracted

## Results of the study

Table 3.1 shows the thickness of seashell layers in different categories and their weights.

**TABLE 3.1 THICKNESS OF LAYERS OF SEASHELL IN DIFFERENT CATEGORIES**

<b>Thickness of the shell layer (cm.)</b>	<b>Average thickness (cm.)</b>	<b>Number of observations</b>	<b>Weight *</b>
0	0	16	0.239
1-25	13	16	0.239
26-50	38	13	0.194
51-75	62.5	09	0.134
76-100	88	04	0.060
101-125	113	05	0.074
126-150	138	02	0.030
150>	202.5	02	0.030
<b>Total</b>		<b>67</b>	<b>1.000</b>

Source: Field Survey, 2003

\* Weight was calculated by using the following formula

$$\text{Weight} = \text{Number of observations} / \text{Total number of observations}$$

- The total extent of the study area including the water bodies is 14 sq. km (based on the topographic map 1:50,000). Since the extent of the water bodies is 8.5 sq. km. the total land area is 5.5 sq. km.
- The average size of an open pit is 8' x 5' (2.4m x 1.5 m. ) = 3.6 sq. m. This figure was obtained through field observation and discussions with seashell miners.
- The total number of grids (average pit size) in the study area is 1,527,778
- Table 4.2 shows the number of grids in different categories, calculated using weights

**TABLE 3.2 NUMBER OF GRIDS IN DIFFERENT CATEGORIES**

Category	Weight	Number of Grids
1	0.239	365139
2	0.239	365139
3	.194	296389
4	.134	204722
5	.060	91667
6	.074	113056
7	.030	45833
8	.030	45833
<b>Total</b>	<b>1.0</b>	<b>1527778</b>

Source: Field Survey, 2003

The total quantity of seashell deposits in the study area is 650,703 cu. m, and details are given in table 3.3

**TABLE 3.3 TOTAL QUANTITY OF DEPOSIT OF SEASHELL IN THE STUDY AREA**

Category	Thickness of the Layer (m)	No; of grids	Quantity in Cubic metres
1	0	365139	0
2	0.125	365139	45642
3	0.380	296389	112628
4	0.625	204722	127951
5	0.880	91667	80667
6	1.130	113056	127753
7	1.380	45833	63250
8	2.250	45833	92812
<b>Total</b>		<b>1527778</b>	<b>650703</b>

Source: Field Survey, 2003

The total quantity of seashell deposits in the study area is 650,703 cu. m, and details are given in table 3.3.

- The total quantity of seashell deposits in the study area is 216,901 metric tons
- The total quantity of the seashell deposits extracted in the past (over 30 years) in the study area was 155,040 metric tons
- The total available seashell deposit in the study area is 61,861 metric tons.
- The available quantity of seashell deposits for future extraction is in the range of 11035 to 13610 metric tons
- The estimated time periods for future seashell mining in the Kalamatiya Lunama area are 5-8 years and 9 to 11 years based on two scenarios.

**Scenario 1.** If the range of extraction is 1350 – 1700 metric tones, the mining period should be 5 – 8 years.

**Scenario II.** If the rang of extraction is 1200 – 1500 metric tones, the mining period should be 9 – 11 years.

## **3.2 Present level of legal and illegal mining**

At present a total of 19 permit holders having 26 permits, both individual and group, are legally engaged in mining activities within the project area (GSMB, 2003). At the same time more than 50 persons were also engaged in illegal shell mining activities.

### **3.2.1 Nature and organizational structure**

In terms of organizational structure shell, mining could be classified into four categories. These categories are the individual permit holders, group permit holders, homestead illegal miners and state land illegal miners. It is evident that most of the individual permit holders are comparatively rich people and they use hired labour as well as family labour for the industry. Group permit holders are mainly *Samurdhi* recipients and with the support of the Divisional Secretariat, they have formed themselves into small groups. The homestead miners carry out mainly small-scale illegal mining in their home gardens or private lands. Miners who use state land for illegal mining also carry out their activities mainly in small groups but comparatively larger scale.

### **3.2.2 Spatial distribution and quantity of legal mining**

The spatial distribution of seashell mining with permits in the study area is primarily concentrated primarily in Kalametiya-Lunama. Mining activities take place largely on private lands out side the sanctuary area. The ownership of the mining lands located within the sanctuary area is claimed by the miners even though area has been declared a sanctuary. At present a total of 28 mining license have been issued by GSMB for of 2002 for the southern region. The average annual extraction of seashells over a period of eight years from 1994, within the study area is about 6460 metric tons. However, the extraction rate shows a declining trend and an amount of 1550 metric tons were recorded in 2002. These figures could change depending on depend on the weather conditions of the year and the selling prices.

### **3.2.3 Spatial distribution and number of illegal miners**

The illegal seashell mining within the project area is concentrated largely on land within the sanctuary, coastal dunes, private land and homesteads in Kalametiya, Hatagala and Lunama. According to field investigations, the number of persons involved in illegal shell mining has been estimated to be in the range of 50-100. This number may also change



depending on the weather conditions in the study area, the level of law enforcement and the buying prices.

### **3.3 Environmental Impact Associated with Shell Mining**

#### **3.3.1 Nature and significance of sea shell mining**

The nature and significance of seashell mining are described under ongoing shell mining areas, abandoned shell mining areas and potential shell mining areas.

##### *(a) Ongoing shell mining areas*

Ongoing shell mines are found in several types of habitats, namely, among natural forests, sand dunes, homesteads, mangroves and flood zones falling within the lagoon reservation of the Department of Wildlife Conservation (DWLC). Seashell mining is practiced in areas where there is natural forest cover but is confined to open spaces (mostly grass or herb patches) and the large and small trees and the thorny shrubs/bushes/small trees remain intact. Only a single ongoing shell-mining site contained very large trees such as Kiri nuga, Kohomba, Nerol, Kon and Divul in its surroundings. This particular site had also associated vegetation consisting of a variety of other trees, shrubs and bushes (e.g. Masan, Katukeliya, Kos Atta, Ranawara, Komkinna, Masbedda, Nava handi, Endaru, Kumburu) and creepers [e.g. Ken wel, Hatti wel, Heerassa palu). The plant species diversity index ( $H'$ ) of this site was 1.8431 (Annex 1). In other ongoing mining sites, typical arid thorny vegetation types (e.g. Prickly Pear (*Opuntia delenii*) *Euphorbia antiquorum* (S: Daluk) *E. tirucalli* (S: Navahandi), *Zizypus mauritiana* (S: Masan), *Carissa spinarum* (S: Karamba), *Z. oenoplia* (S: Heen earminiya), *Z. rugosa* (S: Maha Eraminiya) and *Dichrostachys cinerea* (S: Andara)] were found around the sites. Such sites showed a high plant species diversity index ( $H'$ ) (e.g. 1.31266) (Annex 1).

Dune associated with ongoing shell mine sites showed a considerable destruction to their primary vegetation. Burnt down Pandanus were evident in one site and most of the vegetation in other sites had been removed in the process of mining. Uprooted coconut trees were common in dune areas with eroded tunnels, which had been excavated for shell collection.

Homestead mining operations were very common in the study area. Pits have been excavated among coconut plantations in the homesteads resulting in the uprooting of coconut trees.

Open areas in the flood zones, which fall within the lagoon reservation of the Department of Wildlife Conservation (DWLC) had ongoing mining sites. Destruction of some vegetation was observed in these sites but the adjacent vegetation consisting of mangroves and associates remained intact.

On going mining sites in the mangals have caused a considerable damage to the mangals. Most of the mangals in these sites have been cut off for mining operations. Few trees of species such as *Avecennia marina*, *Sonneratia caseolaris*, *Lumnitzera racemosa*, *Brugiera sp.* and *Excoecaria agallocha* were seen as isolated small clumps or individuals. Such areas had a low plant species diversity index ( $H'$ ) (e.g. 1.0438) (Annex 1).

**(b) *Abandoned shell mining areas***

Abandoned shell mining areas showed three types of vegetation, namely,

- newly abandoned areas with a thin growth of heavily grazed grass patches and random growth of clumps of weeds with a low plant species diversity index ( $H'$ ) (0.89951 –0.1.12566) (Annex 1).
- old abandoned areas with a secondary vegetation dominated by Lokkan nattan Pathok, and young trees of Andara, Divul ,Nika, and Kohomba with a varying plant species diversity index ( $H'$ ) (e.g. 0.89951- 1.64597 ) (Annex 1).
- Abandoned shell mining areas in homesteads replanted with coconut trees

**(c) *Potential shell mining areas***

Only a few potential shell-mining areas are found within natural forest cover, sand dunes, homesteads, mangroves and flood zones not falling within the lagoon reservation of the Department of Wildlife Conservation (DWLC). The vegetation in these potential areas is similar to those given under the section on qualitative assessment of general vegetation in the study area in this document. The quantitative assessment reveals that the identified potential areas have a high plant species diversity index ( $H'$ ) (e.g. between 1.37586 –

2.11421 with an exception of 0.9987 in one site). Higher indices are always associated with areas where natural forest cover is found (Annex 1).

### **3.3.2 Impact of seashell mining on fauna and flora**

Reduction in species diversity of flora is clearly evident in some areas. Most affected are dunes and mangroves. Dune and mangrove vegetation have been cleared for mining operations in on-going sites. A secondary vegetation of shrubs and small trees consisting of fewer species can be seen growing in old abandoned areas while newly abandoned areas have been replaced with a thin growth of heavily grazed grass patches and random growth of clumps of weeds. However, a rich floral diversity can still be seen in the natural forest cover, which has survived as isolated pockets within the study area. Homestead vegetation, particularly the coconut vegetation in the study area is severely affected as many people are carrying out mining operations within their homesteads.

