

APPENDICES

Appendix 1 Detailed Methods of the Study

1-1 Aerial Photography

1-1-1 Flight plan

The HIEI SE- camera was employed for aerial photography. As the number of photo increased by using this camera, comparing with the photography by the Large Format camera, the flight was planned mainly to minimize the numbers of photo. The flight line were planned to fly parallel along the shoreline and considered with the configuration of the mangrove colonies distributed.

The focal length adopted to the HIEI SE- camera was 120 mm, and the effective Screen Size was 115mm × 115mm. Therefore, the formulae for the established flight plan, the aerial photography at a scale 1:20,000 was as follows:

Altitude : $120\text{mm} \times 20,000 = 2,400\text{m}$
Spacing : $115\text{mm} \times 20,000 \times 0.3 = 920\text{m}$ (30% of sidelap)
Exposure interval : $115\text{mm} \times 20,000 \times 0.7 = 1,610\text{m}$ (60% of overlap)

1-1-2 The method of Aerial Photography

The operation of taking the photographs by using the HIEI SE- camera system is similar with the normal vertical photo cameras. According to the speed of chartered aircraft, shooting interval were calculated to input the data into the camera system by which the photographs were taken automatically within the overlap of 60%.

During the flight for aerial photography, direction of respective flight lines were instructed by cameraman on board on the basis of the 1:50,000 flight plan maps. Maps for Aerial Photography Course and List of Negative Films of the Aerial Photographs are attached to Appendix 2-6 and Appendix 2-7 respectively.

1-2 Uncontrolled Mosaic Photographs

For the preparation of the Base Maps which will be established for the data base of mangrove colony resource information, the Uncontrolled Mosaic Photographs were developed as the base information for the Base Maps. The Base Maps were prepared by transcribing and fair drawing the planimetric information on the Uncontrolled Mosaic Photographs. The Uncontrolled Mosaic Photographs were used also as the base information for the vegetation study in the

field work.

The 1:10,000 scale Mosaic Sheets were prepared by enlarging the existing 1:50,000 scale topographic maps, five times larger. The neat lines of the Mosaic Sheets were divided as same size, same longitude and latitude of neat lines of the Base Maps, and at the four corners of the neat lines, the longitude and latitude were registered. In the preparation of two times enlarged 1:10,000 scale photographs, the 1:20,000 scale aerial negative films were used.

The 1:10,000 scale Uncontrolled Mosaic Photographs were prepared by mosaicking with adjustment of the planimetric feature such as roads, coastal lines, rivers, and land use which were shown on the mosaic sheets, and the same object feature on the two times enlarged photographs.

1-3 Base Map

1-3-1 Methods

1:10,000 scale Planimetric maps were prepared as the Base Maps of respective thematic maps, such as forestry map, land use map which will be prepared in the field work of forestry resources, by using the Uncontrolled Mosaic Photographs. 1:250,000 scale Index Maps were prepared as the Base Map searching the data of respective thematic maps, in the database, by using the existing 1:250,000 scale topographic maps. Maps for Division of Neat Lines for the Base Maps are attached to Appendix 2-6.

The order to prepare the 1:10,000 scale Base map and 1:250,000 scale Base Map were as follows:

- (1) The neat lines were drawn on the polyester-base.
- (2) The neat lines for 1:10,000 Base maps were drawn as the same size (600mm × 800mm) and same longitude and latitude as for the Uncontrolled mosaic photographs. The neat lines for 250,000 Base maps were drawn as the same size(60' × 90') and the neat lines as for the existing maps.
- (3) Based on the “SYMBOLS AND SPECIFICATION FOR PLANIMETRIC MAP” prepared by the study team, the road, rivers, lakes, coastal line, buildings, arable land, fishpond, sand and forest were drawn by photo interpretation for the compilation manuscript of 1:10,000 Base maps, and by transcribing from the existing topographic maps for the original manuscript of 1:250,000 Base

maps.