A comparison of present faunal diversity with the past is not possible due to the fact that no previous studies were confined to the study area only. However, previous studies show that the Lunama, Kalametiya lagoon system is a very important bird habitat where around 151 species of birds of which 54 are migrants have been recorded. (CEA, 1995). The present survey also reveals the importance of the lagoon system for birds where about 50 species of birds were observed. Protection of lagoon vegetation that is an important nesting and resting site for birds through declaration as a DWLC reservation is the main reason for the abundance of bird life in the study area. The land animals in the study area are generally low. This could be due to conversion of the study area into homesteads and clearance of natural vegetation for mining operations.

### **3.3.3 Impact of seashell mining on land**

The sandy soil of the study area is adversely affected by shell mining in the area. Large extents of eroded dunes due to excavation of tunnels in the dunes were observed in several places, which may become vulnerable to sea erosion. This situation is further aggravated by clearance of dune vegetation. In other areas where mining is in progress, mounds of excavated soil are a common sight with unfilled pits. Open abandoned pits become health hazard, as they have become breeding grounds for mosquitoes during rainy seasons.

Exposed mounds of soil also lead to infertility of soils as the nutrients are washed away by rainwater.

### **3.3.4 Impact on water**

The immediate impact of shell mining on water cannot be seen in the study area. However, prolonged mining activities may carry excessive loads of sediment to the lagoon which could have adverse impacts such as a reduced depth of the lagoon and disturbance of the habitat requirements of aquatic fauna and flora.

### **3.3.5 Impact on the community**

Although shell mining is an income generating activity in the area it may also have adverse impacts in the long run. A potential threat for health can be caused by abandoned pits as they make ideal breeding grounds for vector mosquitoes of diseases such as Dengue fever, Malaria and Filariasis during the rainy seasons. The community also faces a potential threat of converting their homesteads into barren lands unless they are refilled, fertilized and replanted suitably.

## **3.4 Socio-Economic Situation**

### **3.4.1 Introduction**

The socioeconomic survey was expected to cover the entire population of seashell miners in the RUK area (Rekawa, Ussangoda and Kalametiya). However, during the pre-testing survey, it was revealed that active seashell mining is limited only to the Kalametiya-Lunama area.

The Kalametiya and Lunama lagoons, and the Kalametiya Sanctuary are the distinct features in the Kalametiya area which is located in the Ambalantota DS Division. The Kalametiya area has seven GN divisions namely Hatagala, Kivula South, Kivula North, Lunama South, Lunama North, Hungama, and Bata-Atha South. The total population in these seven GN divisions is 7006 (Resources Profile, 2003).

At present, legal as well as illegal seashell mining is carried out in the Kalametiya-Lunama area in different locations such as private lands, homesteads, and the sanctuary. No records are available on the number of persons engaged in seashell mining. In 2003 the Geological Survey and Mining Bureau (GSMB) issued 28 permits for seashell mining. Of these, 26 permits were issued to the Kalametiya-Lunama area. Individual and group permits are the two different types of permits issued by the GSMB. Seashell mining without a valid permit is illegal and the exact number engaged in shell mining is not known. However, according to the people in the area, the number of persons involved in illegal mining is estimated to be over 50 in the Kalametiya-Lunama area.

### **3.4.2 Methodology**

A detailed questionnaire on socioeconomic conditions such as the nature of activities, age structure, level of education, housing conditions and amenities, resources and skills, community preference to leave seashell mining, and potential livelihood opportunities etc. was drafted and pre-tested before the actual data and information were collected.

The list of permits issued for seashell mining by the Geological Survey and Mining Bureau (GSMB) during 2000-2003 was collected and there were discussions with the Divisional Secretariat Office at Ambalantota on illegal mining prior to commencing the socioeconomic survey. A list of name of members in comprising group permits was also obtained from the RUK project office at Hatagala. The unavailability of a list of illegal miners made it difficult to predict the exact number and organize the survey. However, based on discussions with some illegal miners and group permit holders, it was revealed that around 50 illegal miners are involved in mining in the Kalametiya-Lunama area.

Based on above findings a Quasi Random Approach was used to select the seashell miners and those engaged in activities for the socioeconomic survey. Data and information were collected during the survey from 45 families in the seven GN divisions in the Kalametiya-Lunama area covering permit holders and illegal miners.

A Participatory Workshop was conducted to assess the community preference for alternative livelihood and skills development.

### 3.4.3 Results of the socioeconomic survey

#### (a) *Population and age distribution*

The total population in the Kalmetiya-Lunama area is 7006 (Resource Profile Ambalantota, DS division 2002). This consists of seven GN divisions. Of these GN divisions, Hungama has the largest population while Kivula North has the smallest population.

The total number of families in the survey area is 45 and the population is 185. This includes 45 households and their family members. The average family size of the sample is 4.1, which is smaller than the average size of rural families (4.9) in Sri Lanka. The largest family recorded in the survey had 7 (seven) members while the smallest had 2. The total number of males in the entire sample was 96, which is 52 percent to the total population.

The share of potential labour force in the sample, (those who are between 18 to 55 years) is 97 (52%). The share of infant population is 6 percent and persons over 55 years are 5 percent. The remainder (35 %), which is between 6-18 years, is the school going age group. Table 3.4 shows details of the education level in the entire sample population.

**TABLE 3.4 DETAILS OF THE LEVEL OF EDUCATION IN THE POPULATION**

Category	Number	Percentage
No schooling	14	8
1-5 grade	20	11
6-10 grade	68	36
G.C.E.(O.L.)	66	36
G.C.E.(A.L.) and above	17	9

Source: Field Survey, 2003

According to the above table, over 90 percent of the population has obtained primary and secondary level education. As far as education is concerned, this is a satisfactory situation.

It was found that the household chief is engaged in seashell mining or related activities. A majority of the other members in the family do not work or are engaged in different activities such as schooling. Some are or waiting jobs.

Of 45 households 78 percent is male and the remaining 22 percent is female. Moreover, 91 percent is between 18 to 55 years, and 9 percent is over 55years. This shows that 91 percent of the population is in the active labour supply category.

**(b) Level of education**

The socioeconomic survey used five categories to examine the level of education of seashell miners and the results are given in table 3.5.

**TABLE 3.5 EDUCATION AND SEASHELL MINING**

<b>Category</b>	<b>Number</b>	<b>% to total</b>
No schooling	0	0
Grade 1-5	16	36
Grade 6-10	15	33
G.C.E.(O.L)	8	18
G.C.E (A.L) and above	6	9
<b>Total</b>	<b>45</b>	<b>100</b>

**Source: Field Survey, 2003**

Table 3.5 shows that, a majority of persons have received an education to between grades 6 and 10. Sixty nine percent of the shell miners have received an education to between grades 1 and 10. Twenty seven percent of the samples have followed the GCE (Ordinary Level) and GCE (Advanced Level).

**(c) *Housing conditions and amenities***

The total number of houses surveyed was 45. All housing units are single-family ones. Three categories were used to evaluate the conditions of housing, namely, permanent, semi-permanent, and temporary houses. 87 % are permanent houses, which are built with bricks, asbestos/tiles etc. 11 % are semi-permanent while 4 % are temporary houses.

67 % of the households in the sample depend on pipe borne water and 20 % of the houses in the sample have rain water tanks. Others are served by public wells. All the permanent houses have got electricity connection while temporary houses use kerosene for lighting.

The survey reveals that 87 % of the households in Kalametiya-Lunama have toilet facilities. The remainder does not have toilets and use the lagoon system for defecation purposes. Septic tanks and pit latrines are the types of latrines in the Kalametiya-Lunama area.

The general health condition of the communities in the Kalametiya-Lunama area is satisfactory. However, the majority of them complained that mosquitoes have become a serious problem during the rainy season. Stagnant water in unfilled/abandoned mines, ignorance about primary health care are the main reasons for this situation.

**(d) *Nature of activities***

Seashell mining and related activities and other activities were the broad categories of employment activities used in the socioeconomic survey to assess the nature of activities. As regards other activities, fisheries and agriculture are the important ones. According to them, the actual time devoted to these activities is insignificant to generate income.

Seashell mining, transport, processing and marketing are considered as the seashell related activities. Planning and decision-making in these activities are entirely done by the user/owner of the mining operation.



**TABLE 3.6 NATURE OF ACTIVITIES**

Category	Number	Number of males	Number of females	% Of males to total	% Of females to total
Mining	27	23	4	85	15
Transport	4	4	-	100	-
Processing	4	4	-	100	-
Marketing	3	2	1	67	33
More than two	5	4	1	80	20
All four	2	1	1	50	50
<b>Total</b>	<b>45</b>	<b>38</b>	<b>7</b>		

Source: Field Survey, 2003

Results of the socioeconomic survey of the nature of the activities are shown in table 4.6. It appears that seashell mining is the major economic activity (60 %). 85 percent of males are engaged in seashell mining. Seven persons (16 %) of the population do more than two of the activities listed above and only two persons are engaged in all four activities. Some individual permit holders come under this category.

*(e) Level of income*

Since seashell miners of Kalametiya-Lunama area do not maintain proper records of income and expenditure it was decided to rely on the best estimates by seashell miners of their income and the expenditure.

Household income is related to the nature of activity/activities. For instance persons who are engaged in mining only have low income compared with others. They do not have a regular 25 or more working days per month and work around about 10-20 days per month. According to their responses, except for marketing, all other activities are conducted around six months per year. There is a great variation of income in activities relating to seashell mining. Therefore, during the pre-testing it was decided to have different categories as Rs. <3000/=, 3000/= - 4999/=, 5000/= - 6999/=, 7000/= - 8,999/=, 9000/= - 10999/=, 11000/= - 15000/= and >15,000/=.

The results of the monthly income in the survey are depicted in Table 4.7. According to the findings it appears that the majority of shell mining income falls into the category of Rs. 3000/= to 4999/=. No person earns less than Rs. 3000/= per month. Some persons earn over Rs.15, 000/= per month as they are engaged in two or more activities. Household

expenditure is more or less uniform and spent on food, fuel etc. Rice is the staple food in their daily diet while fish is used as the animal food supplement. Many shell miners report that their monthly expenditure exceeds their income.

**TABLE 3.7 LEVEL OF MONTHLY INCOME**

Category (Rs.)	Number	Percentage
<3000/=	-	-
3000/= - 4999/=	25	56
5000/= - 6999/=	5	11
7000/= - 8999/=	2	4
9000/= - 10999/=	4	9
11000/= - 15000/=	4	9
>15000/=	5	11
<b>Total</b>	<b>45</b>	<b>100</b>

*Source: Field Survey, 2003*

### **3.4.4 Alternative livelihood and skills development opportunities for shell miners**

#### **Resources and skills owned**

Table 4.8 shows the resources owned by the households engaged in seashell mining and other related activities. These resources are mainly land based resources and useful for investment as a revenue generating source.

**TABLE 3.8 RESOURCES OWNED BY SHELL MINERS**

Category	Number	Percentage
No resources	23	52
Agricultural resources	10	22
Sea shell deposits	10	22
Other economically valuable resources	2	4
<b>Total</b>	<b>45</b>	<b>100</b>

*Source: Field Survey, 2003*

According to this table, 52 percent of the villagers do not have any resources for income generation. Twenty two percent have agricultural resources such as a few coconut trees and/or fruit trees. The number of persons who own seashell deposits is 10, which represent 22% of the sample population. The remainder of the sample (4%) has some other resources such as fishing gear, boats etc.

The survey also examined the skills of the seashell miners, which can be used to find alternative employment opportunities. Skills in Agriculture related activities such as paddy and vegetable cultivation, livestock production and fishing are the major areas indicated by them. A majority of the persons (56%) do not have any type of skill. This situation demonstrates the necessity for skills development programmes to ensure sustainability of alternative livelihood development.

The socioeconomic survey also examined the knowledge of environmental damage due to seashell mining. Over 75 percent of the persons have a fair knowledge of the environmental damage caused due to seashell mining. The remainder stated that if back filling is done properly, no damage will occur.

#### **3.4.5 Community preference for alternative livelihood/skills development**

The socioeconomic survey examined the willingness of the seashell miners to give up seashell mining and related activities. About 20 percent of the persons in the survey responded that they did not wish to give up the seashell industry but wanted to continue until the seashell deposits had been exhausted. Eighty percent of the shell miners in the survey stated that they were willing to give it up if appropriate alternative sources of income were available. However, the partial success or failure of alternative livelihood programme introduced in previous development programmes in the Hambantota District have given rise to a negative attitude towards introducing new alternative income generating activities.

## Potential sources of livelihood proposed by shell miners

Table 3.9 shows the potential sources of livelihood proposed by shell miners.

**TABLE 3.9 POTENTIAL SOURCES OF LIVELIHOOD**

Category	Number	Percentage to total
Agriculture	12	27
Fisheries	08	18
Industry/Business enterprises	10	22
Others	06	13
No response	09	20
<b>Total</b>	<b>45</b>	<b>100</b>

Source: Field Survey, 2003

According to this table a majority of households prefer agriculture related activities. These consist of poultry and farming, cultivation of vegetables, banana cultivation and paddy cultivation if lands are provided close to their residence. As regard fisheries the respondents prefer fish drying, fish marketing, fishing as well as ornamental fish farming. Small scale business enterprises such as having a retail shop and foreign employment, driving, brick making etc. are the other potential source of livelihood indicated by them.

Table 3.10 shows a detailed breakdown of community preference on alternative income generating activities and the expected assistance.

A majority of persons stated that they require technical and financial assistance on employment opportunities alternative to seashell mining. The expected assistance ranges from Rs.50,000/= to Rs.200,000/=. A machine to grind salt for chicken feed and which is the main item of salt production activity was cited by one respondent who ask for Rs.200,000. Production of lime from other imported sources such as dolomite for marketing was indicated by another respondent. Many of the women shell miners were interested in poultry farming.

**TABLE 3.10 DETAILS OF ALTERNATIVE SOURCES LIVELIHOOD AND EXPECTED ASSISTANCE**

<b>TYPE</b>	<b>NUMBER OF RESPONSES</b>	<b>EXPECTED ASSISTANCE</b>
<b>Agriculture</b>		
Paddy cultivation	2	Land close to the residence and financial assistance (Rs.50,000)
Rice processing	2	Financial assistance Rs.200,000.
Coconut and banana cultivation	1	Irrigation facilities and Rs.50,000
Poultry farming	4	Technical training and Rs.50,000
Goat farming	3	Technical training and Rs,50,000
<b>Industry</b>		
Salt production for chicken	1	Rs.200,000
Lime industry	2	Rs.200,000
Small scale business enterprises	7	Rs.50,0000 and technical training
<b>Others</b>		
Driving	4	Assistance to get the required training
Foreign job training	2	Assistance to get the required training
<b>Fisheries</b>		
Dry fish production	4	Rs.50,000
Fishing, and fish marketing	3	Rs,50,000
Ornamental fish farming	1	Technical training and Rs,50,000
<b>Total</b>	<b>36</b>	

Source: Field Survey, 2003.

## **3.5 Evaluation of relevant legislations**

### **3.5.1 Introduction**

The extraction of shells from the inland shell deposits can be carried out only by obtaining an Industrial Mining License (IML) from the GSMB. The procedure for licensing and the prescribed form of the IML is given in the Mining (Licensing) Regulations No. of 1993 under the Mines and Minerals Act No 33 of 1992. These regulations are published in the gazette extraordinary No 794/23 of 26.11.1993.

The definition of “industrial minerals” is in these regulations. It includes, among other changes, shell deposits. Thus, the mining of shell deposits has to be carried out under an IML and in accordance with the terms and conditions provided.

### **3.5.2 Present situation of existing laws and regulations**

The following observations were made as regards to the extraction of shell deposits in the project area.

1. The owner or occupier of a private land can apply for an IML.
2. Part of the area falls within the Kalametiya-Lunama sanctuary declared under the Fauna and Flora Protection Ordinance. The declaration has been made in the gazette extraordinary No 303/7 of 28.06.1984. According to this, parts of the two adjacent lagoons of Kalametiya and Lunama falls within the sanctuary. The area of water body is demarcated by the high flood levels. Since the lagoons do not contain much water during most months of the year, part of the lagoon bed is exposed and shell mining is carried out in some such areas.

According to section 7 (1) (c) (ii), it is an offence to break-up any land within a sanctuary for mining. Thus, there is no scope for obtaining a license to mine in any state land within the sanctuary.

A corresponding section is found in the Mines and Mineral Act. According to section 39 (d), the GSMB shall not issue a license either to explore or mine for any minerals in change of the subjects of mines and minerals and lands. However, this situation had changed since the amendment to the Fauna and Flora Protection Ordinance (No 49 of 1993) and it is not possible to extract minerals even with the consent of the ministers.

3. Land under the state can be leased to private parties under the Crown Lands (State Lands) Ordinance and the Land Department Ordinance. However, State lands falling within the boundaries of a sanctuary cannot be alienated in this manner. Even if alienated in such manner, the occupier of the land is not the owner, and the land remains State land. Hence, a permit issued to mine seashells in a land inside the sanctuary, even if it is alienated in a person can not be used to carry out mine because Section 7 (1) (c) (ii) applies to these lands as well.
4. The Coast Conservation Act (No 57 of 1981 as amended) has powers to regulate and control activities occurring within the coastal zone. According to the definition of the Coastal Zone, the entire water body of the Lunama lagoon and most of the water body of the Kalametiya lagoon belong to the coastal zone. According to Section 14 of the Coast Conservation Act, a person engaging in any kind of development activity within the coastal zone has to obtain a permit issued by the Director of Coast Conservation Department. The definition of development activity in Section 42 of the Coast Conservation Act includes the removal of shells. Thus, the removal of shells from any part of the Coastal Zone can only be carried out under a permit issued by the Director. This is in addition to the IML.

However, it is not possible to remove shells under these permits from the areas of the coastal zone that are within the Kalametiya-Lunama Sanctuary.

5. The Director of the Coast Conservation Department has the power to request an Environmental Impact Assessment (EIA) report from an applicant of a development activity that is within the Coastal Zone. There is no provisions that state which type of development activity needs an EIA. Thus, the Director has power to call for a shell mining activity that may be within the sensitive area or that will have a great impact. The coastal area around Kalametiya is known as an important nesting (egg-laying) area for sea turtles.