- (4) The geographical names, administrative boundaries and mangrove vegetation boundaries were drawn in accordance with the results of the field work.
- (5) The copy of the compilation manuscript (1:10,000 Base maps) was prepared by manual tracing and used in the field work. The compilation manuscript was completed by the results of the field work, and the original manuscript of 1:10,000 Base maps were prepared.

1-3-2 Subcontract

To produce all the results as scheduled, the works for the Base maps on the two areas, Aparri and Lamon Bay area, were subcontracted to the local survey company, ACRE SURVEYING & DEVELOPMENT.

On 4 May 1998, the explanation of work site was made to receive the technical proposal and cost estimates from four local surveying companies. As the criteria for selecting a subcontractor, it was examined and evaluated whether the company had enough capability of supplying the required cartographer, equipment, material, it had reliability without any financial problem in the Philippines, and had enough similar work experiences (such as projects of JICA, etc.). As the result of the evaluation, the said company (ACRE) was selected as the subcontractor, for meeting those requirements with the lowest and acceptable cost estimate among the tenderers.

The contents of the subcontract were as follows:

- (1) Preparation of 1:10,000 Base maps
Compilation and fair drawing by photo interpretation
Lamon Bay area : 12 sheets
Aparri area : 7 sheets
Term : From 11 May 1998 till 30 June 1998
- (2) Preparation of 1:250,000 Base maps
Compilation and fair drawing by using existing maps
Lamon Bay area : 2 sheets
Aparri area : 2 sheets
Ulugan Bay area : 2 sheets
Term : From 11 May 1998 till 15 July 1998

1-4 Survey of Natural Conditions

1-4-1 Soil Sedimentation Survey

The following items were covered by the soil survey.

- (1) Total depth of soil
- (2) Thickness of each soil layer
- (3) Soil color
- (4) Soil texture
- (5) Mixture condition of gravel and shell and coral pieces
- (6) Humus
- (7) Root systems
- (8) Moisture

This survey was carried out by observing soil structures profiles in the field. Mangrove soil, consisting of soft mud, cannot be observed by the usual method of making a pit. Accordingly, a special device called a piston soil sampler designed to collect soft muddy soil samples was used. In practice, core samples were collected to observe the order of soil layers. This device can collect core samples down to a maximum depth of 3 meters relatively easily unless it hits obstacles such as large pieces of gravel and thick root systems. The specifications for the piston soil sampler are shown in Fig. A-1-1

In addition, the following items were also included in the survey in order to know the nature of brackish water.

- (1) pH
- (2) Salinity
- (3) Volume of dissolved oxygen (oxidation-reduction potential, which was covered in some plots.)

The instruments used to measure the above-mentioned three items were the portable pH meter (PICCOLO, HI-128), the seawater salinity meter (Salinity S/Mill made by Atago), and the portable ORP meter (RM-12P made by Toa Denpa Kogyo), respectively. To pick up soil water, soil water sampler (DIK-8390 made

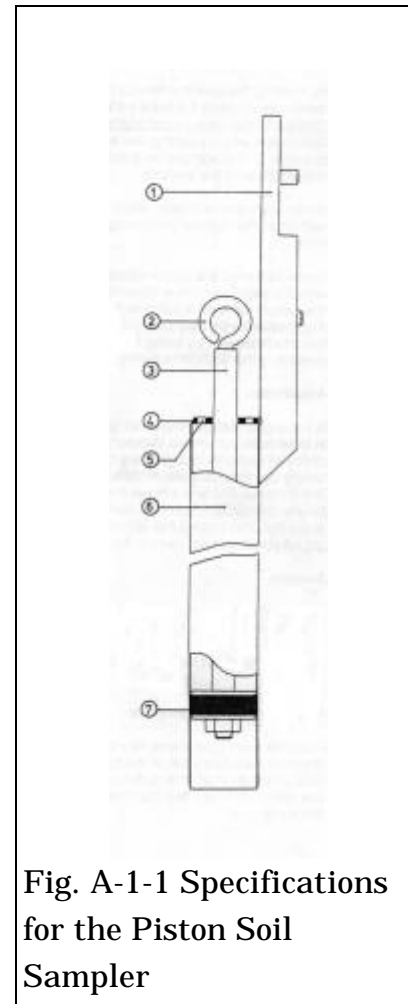


Fig. A-1-1 Specifications for the Piston Soil Sampler

by Daiki Rika Kogyo) was used. It is designed to pick up soil water by applying absorptive pressure to the porous cup at the tip of the device. The specifications for "Soil water sampler" are shown in Fig. A-1-2.