6. The approval of prescribed projects has to be done in accordance with the provisions in Part IV C of the National Environmental Act. The lists of prescribed projects are given in the schedule published in the gazette extraordinary No 772/22 of 24.06.1993. According to this, any use of a wetland exceeding few hectares and an inland surface mining of a cumulative area exceeding 10 hectares are declared as prescribed projects. However, the prescribed activity is located wholly or partly within an area specified in Part III of the schedule, then the approval is necessary irrespective of their magnitude.

The approval of a prescribed project has to follow the procedure given in the National Environmental (Procedure for approval of projects) Regulations No 1 of 1993, published in the gazette extraordinary No 772/22 of 22.06.1993, and requires the preparation of an EIA report by the proponents of projects, and submitted to the Project Approving Agency and the Central Environmental Authority,

The regulations published in gazette extraordinary No 854/14 of 23.02.1995 has included the sanctuaries and 100 metres from a boundary of a sanctuary in to Part III. Thus, this applies to any land within or in the area within 100 metres from the boundary of the Kalametiya–Lunama sanctuary.

### **3.5.3 Suggestions/recommendations**

Therefore, the extraction of seashells from inland shell beds is subjected to the following:

1. Private lands outside any special zones. The extraction of seashells can be carried out under an IML from the GSMB and under the terms and conditions in the permit.
2. Private lands within the coastal zone. The extraction of seashells needs a permit from the Department of Coast Conservation in addition to the IML. The Department of Coast Conservation has the discretion/ power to call for EIA report, grant for permission.
3. Private lands within 100 metres from the boundary of the sanctuary.



It becomes a prescribed project under the National Environmental Act. Thus, approval has to be obtained by submitting an EIA or IEE report, before obtaining an IML.

4. Private lands within the boundaries of the sanctuary.

The usual procedure is as (3). But in Kalametiya-Lunama sanctuary, the area is restricted to the beds of the two lagoons. According to the State Lands Ordinance the beds of all reservoirs, rivers & other water bodies are comprised of state land only. Hence, it is not possible to get permission in this particular area.

5. It is possible to get a grant to possess state land in order for the purpose of dwelling & cultivation. These grants are possible under the constitution, the state lands ordinance, land development ordinance & the land grants (Special Provisions). Act do not permit the extraction of any minerals. Therefore, it is not possible to get a industrial mining license to get shells from a state land that is being held under a grant.

## **CHAPTER 4 - EFFECTIVENESS OF PAST INITIATIVES IN ARRESTING ENVIRONMENTAL DEGRADATION**

### **4.1 Effectiveness of Institutional Initiatives**

As part of the assignment, the study team made an attempt to assess the effectiveness of past initiatives implemented by the government and non-governmental organizations to arrest the environmental degradation caused by the shell mining industry. In this exercise it was mainly the past initiatives implemented by the government agencies such as GSMB, Divisional Secretariat, Coast Conservation Department, Wildlife Conservation Department, Police Department, and the ADB-CRMP, HICZMP that were investigated. These investigations were focused mainly on the effectiveness of law enforcement, development of interventions, alternative livelihoods and awareness creation.

The survey of literature and the field investigations show that the government institutions have initiated some action to control seashell mining within the study area. Among these, the most important is the introduction of industrial mining and the transportation license system under the Mines and Mineral Act by the GSMB. The main intention of the GSMB license system is to control illegal shell mining and to ensure post mining rehabilitation.

Miners are required to pay royalty for the resource as well as a cash deposit amounting to Rs.10, 000/= to ensure rehabilitation by back filling of the mined pits. However, the field investigations revealed that the license holders are not interested to claim reimbursement of the cash deposit by back-filling. This is due to the fact that they could extend the duration of the permit without paying an additional cash deposit. On the other hand, a large number of miners are engaged in mining activities without obtaining permits. In response to this situation, the Divisional Secretariat of Ambalantota has introduced a group permit system which has created small groups among the *Samurdhi* recipients. This system has been considered with the realization of inability to pay cash deposit by the individual miners,. With the implementation of this scheme, it was expected that all the illegal miners would join this scheme.

This has resulted in the formation of eight by small groups, some of the illegal miners to obtain permits to continue with mining activities. However, there is still a large number of people engaged in illegal shell mining in the sanctuary area, the homesteads and on private lands. Hence the effectiveness of the license system as a management tool is not very effective. There is a clear need for a proper institutional mechanism to absorb the illegal miners into the legal stream.

Apart from a permit system, legal action against illegal miners has been carried out by the relevant police stations. However due to political and other influences, this level of legal enforcement and its effectiveness is not satisfactory. According to the existing police records, over 20 raids have been carried out during the last five years.

In terms of the Coast Conservation Act No.57 of 1981, a permit has to be obtained for all types of mining activities except coral within the coastal zone. Coral mining is a prohibited activity in accordance with the Act. However CCD records illustrate that no permits have been issued for seashell mining within the coastal zone in this area, since it came into operation in 1983. Although the Coast Conservation Department has delegated the authority to the Divisional Secretaries to issue mining permits in 1992, this activity has not been prescribed under the category of mining permits and no such records were found at the Divisional Secretariat at Ambalantota.

## **4.2 Effectiveness of Project Intervention**

The first and second phases of the Hambantota Integrated Coastal Zone Management Project (HICZMP) funded by NORAD and implemented by the Coast Conservation Department has taken some initiatives directing the seashell miners as a target group. During the first phase of the project, a variety of environmental education and awareness programmes were conducted to demonstrate the negative impacts of the shell mining activities within the study area. During the second phase of the project, being implemented since year 2000, a revolving fund has been established and livelihood development programmes have been introduced. Under this programme, few community members who engaged in seashell mining were given micro enterprise training and were supported to initiate small-scale business ventures. According to the information provided by HICZMP officials, the loan recovery rate and the progress of this programme is very impressive.

The Cathyrich International Food Processing Centre has provided food processing training for 12 shell mining families and the Agromart has also provided the same training facilities for 70 families at Bata Ata south. However, it is difficult to assess the effectiveness of this programme, since the target population comprises all resource abusers and the numbers of recipients are too small. It is also important to monitor the progress of this programme for a sufficient period of time to determine its effectiveness.

Besides the HICZMP, the Field Implementation Unit of the Coastal Resource Management Project (CRMP) at Kalametiya, funded by the Asian Development Bank, has also initiated awareness creation among the stakeholders.

In general, no action has been taken so far either by the government or by non-governmental organizations with respect to rehabilitation of the degraded environment within the study area. Although a large number of non-governmental organizations are functioning within the district, negligible efforts have been made to arrest the environmental degradation caused by shell mining within the study area in the past. At the same time, local communities have also been reluctant to initiate any environmental rehabilitation action due to social and political interference and also because they have not experienced direct negative impact on their day-to-day work.

## **CHAPTER 5 - PROPOSED MITIGATORY MECHANISM**

### **5.1 Proposed Mitigatory Mechanism**

The proposed mitigatory mechanism includes the strengthening of legal and institutional procedures in relation to seashell mining, the introduction of alternative livelihood/skill development for miners, the rehabilitation and conservation of mining areas, the introduction of a new mining plan, creation of awareness among stakeholders and the introduction of monitoring procedures.

#### **5.1.1 Strengthening the institutional and legal framework**

The study reveals that the existing institutions and laws are adequate to mitigate the past, present and future environmental impact of sea shell mining. Therefore no new of legislation is required. However efforts have to be made in collaborative management rather than reliance solely on regulatory mechanisms. In order to comply with the overall goal of the bio-diversity conservation project in the RUK area and the limited resources to be extracted; more emphasis should be placed on strengthening the institutional set up and the proper implementation of the proposed mining and rehabilitation plan. In this respect, effective programmes have to be developed to ensure the adherence to the mining and post mining guidelines spelt out. At the same time the linkage among the mining and rehabilitation committees, appointing two representatives from these committees to the CCC (Community Coordinating Committee) should strengthen bio-diversity taskforce and the CCC.

#### **Strengthening of permit procedure**

At present, the GSMB is responsible for issuing mining licenses. The Divisional Secretary's role in assessing permits is confined to clearing the land and formulating small groups. When the approval is given by the DS for the relevant lands, he/she mainly relies on the report submitted by the Grama Niladari and there is no consultation with other key agencies such as the Coast Conservation Department and Department of Wild Life Conservation. This is one of the major shortcomings and, in view of this, it is proposed to strengthen the permit system by implementing the following procedures;

- a) The mining application should comply with the guidelines spelt out in the mining plan.
- b) The consensus of the DWLC, mining committee and the CCC should be obtained prior to the issue of the mining permit
- c) No permit should be extended where the post mining conditions of the original permit have not been fulfilled.
- d) No permit should be issued for the land located within the designated conservation areas and the seaward side of the dune protection line.

### **Implementation and coordination**

There are major areas of concern relating to implementation and coordination. In this connection, the implementation of the proposed mining plan, rehabilitation programme and the monitoring programmes is important. In considering the overall goal of the project, the responsibility for the implementation y for different tasks could be assigned as follows (Table 5.1):

**TABLE 5.1 RESPONSIBILITIES FOR IMPLEMENTATION OF DIFFERENT TASKS**

<b>Task</b>	<b>Agencies Responsible for Implementation</b>
Implementation of the rehabilitation plan	Project Manager – GEF-RUK DS, AD-DWLC, Local communities
Implementation of Mining Plan	GSMB, Miners, DS, CCD, DS, DWLC, Mining Committee, CCC
Implementation of Alternative Livelihood	CC, PM-GEF-RUK, ISB, BDTF
Implementation of awareness programmes	PM, BDTF, CCC
Law enforcement	DWLC, CCD, Police

### **5.1.2 Alternative livelihoods and skills development**

According to the results of the socio economic survey proposed alternative livelihood and skills development are the major areas that can be used to mitigate environmental impacts and conservation of biodiversity. The skill development programmes should focus on providing appropriate training for shell miners and school leavers who are potential shell miners. This will limit numbers. The employment opportunities within the project area are limited and skills development programmes are needed to help to find employment opportunities outside the project area and development intervention in the Southern

Region. To ensure the sustainability of alternative income generating activities it is essential to conduct a detailed market survey including availability of input, agencies, output market, market potential and quality improvement.

### **5.1.3 Rehabilitation and conservation**

The existing information revealed that the environmental status in Kalametiya and Lunama coastal areas has been rapidly degraded due to unsystematic shell mining. No attempts have been made to rehabilitate the environmental degradation caused by shell mining in the Kalametiya-Lunama coastal areas during the past. Although a cash deposit is obtained from the permit holders to ensure post mining rehabilitation by means of back filling, in practice, the permit holder are not interested in back filling and withdraw the cash deposit. In general, there is no proper mechanism for rehabilitation of the mining sites at present. Hence it is important to formulate a rehabilitation strategy for present and the future needs.

#### **Status of abandoned mining areas**

The mining method being adopted for seashell extraction in the study area can be called open pit or surface mining. It involves raw material extraction from deposits near the surface. In this process, complete removal of non-bearing surface strata (overburden) is carried out by miners in order to gain access to the resource. The decommissioned surface mines or pits in the study area vary in size according to the nature and the extent of the deposit. Field investigations have revealed that those abandoned mines range in size from small-scale to large-scale pits (1.0sq. m to 420.0 sq. m). The maximum depth of the mined pit is around 4 meters.

#### **Environmental impact**

The existing environmental consequences associated with these activities were assessed to formulate a comprehensive rehabilitation plan for abandoned shell-mining areas. In this connection the environmental impact in the area was classified as follows. Table 5.2 shows the environmental impact with different components.

## 5.2 Proposed Rehabilitation Plan and Mechanism for Implementation

The problem of rehabilitating mined areas and associated deposit of mining waste was discussed with the stakeholders at the workshop conducted by the study team on October 25<sup>th</sup> 2003. At this workshop the environmental consequences experienced due to abandoned open pit mining operations were described and the importance of formulating a rehabilitation programme was highlighted.

**TABLE 5.2 ENVIRONMENTAL IMPACT**

<b>Component</b>	<b>Impact</b>
Earth's Surface	<ul style="list-style-type: none"><li>• Aerial devastation</li><li>• Altered morphology</li><li>• Destruction of sand dunes</li></ul>
Surface Water	<ul style="list-style-type: none"><li>• Siltation</li><li>• Pollution</li></ul>
Ground water	<ul style="list-style-type: none"><li>• Recession of ground water</li><li>• Deterioration of water quality</li></ul>
Soil	<ul style="list-style-type: none"><li>• Loss of top soil in the extracted areas</li><li>• Swamping</li><li>• Soil erosion</li></ul>
Flora	<ul style="list-style-type: none"><li>• Destruction of endemic vegetation</li><li>• Alteration in surrounding areas due to altered ground water level</li></ul>
Fauna	<ul style="list-style-type: none"><li>• Expulsion of fauna</li></ul>

**Source: Field Survey, 2003**

The objective of the rehabilitation programme is two fold. Firstly, it envisages the formulation of a strategy to rehabilitate the abandoned mining sites widely scattered over the project area. The second objective is to formulate new guidelines for rehabilitation and reshaping the landform of future mining areas. During the community consultations, stakeholders agreed upon these objectives and consensus was reached on the following actions;

- Re-contouring and re-vegetating the land
- Identification of borrow areas for back filling
- Contributions towards rehabilitation from the community and the GEF-RUK Project
- Guidelines for rehabilitating new mining areas



- Monitoring of the condition of soil and water

## **Re-contouring and re-vegetating the land**

### ***Material required***

A total of about 10000 sq. meters of land area have been identified as abandoned open pits in the area that require a comprehensive rehabilitation programme. According to the survey estimates approximately 6000 cubic meters of suitable material is required for reshaping the altered landform in the mining areas. To fulfil this requirement, alternative areas have to be identified for borrow materials. Apart from the mining waste and removed overburden lying in the vicinity of mining areas, the remainder of the material has to be transported from outside.

### ***Proposed Method of filling and grading***

In consultation with the stakeholders, it was suggested that light grading equipment with low noise be used. In this connection, the two grading/loading machines available at Tangalle Pradesiya Sabawa could be used. To avoid disturbance to the existing environment it is proposed to use light vehicles such as tractors and small open trucks for transportation of materials to the site.

### ***Method of replanting***

According to the survey carried out in the study area it was found that the most of the native vegetation has been removed from the mined areas. Hence it is suggested to launch a replanting campaign after reshaping the landform. In this regard it is proposed to replant the following species of vegetation to improve the floral communities (Table 5.3).

**TABLE 5.3 SPECIES OF PLANTS FOR REPLANTING**

<b>Trees</b>	<b>Associated Shrubs/trees</b>
Kiri nuga	Masan
Kohomba	Katukeliya
Nerol	Kos atta
Kon	Ranawara
Divul	Komkinna
	Masbedda
	Navahandi
	Endaru
	Kamburu

In addition to the above species, creeping and arid thorny vegetation could be used to stabilise the topsoil cover. It is also important to obtain concurrence from the Forest Department prior to finalisation of the list of plants used in the re-plantation programme. It is proposed to mobilise the schools, NGO's, other relevant government institutions and shell miners in the area to implement this programme.

#### ***Identification of borrow areas for back-filling***

In relation to identification of borrow areas to obtain suitable materials for back filling, detailed community consultations were carried out by the study team. In this process two sites have been identified as potential borrow areas:

- Badde wewa (Kiula GN Division)
- Sera wewa (Hatagala GN Division)

Without much environmental damage, the materials from Sera Wewa could be used for rehabilitation work at Kalametiya in the Hatagala GN Division. The borrow materials from Bedda wewa could be used for rehabilitation work in the Kiula GN Division. The requirements for rehabilitation at Lunama are comparatively small. Hence a suitable location should be selected closer to the Lunama Lagoon. to rehabilitate the abandoned mined areas in Lunama.

#### ***Contributions towards rehabilitation***

As discussed at the community workshops, it was agreed to draw for render the community as well as the agency for the rehabilitation programme. The community,

specifically the people who involved in mining, agreed to provide their contribution towards the rehabilitation programme in the form of labour and transport. From the Project side, it is recommended to provide the cost of fuel and the, hiring charges for grading and loading machines.

#### ***Monitoring of soil, plants and water condition***

Once the rehabilitation work is completed, it is necessary to monitor the stability of the soil, plants, and the quality of the water in the surrounding water bodies. Therefore, a proper monitoring mechanism should be established at the early stages of the implementation of the rehabilitation programme. For this, the services of the Ruhuna University could be obtained. Emphasis should be placed on the following aspects through the proposed monitoring programme;

- Soil erosion and sedimentation
- Recovery of forest cover
- Water quality changes if any

#### ***Guidelines for rehabilitating new mining areas***

The proposed guidelines have been incorporated in the mining plan spelt out in the previous section (see the proposed mining plan)

### **5.3 Sustainable Seashell Mining Plan for Kalametiya - Lunama Coastal Areas**

Considering the importance of biodiversity conservation in the RUK area and the need for collaborative resource management, it is suggested that a sustainable seashell-mining plan be introduced. This mining plan is developed in consultation with and with the consensus of the relevant stakeholders in the study area and strongly recommended for implementation.

#### ***Rationale***

The main rationale for the proposed mining plan is as follows:

- a) The seashell mining industry is viewed as a traditional industry and a significant proportion of the local communities is highly dependant on it;
- b) The existing locations, method of mining and transportation routes have had a negative impact on the bio-diversity of the area;
- c) The present method of mining is neither systematic nor sustainable;
- d) The remaining shell deposits should be exploited for the social and economic benefits of the local communities while maintaining the quality of environment.
- e) If the ongoing practices are continued in the same manner introducing a complete ban on shell mining is unavoidable.

### ***Objectives of the Mining Plan***

The main objectives of the seashell-mining plan are to;

- Introduce best practices to minimise environmental degradation, notably in the absence of specific environmental guidelines for mining stockpiling and transportation.
- Encourage stakeholders at all levels to recognise their responsibilities for proper environmental management and conservation of biodiversity.
- Establish environmental accountability at the community level
- Stimulate stakeholder participation in collaborative management by minimising social risk and uncertainty.

### ***Components of the Plan***

1. Legal and Institutional Requirements
2. Guidelines and Criteria to be used in selecting locations/sites in mining
3. Guidelines for mining and transportation

### ***Legal and Institutional Requirements***

The existing seashell mining and related activities in the RUK area are operating both within and outside the law. While a large number of community members have valid permits to mine and transport seashells, another considerable number are being engaged in illegal mining. In these circumstance, it is not possible to implement a mining plan without

absorbing the people who are engaged in illegal mining into operating within the law. Hence, with respect to the legal and institutional requirements, the stakeholders agreed upon the following.