1-4-2 Survey on Salinity by Influent Sea-water

In the process of observation, the Study Team on a boat approached mangroves growing on the riverbanks as closely as possible, recorded all species which appeared about 10 m wide front and behind the boat, and the frequency of appearance by each species in percentage. To measure salinity, the foregoing salinity meter was directly dipped in the river water from the edge of the boat at the same site as the observation of mangroves.

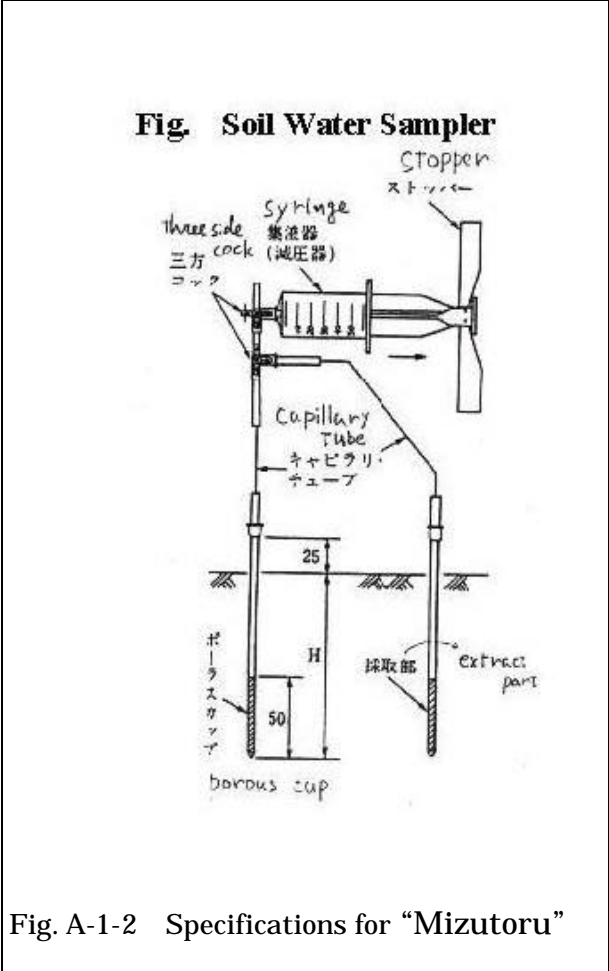


Fig. A-1-2 Specifications for "Mizutoru"

In the Buguey Zone in Aparri, mangroves were observed from the road bridge crossing the small river flowing into the tidal flat and the sample of the river water was collected ance of mangrove species (Fig. A-1-3).

1-4-3 Survey on Duration of Submergence (Effects of Tide Level)

As already stated in Part II, Subchapter 1-2-2, the structure of mangrove forests depends on the frequency and duration of submergence. As a result, the structure shows zonal changes in parallel with the coastline. However, it is still unknown how often and how long submergence should occur so that such changes