1. Two categories of permits (viz. individual and group ) will be issued by the GSMB and the community members should ensure that no person shall engage in mining and transportation activities without a valid permit.
2. All possible arrangements should be made by the CCC to issue a special identity card for those who are involved in mining and transportation
3. A new Seashell Miners Committee should be established to implement and monitor the mining plan and should function under the guidance of the CCC
4. The Miners Committee and the community members should ensure that no new comers will enter the industry for a specified period determined by the Miners Committee.

***Guidelines and Criteria to be used in selecting locations/sites for mining***

1. The location of the mining sites should be the potential locations marked in the annexed plan that is based on bio-physical sensitivity.
2. No mining should be carried out in a sand dune area and within 10 meters from the toe of the dune
3. No mining is permitted in the lagoon and the existing water ways.
4. No mining should be carried out within the area between the lagoon and the access road to the Kalametiya Fishing Centre.
5. Valuable trees and water ways should be excluded when mining pits are demarcated
6. Natural vegetation should be completely excluded when mining pits are demarcated.

***Guidelines for mining and transportation***

1. The maximum size of a pit should be 10' x 15'
2. The top soil of the mining site should be removed and preserved for top dressing during rehabilitation
3. Mining activities should be limited to six days per week

4. Mining time should be between 7 am. and 6 pm.
5. Sieving of seashells and soil particles should be carried out closer to the mining pit and arrangements should be made to reuse the soil for back filling.
6. Once the mining is over, back filling and rehabilitation activities should be completed before moving to a new location.
7. The pre demarcated transport routes should be used for transportation of raw materials from the mining sites to the processing sites

#### **5.4 Awareness Creation**

Public education and awareness creation should be an integral part of the mitigatory mechanism proposed for upgrading the environmental status degraded by seashell mining in the RUK area. The main objectives of the proposed education and awareness creation programme should be to focus more on encouraging youth to accept alternative livelihood/skills development, curtailing new-comers into the industry, and influencing miners to adhere to the mining and rehabilitation guidelines.

In this connection, more emphasis should be placed on the target groups which consist of seashell miners both legal and illegal and school leavers who could enter this industry in the future. A specific education and awareness creation programme should be designed under the overall education and awareness programme of the project or as a separate programme.

#### **5.5 Monitoring Procedure**

A proper monitoring programme should be developed to increase the efficiency and effectiveness of the proposed mining and rehabilitation programmes. Once the mining and rehabilitation plans are in operation, monitoring procedures have to be formulated to comply with the ground situation. However, monitoring responsibility should be given to the stakeholder group within the community. In this regard the Biodiversity Task Force, the Mining Committee and the Rehabilitation Committee could be used.

## CHAPTER 6 - CONCLUSIONS AND RECOMMENDATIONS

### 6.1 Conclusions

1. The field investigations revealed that the seashell deposits in the study area are spatially located mainly in the GN Divisions of Hathagala, Hungama, Kiula South, Kiula North, Lunama, South, Lunama North and Bata Ata South.
2. The extent of seashell resources available within the study area is estimated as 11035 – 13610 metric tons and if the current mining rates (1525 average metric tones) are maintained the available resources could be used for another five to eight years. But, if the average mining rate is 1350 metric tons, the available resources could be used for another 9 – 11 years.
3. Shell mining is the major economic activity in the Kalametiya-Lunama area. The share of the productive labour force between 18 and 55 is relatively large.
4. At present seashell mining is done indiscriminately in the sanctuary, within the sand dune area, mangrove and other natural forest cover, and also in home gardens. Negative environmental impacts have been created mainly in the areas of denudation of vegetation, destruction of the sand dune system and degradation of landforms
5. The present study has revealed that approximately 150 people are involved in authorised shell mining while around 50 people are involved in illegal mining activities within the study area.
6. The average monthly income level of the shell miners in the survey area is relatively high. However, the level of income fluctuates with the type and thickness of the deposits, weather conditions and the market price.
7. In terms of initiatives launched for arresting environmental degradation caused by seashell mining in the study area, there were no effective strategies adopted in this connection apart from the GSMB permit system.
8. The industrial mining licence holders were not interested in obtaining a reimbursement of cash deposit retained with the GSMB by engaging post mining rehabilitation since there was the possibility of extending the duration of the permit without fulfilling the condition of the permit on rehabilitation.
9. The existing information revealed that the major part of the seashell mining area is mainly covered by the following special declarations made under the Coast

Conservation Act No.57 of 1981, Antiquity Ordinance and Fauna and Flora Protection Ordinance -

- Coastal zone
- Archaeological site
- Kalametiya -Lunama sanctuary
- Rekawa Lagoon Fisheries Management Area

10. A majority of shell miners are willing to give up shell mining if appropriate alternative income generating opportunities exist with necessary technical and financial assistance.

## **6.2 Recommendations**

1. A sustainable seashell mining plan should be implemented in collaboration with the stakeholders to control haphazard mining.
2. A rehabilitation plan as outlined in this report should be implemented to reshape the landform of the abandoned shell mining pits.
3. A Committee should be set up to implement and monitor the mining and rehabilitation plans and should function under the guidance of the CCC
4. The guidelines presented on seashell mining in the study area should be strictly enforced and should be monitored by the Mining Committee
5. Agreement should be reached on the implementation of the proposed mining and rehabilitation plans as well as monitoring mechanism with the Department of Wild Life Conservation, Geological Surveys and Mines Bureau (GSMB) and the Divisional Secretary (Ambalantota)
6. A policy decision has to be taken on permitting seashell mining in the state land that comes under the sanctuary area in keeping compliance with the existing laws and regulations.
7. The following areas should be excluded from the future mining to ensure the sustainability of the bio-diversity of the study area.
  - The sand dunes and the beach front
  - The area lying between the Kalametiya lagoon and the access road
  - Areas within the bodies of water



- Mangrove and swamp areas
  - Natural forest cover
8. Sign boards should be established to demarcate the red areas that are marked as no mining areas
  9. Comprehensive target group oriented public awareness and education campaign should be launched to educate the stakeholders linked with mining activities. In this connection the importance of excluding sensitive areas from mining, the importance of post mining rehabilitation, and the future insecure status of the industry should be highlighted.
  10. The areas and the amount of live shells that could be removed seasonally from the Rekawa Lagoon should be determined and allowed only after proper research and investigation.
  11. Shell miners who cannot be absorbed into the livelihood programme should be accommodated within the industry in compliance with the mining guidelines.
  12. Shell miners who are willing to accept alternative income generating opportunities should be provided suitable skills development programmes.
  13. Proper skills development/alternative livelihood programmes should be formulated for school leavers and youth in the study area to curtail the numbers of new comers into the industry.
  13. Priority for alternative livelihoods should be given to those who have lost their jobs due to the closure of the ceramic factory are at present and engaged in shell mining.

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## ANNEX - 1

### Plant Species Diversity Indices in the study sites

Geo-position and description of site	Study site		
	Abandoned shell mining areas	Ongoing shell mining areas	Potential shell mining areas
6° 06.68'N 80°56.97'E-private land with very few trees		1.4091	
6° 06.57'N 80°57.13'E- private land with no trees		No vegetation	
6° 05.93'N 80°57.38'E- area adjacent to a water hole and natural forest area	1.64597		
6° 05.91'N 80°57.27'E- pits associated with natural forest		1.31266	
6° 05.79'N 80°57.38'E- thick cover of natural vegetation			2.11421
6° 05.82'N 80°57.36'E—vegetation around abandoned pits	0.89951		
6° 05.75'N 80°57.33'E- shrubs around the abandoned pits	1.17061		1.68172
6° 05.71'N 80°57.36'E- fully grown shrub vegetation around abandoned pits	0.96073		
6° 05.47'N 80°57.33'E- -shrubs around pits	1.01755		
6° 05.42'N 80°57.36'E- shrubs around pits	1.12566		
6° 05.40'N 80°57.42'E- natural forest cover			1.78280
6° 05.35'N 80°57.26'E-natural forest cover			1.53482
6° 05.32'N 80°57.25'E--	1.00875		
6° 05.35'N 80°57.26'E- natural forest cover			1.73718
6° 05.35'N 80°57.08'E- natural forest cover			1.37586
6° 05.35'N 80°56.99'E- site with a cattle farm and shrubs			0.99082
6° 05.17'N 80°56.97'E- dune area with burnt <i>Pandanus</i> sp and dune vegetation	0.92020		
<u>Mangrove belt</u>		1.0438	
6° 05.08'N 80°56.53'E-dune area with secondary vegetation			1.89619
6° 05.04'N 80°56.43'E- home stead	1.37620		
6° 04.88'N 80°56.20'E- secondary vegetation	1.50072		
6° 04.98'N 80°56.18'E- surrounding area consists of large trees		1.8431	

Source: Field Survey, 2003

## ANNEX 2:

### List of common plant and animal species recorded in the study area Common plant species :

#### I. Natural forest area

Family	Species	Sinhala name
Acanthaceae	<i>Barleria prionitis</i>	Katu karadu
Malvaceae	<i>Thespesia populnea</i>	Gan Suriya
Meliaceae	<i>Azadirachta indica</i>	Kohomba
Asclipiaceae	<i>Gymnema sylvestre</i>	Masbedda
Celastraceae	<i>Elaeodendron glaucum</i>	Neralu
Euphorbiaceae	<i>Euphorbia nerifolia</i>	Pathok
Cactaceae	<i>Opuntia delenii</i>	Pathok
Rhamnaceae	<i>Zizyphus mauritiana</i> <i>Z. oenoplia</i> <i>Z. rugosa</i>	Masan Heen earminiya Maha Eraminiya
Apocynaceae	<i>Carissa spinarum</i>	Karamba
Salvadoraceae	<i>Salvadora persica</i>	Maliththan
Cucurbitaceae	<i>Bryonopsis laciniosa</i>	Kemvel
Leguminosae	<i>Erythrina fusca</i> <i>Acacia leucophloea</i> <i>Tephrosia purpurea</i> <i>Cassia auriculata</i> <i>Cassia sophera</i> <i>Asparagus racemosus</i> <i>Dichrostachys cinerea</i>	Katukeliya Maha andara Katupila Ranavara Ooruthora Hathawariya Andara
Loranthaceae	<i>Barathranthus nodiflorus</i>	Pilila
Moraceae	<i>Ficus altissima</i>	Nuga
Vitaceae	<i>Cissus quadrangularis</i>	Hirassapalu
Sapotaceae	<i>Manilkara hexandra</i>	Palu
Euphorbiaceae	<i>Euphorbia antiquorum</i> <i>Euphorbia tirucalli</i> <i>Excoecaria agallocha</i>	Daluk Navahandi Telakiriya

Annonacea	<i>Xylopiya championii</i>	Datketiya
<b>Family</b>	<b>Species</b>	<b>Sinhala name</b>
Apocynaceae	<i>Ichnocarpus frutescens</i>	Kiriwel
Asclepiadaceae	<i>Sarcostemma brunonianum</i>	Muwakiriya wel
Compositae	<i>Vernonia cinerea</i> <i>Vernonia zeylanica</i>	Monarakudumbiya Hin-betiya (Pupula)
Meliaceae	<i>Azadirachta indica</i>	Kohomba
Malvaceae	<i>Sida veronicifolia</i>	Bevila
Mimosaceae	<i>Mimosa pudica</i>	Nidikumba
Rhamnaceae	<i>Zizyphus mauritiana</i>	Debara, Masan
Rubiaceae	<i>Ophiorrhiza mungos</i>	Datketiya
Rutaceae	<i>Glycosmis pentaphylla</i>	Dodanpana
Salvadoraceae	<i>Salvadora persica</i>	Maliththan
Apocynaceae	<i>Caparanthus roseus</i>	Minimal (Sohonkumba)

## II. Secondary vegetation (in abandoned pits)

<b>Family</b>	<b>Species</b>	<b>Sinhala name</b>
Euphorbiaceae	<i>Acalypha indica</i>	Kuppa meniya
Amaranthaceae	<i>Achyranthes aspera</i> <i>Aerva lanata</i>	Gaskaralheba Polpala (polkudupala)
Monomiaceae	<i>Hortonia floribunda</i>	Maduruthala
Labiatae	<i>Ocimum sanctum</i>	Maduruthala
Mimosaceae	<i>Mimosa pudica</i>	Nidikumba
Acanthaceae	<i>Adhatoda vasica</i>	Adhatoda
Malvaceae	<i>Abutilon asiaticum</i> <i>Abutilon indicum</i>	Anoda Anoda

Annonaceae	<i>Annona reticulata</i> <i>Annona squamosa</i>	Anoda Anoda
Euphorbiaceae	<i>Euphorbia nerifolia</i>	Pathok
Cactaceae	<i>Opuntia</i> sp.	Pathok

<b>Family</b>	<b>Species</b>	<b>Sinhala name</b>
Zygophyllaeaceae	<i>Tribulus terrestris</i>	Nerenchi
Cyperaceae	<i>Cyperus rotundus</i>	Kalanduru
Leguminosae	<i>Tephrosia purpurea</i>	Katupila
Apocynaceae	<i>Nerium oleander</i>	Kaneru
Apocynaceae	<i>Plumeria acuminata</i>	Kaneru
Apocynaceae	<i>Caparanthus roseus</i>	Minimal (Sohonkumba)
Salvadoraceae	<i>Salvadora persica</i>	Maliththan
Cyperaceae	<i>Cyperus rotundus</i>	Kalanduru

### III. Mangroves and associate area

<b>Family</b>	<b>Species</b>	<b>Sinhala name</b>
Sonneratiaceae	<i>Sonneratia caseolaris</i>	Kirilla
Typhaceae	<i>Typha latifolia</i>	
Verbenaceae	<i>Clerodendrum inerme</i> <i>Lantana camara</i>	Walgurenda Gandapana
Aviceniaceae	<i>Avicennia marina</i>	Manda, mada gas
Combretaceae	<i>Lumnitzera racemosa</i>	Beriya
Rhizophoraceae	<i>Brugiera gymnorhiza</i>	Kadol
	<i>Ceriops tagal</i>	Rathugas, Punkanda
Chenopodiaceae	<i>Suaeda monoica</i> <i>Excoecaria agallocha</i>	Telakiriya, Thela

### III. Sand dunes

<b>Family</b>	<b>Species</b>	<b>Sinhala name</b>
Verbenaceae	<i>Phyla nodiflora</i>	Hiramana-detta

Pandanaceae	<i>Pandanus tectorius</i>	Muhdukeiya
Euphorbiaceae	<i>Euphorbia nerifolia</i>	Pathok
Cactaceae	<i>Opuntia delenii</i>	Pathok
Euphorbiaceae	<i>Euphorbia antiquorum</i>	Daluk
	<i>E. tirucalli</i>	Navahandi
Palmae	<i>Cocus nucifera</i>	Pol

#### IV. Salt marshes and adjacent aquatic ecosystems

Family	Species	Sinhala name
Scrophulariaceae	<i>Bacopa monniera</i>	Lunuwila
Compositae	<i>Eclipta prostrata</i>	Kikirindiya
Annonacea	<i>Annona grabra</i>	Vel anoda
Convolvulaceae	<i>Ipomoea aquatica</i>	Kankun
Portulacaceae	<i>Portulaca oleracea</i>	Gendakola

#### V. Homestead

Family	Species	Sinhala name
Liliaceae	<i>Aloe vera var. littoralis</i>	Komarika
Palmae	<i>Cocus nucifera</i>	Pol
Rubiaceae	<i>Ixora coccinea</i>	Ratmal
Punicaceae	<i>Punica granatum</i>	Delum
Rutaceae	<i>Citrus aurantifolia</i>	Dehi
Melastomaceae	<i>Memecylon</i>	Dodam
Bromeliaceae	<i>Ananas comosus</i>	Annasi

#### Common animal species:

#### Fish species found in the study area of the Kalametiya lagoon

Family/Species	English name	Sinhala name
<b>Anguillidae</b>		
<i>Anguilla bicolor</i>	Level-finned Eel	kalu aandha
<i>Anguilla nebulosa</i>	Long-finned Eel	pol mal aandha



Cyprinidae	<i>Labeo dussumieri</i>	Common Labeo	hiri kanaya
	<i>Puntius amphibius</i>	Scarlet-banded Barb	mada ipilla

Bagridae	<i>Mysrus gulio</i>	Long-whiskered Catfish	anguluwa
	<i>Mysrus kelerius</i>	Yellow Catfish	path ankutta
	<i>Mysrus virrarus</i>	Striped Dwarf Catfish	iri ankutta

<b><i>Family/Species</i></b>	<b>English name</b>	<b>Sinhala name</b>
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Clariidae	<i>Clarias brachysoma</i>	Walking Catfish	magura
Heteropneustidea	<i>Hereropneustes fossilis</i>	Stinging Catfish	hunga
Hemiramphidae	<i>Zenarchopterus dispar</i>	Viviparous Halfbeak	morella
Syngnathidae	<i>Microphis ocellatus</i>	Ocellated Pipefish	punchi ata theliya
Centropomidae	<i>Lares calcarifer</i>	Barramundi	modha
	<i>Ambassis commersoni</i>	Common Glassfish	katilla
Kuhliidae	<i>Kuhlia marginata</i>	Spotted Flagtail	gal pulunna
Carangidae	<i>Carnax sexfasciatus</i>	Bigeye Trevally	inguru parau
Monodactylidae	<i>Monodactylus argenteus</i>	Mono	kapuwa
Scatophagidae	<i>Scatophagus argus</i>	Scat	ilattiya
Cichlidae	<i>Etroplus maculatus</i>	Orange Chromide	kaha koraliya
	<i>Etroplus suratensis</i>	Pearl Spot	koraliya
	<i>Saratherodon mossambicus</i>	Tilapia	tilapia
	<i>Oreochromis niloticus</i>	Tilapia	tilapia
Anabantidae	<i>Anabus testudineus</i>	Climbing Perch	kavaiya Belontiidae
	<i>Trichogastor sp.</i>	Gourami	theppili
Channidae	<i>Channa gachua</i>	Brown Snakehead	parandal kanaya

Mastacembelidae	<i>Mastacembelus armatus</i>	Marbled Spinyeel	gan theliya
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## Reptile species recorded in the study area

<i>Family/Species</i>	<b>English name</b>	<b>Sinhala name</b>
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### SNAKES

#### Boidae

<i>Python molurus</i>	Python	pimbura
<i>Ptyas mucosus</i>	Common Rat Snake	garandiya
<i>Dryocalamus nympha</i>	Bridal Snake	karavala*
<i>Boiga</i> sp.	Cat Snake	mapila *
<i>Dendrelaphis tristis</i>	Bronze-back	haldanda *
<i>Ahaetulla nasutus</i>	Green Whip Snake	ahatulla
<i>Amphiesma stolata</i>	Buff-striped Keel-back	ahara kukka
<i>Xenochrophis piscator</i>	Keel-back	diya naya
<i>Cerberus rhynchops</i>	Dog-faced Water Snake	kunu diya kaluwa