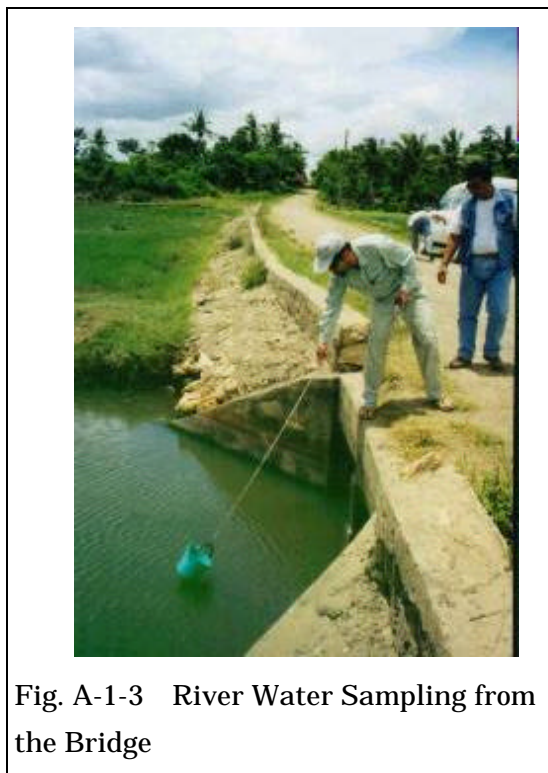


Fig. A-1-3 River Water Sampling from the Bridge

will take place. In this study, the correlation between the zonation of mangroves and the tidal level was studied and observed in Ulugan Bay compared with the other two study areas.

To observe the correlation between the zonation of mangrove species and the tidal level, the Study Team went into the mangrove forest at the peak of the tidal level on the date of observation, set a belt about 1 meter wide landward, and marked the stems of mangrove trees included in the belt. Trees were marked by using both wood chalk and vinyl tapes (Fig. A-1-4).



Fig. A-1-6 Measuring the Tide Level with the Simple Water Gauge

When the team could not go into the mangrove forest at the peak, simple



Fig. A-1-5 Specifications for the Simple Water Gauge

water gauges (pieces of styren foam were put in a transparent acrylic tube) were set at several sites to measure the maximum tidal level. Then, mangrove species found around each site were observed in relation to the tidal level. The specifications for the simple water gauge using an acrylic tube are shown in Figs. A-1-5 and A-1-6.

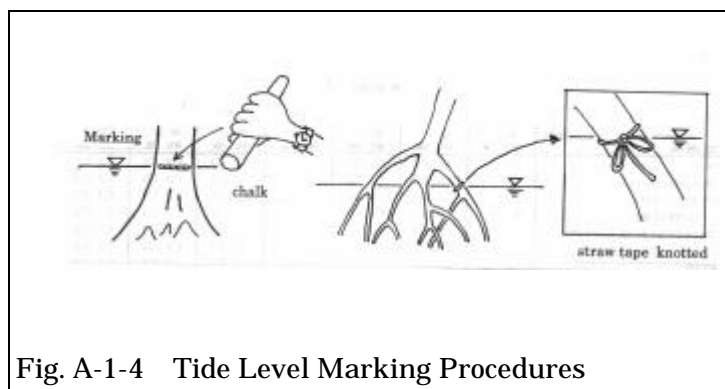


Fig. A-1-4 Tide Level Marking Procedures

1-5 Mangrove Forest Inventory

1-5-1 Transect Survey

The objectives of the Transect Survey on the mangrove forests were:

- 1) to identify species distribution patterns in the mangrove forests;
- 2) to examine the correlation between mangrove association and natural conditions such as tidal level, estuary location, layers of soil sediment, soil ingredients, and micro topography; and
- 3) to obtain information that will help in the selection of appropriate sites for subsequently conducting sample plot surveys.

Since the interrelation between mangrove species distribution and tidal level are generally recognized, the transect survey was carried out by setting a transect line from seashore to landward. Ideally the sites for transect survey should be selected within the primary forests, however, in the actual field, to find such sites are difficult. Therefore, the sites were set on the area which is not disturbed and/or damaged by human activities as far as possible.

Direction of the transect line should be decided so as to observe changing patterns of mangrove vegetation types effectively, and the line should be straight as much as possible.

The methods of the transect survey was divided to three (3) parts, i.e. levelling, tree stands measurement, and soil survey. The contents of these three parts were as follows:

(1) Levelling

Firstly, direction of transect which was decided by using a compass was kept until the last point as much as possible. The leveling was executed at the

changing point of micro-topography or mangrove vegetation.