#### Elapidae

<i>Bungarus caeruleus</i>	Indian Krait	thel karavala *
<i>Naja naja</i>	Cobra	naya *

### TETRAPODS

#### Dermochelidae

<i>Dermochelys coriacea</i>	Leathery Turtle	dhara kesbawa*
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#### Chelonidae

<i>Lepidochelys olivacea</i>	Olive Ridley	batu kesbawa*
<i>Caretta caretta</i>	Loggerhead Turtle	olugedi kesbawa*
<i>Eretmochelys imbricata</i>	Hawks-bill Turtle	pothu kesbawa*
<i>Chelonia mydas</i>	Green Turtle	gal kesbawa*

#### Emydidae

<i>Melanochelys trijuga</i>	Hard-shelled Terrapin	gal ibba
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#### Testudinidae

<i>Testudo elegans</i>	Star Tortoise	tharaka ibba
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<i>Family/Species</i>	<b>English name</b>	<b>Sinhala name</b>
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#### Trionychidae

<i>Lissemys punctata</i>	Soft-shelled Terrapin	kiri ibba
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#### Crocodylidae

<i>Crocodylus palustris</i>	Marsh Crocodile	hala kirnbula*
<i>Crocodylus porosus</i>	Estuarine Crocodile	gata kirnbula*

Gekkonidae

<i>Calodactylodes illingwqrthi</i>	Great Rock Gecko	maha gal huna
<i>Cryptodactylus</i> sp.	Gecko	huna
<i>Hemidactylus depressus</i>	Jungle Gecko	hali huna
<i>Hemidactylus leschenaulti</i>	Crocodile Gecko	kirnbul huna
<i>Hemidactylus frenatus</i>	House Gecko	geval huna

Agamidae

<i>Calotes calotes</i>	Green Garden Lizzard	pala katussa
<i>Calo/es versicolor</i>	Com. Agamid Lizzard	gra katussa

Scincidae

<i>Dasia heliana</i>	Haly's Skink	polon heeraluwa
<i>Mabuya beddomii</i>	Stripped Skink	vairan hikanela
<i>Mabuya bibronii</i>	Sand Skink	le hikanela
<i>Mabuya carinata</i>	Common Skink	garandi hikanela

Varanidae

<i>Varanus salvator</i>	Water Monitor	kabaragoya
<i>Varanus cepedianus</i>	Land Monitor	thalagoya

**Bird species recorded in the study area**

<b>Family/Species</b>	<b>English name</b>	<b>Sinhala name</b>
<b>Pelicanidae</b>		
<i>Pelicanus philippensis</i>	Spotted-billed Pelican	alu pasthuduwa
<b>Phalacrocoracidae</b>		
<i>Phalacrocorax fuscicollis</i>	Indian Shag	hadapalu diyakava
<i>Phalacrocorax niger</i>	Little Cormorant	punchi diyakava
<b>Ardeidae</b>		
<i>Ardea cinerea</i>	Eastern Grey Heron	alu koka
<i>Ardea pulpurea</i>	Eastern Purple Heron	karaval koka
<i>Butorides striatus</i>	Little Green Heron	kuda pala kana koka
<i>Ardeola grayii</i>	Pond Heron	kana koka
<i>Bubulous ibis</i>	Cattle Egret	gava koka
<i>Egretta alba</i>	Eastern Large Egret	maha sudu koka
<i>Ixobrychus sinesis</i>	Little Yellow Bittern	kaha meti koka
<i>Dupetor flavicollis</i>	Black Bittern	kalu koka
<b>Threskiornithidae</b>		
<i>Platalea leucorodia</i>	Indian Spoonbill	handi alawa

<b>Family/Species</b>	<b>English name</b>	<b>Sinhala name</b>
<b>Anatidae</b>		
<i>Nettapus coromandelianus</i>	Cotton-Teal	mal-sera
<b>Accipitridae</b>		
<i>Circus aeruginosus</i>	Marsh Harrier	waguru harikussa
<b>Phasianidae</b>		
<i>Gallus lafayetti</i>	Sri Lanka Jungle Fowl	lanka wali kukula

<i>Pavo cristatus</i>	Indian Peafowl	monara/sebeda
Tumicidae		
<i>Turnix suscitator</i>	Sri Lanka Bustard-Quail	bola watuwa
Rallidae		
<i>Amaurornis phoenicurus</i>	White-breasted Waterhen	laya sudu korawakka
<i>Porphyrio porphyrio</i>	Purple Coot	nil kithala
Charadriidae		
<i>Vanellus indicus</i>	Red-wattled Lapwing	rathu karamal kirala
<i>Vanellus malabaricus</i>	Yellow-wattled Lapwing	kaha karamal kirala
Scolopacidae (continued)		
<i>Philomachus pugnax</i>	Ruff	lovichchiya
Phalaropidae		
<i>Phalaropus labatus</i>	Red-necked Phalarope	gela rathu diya-watuwa
Burhinidae		
<i>Esacus magnirostris</i>	Great Stone-Plover	maha golu-kirala
Laridae		
<i>Sterna albifros</i>	Little Tern	kuda muhudu lihiniya
Columbidae		
<i>Streptopelia chinensis</i>	Spotted Dove	alu kobeyiya
Psittacidae		
<i>Psittacula krameri</i>	Rose-ringed Parakeet	rana girawa
Cuculidae		
<i>Centropus si~ensis</i>	Southern Coucal	ati-kukula
Apodidae		
<i>Cypsiurus parvus batassiensis</i>	Palm Swift	wehi-lihiniya

### **Family/Species**

	<b>English name</b>	<b>Sinhala name</b>
Alcedinidae		
<i>Ceryle rudis</i>	Sri Lanka Pied Kingfisher	gomara kalapu-pilihuduva
<i>Alcedo atthis</i>	Common Kingfisher	podu mal-pilihuduva
Capitonidae		
<i>Megalaima zeylanica</i>	Brown-headed Barbet	polos kottoruwa
Picidae		
<i>Dinopium benghalense</i>	Red-backed Woodpecker	pita rathu rath-kerala
Hirundinidae		
<i>Hirundo riparia</i>	Common Swallow	karaval ivuru-lihiniya
<i>Hirundo rustica</i>	Eastern Swallow	wehi-lihiniya ,
<i>Hirundo daurica</i>	Sri Lanka Swallow	rathu kati wahi-lihiniya ,
Oriolidae		
<i>Oriolus oriolus</i>	Indian Golden Oriole	ran kahakurulla
Dicruridae		

<i>Dicrurus caerulesens</i>	White-vented Drongo	podu kauda
<b>Sturnidae</b>		
<i>Acridotheres tristis</i>	Common Mynah	myna
<b>Corvidae</b>		
<i>Corvus splendens</i>	House Crow	colamba kakka
<i>Corvus macrorhynchos</i>	Jungle Crow	kalu kaputa
<i>Pycnonotus cafer</i>	Red-vented Bulbul	kondaya
<i>Pycnonotus luteolus</i>	White-browed Bulbul	ama sudu kondaya
<b>Muscicapidae</b>		
<i>Turdoides affinis</i>	Common Babbler	demalichcha
<i>Orthotomus sutorius</i>	Tailor Bird	battichcha
<i>Copsychus saularis</i>	Southern Magpie-Robbin	polkichcha
<b>Dicaeidae</b>		
<i>Dicaeum erythrorhynchos</i>	Small Flowerpecker	kuda pilalichcha
<b>Nectariniidae</b>		
<i>Nectarinia zeylonica</i>	Purple-rumped Sunbird	damkati sutikka

### **Mammal species recorded in the study area**

<b>Family/Species</b>	<b>English name</b>	<b>Sinhala name</b>
<b>Soricidae</b>		
<i>Crocidura sp. .</i>	Shrew	hikmiya
<b>Cercopithecidae</b>		
<i>Macaca sinica</i>	Toque Monkey	rilawa
<i>Presbytis entellus</i>	Grey Langur	alu wandura
<b>Canidae</b>		
<i>Canis aureus</i>	Jackal	nariya
<b>Mustelidae</b>		
<i>Lutra lutra</i>	Otter	diyaballa
<b>Family/Species</b>	<b>English name</b>	<b>Sinhala name</b>
<b>Viverridae</b>		
<i>Paradoxurus hermaphrod*</i>	Palm Cat	kalawadda
<i>Viverricula indica*</i>	Ring-tailed Civet	urulawa
<b>Herpestidae</b>		
<i>Helpestes edwardsi</i>	Grey Mongoose	alu mugatiya
<b>Felidae</b>		
<i>Felis chaus *</i>	Jungle Cat	wal balala
<i>Felis viverrina*</i>	Fishing Cat	handun diviya
<b>Suidae</b>		
<i>Sus scrofa*</i>	Wild Boar	wal ura
<b>Tragulidae</b>		
<i>Tragulus meminna*</i>	Mouse Deer	meminna

Cervidae			
	<i>Cervus axis</i>	Spotted Deer	thith muva
Manidae			
	<i>Manis crassicaudata</i> *	Pangolin	kaballawa
Sciuridae			
	<i>Funambulus palmarum</i>	Palm Squirrel	iri lena
Muridae			
	<i>Bandicota</i> sp.	Mole Rat	podu uru miya
	<i>Coelomys mayori</i>	Bicoloured Spiny Rat	katu miya
	<i>Rattus rattus</i>	Common Rat	ge miya

\*reported by the villagers