(2) Tree Measurement

Tree measurement was to record species, height, DBH, and location from starting point of transect belt. The stands to be recorded were upper 3 cm in DBH within 1 meter wide on one side of the transect line. DBH was measured as rounded in every 2 cm. In case of *Rhizophora spp.* which has aerial stilt-roots in the place upper than breast height, diameter was measured at the point of the highest aerial stilt-root arise.

Two methods of recording were made, which were; 1) to record species, height, DBH, and location from starting point on field inventory book and, 2) to sketch rough profile of the all stands on the transect belt on section paper. As reference, not only stands upper 3 cm in DBH but also young stands below 3 cm in DBH and even seedlings were drawn in case of sketching.

(3) Soil Survey

The soil survey was conducted at the place that different mangrove vegetation were found along the transect line. The method of the soil survey were as shown sub-chapter 1-4-1 in this Appendix 1.

1-5-2 Sample Plot Survey

The objective of sample plot survey on the mangrove forests were:

- 1) to grasp stands structure of mangrove forest under different land conditions,
- 2) to carry out field verification through identifying real stands on the field with compilation of aerial photograph imagery.

The sample plots for the survey should be established on every different pattern of mangrove vegetation which can be identified on aerial photographs. Therefore, the sample plots were selected in consideration with vegetative features of mangrove forest, condition of crown density etc. based on results of pre-interpretation of the aerial photographs.

(1) Procedure for the Establishment of the Plot

After the team reached to target point for a sample plot marked on an aerial

photograph in advance, the center point of the plot was decided. Next, four (4) persons moved the following distance decided by average tree height in the plot, from the center point to east, west, south and north respectively.

- 1) In case that average tree height in a plot was less than 5 m, distance from the center point to corner point was 10 m. Consequently a plot of square of approximately 14 m x 14 m (200 m²) was established.
- 2) In case that average tree height in a plot was from 5m to 20m, distance from the center point to corner point was 15 m. Consequently a plot of square of approximately 21 m x 21 m (450 m²) was established.
- 3) In case that average tree height in a plot was more than 20 m, distance from the center point to corner point was 20 m. Consequently a plot of square of approximately 28 m x 28 m (800 m²) was established.

Then, each four person marked each corner point by color tape and stretch nylon color tape up to the corner point on next side. Consequently circumference of the plot was surrounded by the tape and the plot was established.

(2) Contents of the Plot Survey

Items and the contents to be investigated in the plot survey were as follows:

1) Tree measurement

Tree measurement was to record species, height and DBH. The stands to be recorded were 3 cm or bigger in DBH within a plot. DBH was measured as rounded in every 2 cm. In case of *Rhizophora spp.* which has aerial stilt-roots in the place upper than breast height, diameter was measured at the point of the highest aerial stilt-root arise.

2) Plot position

Tidal level and estuarine location in a plot were observed as plot position. The tidal level can indicate soaking time of root system of mangrove forest. The estuarine location can indicate how fresh water affect mangrove ecosystem. There were three categories (low, middle, high) for tidal level and three categories (downstream, intermediate, upstream) for estuarine location.

3) Crown density

Crown density of each layer of upper, middle, lower (classified as upper-layer of more than 15 m in tree height, middle-layer of 10 to 15 m in tree height, lower-layer of less than 10 m in tree height. hereinafter same definition.) was measured in percentage.

4) Dominance

Dominance degree of mangrove species on each layer of upper, middle, lower was recorded. It was categorized in six (6) class (approx. 70% as 5, 50% as 4, 25% as 3, 10% as 2, 5% as 1, few as +).

5) Regeneration

For regeneration survey, two sample areas in 1 m x 1 m square were set at the two corners (east and west corner or south and north corner) of a plot. Then, species and number of all seedlings, of which DBH was less than 3 cm, were recorded by every three class of tree height (less than 1 m, from 1 m to 3 m, 3 m or more).

6) Land use condition or affection of human activities

Land use condition or affection of human activities was observed and described.

7) Stands distribution sketch

Crown projection on the plot was drawn as stands distribution sketch.

8) Land feature sketch

Land feature such as small channel, mound, puddle, rock, fallen tree making gap, stump, community of *Nypa* and other remarkable geographic feature and natural feature on the ground was sketched.

9) Brief description of the mangrove forest

Remarkable feature of the mangrove forest in the plot was observed and described.

10) Taking photographs

Photographs of the mangrove forest in the plot were taken to be inserted in the data base for GIS.

The survey results of each sample plot were described by using the Philippine Mangrove Plot Survey Sheet.

1-6 Interpretation of Aerial Photographs

1-6-1 Pre-interpretation

(1) Classification for Interpretation

In order to obtain a general overview of the status of land use and vegetation, classification standards for interpretation were prepared as shown on Table A-1-1. Then, new aerial photographs of each study area (taken from January to March 1998 on a scale of 1 to 20,000) were pre-interpreted by using information obtained in the first field survey (transect survey).

Table A-1-1 Classification Standards for Interpreting Land Use and Vegetation

Category	Symbol	Standard
Mangrove Forest	M	<ul style="list-style-type: none">- Distributed along shorelines and estuaries.- The crown is round, and extends outward depending on tree height.- The color tone is light to medium black.
Nipa Forest	N	<ul style="list-style-type: none">- Mainly distributed along rivers and covering all of the area (i.e. contiguous, wide expanse).- The color tone is medium to dark black.
Active or Abandoned Fishpond	F	<ul style="list-style-type: none">- Established along shorelines and estuaries.- Boundaries (i.e. dikes) are clear.- Mangrove or nipa forests grow along the boundaries.- Mangroves still remain within part of the area enclosed by the dikes.- The color tone is white to grayish white.
Others	O	<ul style="list-style-type: none">- Other than M, N and F.

(2) Procedures for Pre-interpretation

- 1) Indicate/transfer principal points on/to all photographs.
- 2) Draw photographic base lines.
- 3) Examine objects carefully and thoroughly with a mirror stereoscope.
- 4) Use the central parts of aerial photos in the process of pre-interpretation.
- 5) Write outlines and symbols in accordance with classification standards of land use and vegetation.

- 6) Mark places that are unclear and questionable to be checked at the time of field verification.

1-6-2 Standardization for Interpretation of Aerial Photographs

(1) Field Verification

Places and objects that were not clear or perhaps questionable during pre-interpretation and standard images (i.e. exemplifying typical or specific patterns) were checked on the site in terms how they were reflected on the photographs. Then, errors were corrected. Procedures for field verification are as follows:

- 1) Keep the scale of the photos in mind.
- 2) Go on until the site drawing the route to the site on the photograph, simultaneously checking it on the map.
- 3) If in doubt about which part of the photograph correspond with the spot on which surveyors are standing, return to a spot (place) where surveyors are confident about the location (geographic position) and repeat the foregoing process.
- 4) Verify the present location in the photograph upon arrival at the site. Also, make a detailed comparison between what appears on the photograph and what surveyors see on the site.
- 5) Check and correct places that are unclear or questionable in respect of the standards for classification of land use and vegetation during pre-interpretation (i.e. Table A-1-1).

(2) Refining the Standards for Interpretation

Based on results of the plot surveys and the field verification after pre-interpretation, it was found that in some of the surveyed areas, mangroves were scattered within portions of sites that had previously been classified as nipa forests, based on the classification standards appearing in Table A-1-1. Consequently, the portions with mixed nipa and mangrove were subdivided, and classification standards for interpretation of forest types were prepared as shown on Table A-1-2.

Table A-1-2 Classification Standards for Forest Type Interpretation

Category	Subcategory	Sym bol	Standard
Mangrove Forest		M	<ul style="list-style-type: none"> - Distributed along shorelines and estuaries. - The crown is round, and extends outward depending on tree height. - The color tone is light to medium black.
Nipa Forest	Nipa Forest	N	<ul style="list-style-type: none"> - Mainly distributed along rivers and covering all of the area (i.e. contiguous, wide expanse). - The color tone is medium to dark black.
	Nipa Forest mixed with Mangroves	Nm	<ul style="list-style-type: none"> - Mainly distibuted along rivers. Crowns are round and widely distributed in the area. - The color tone is light black but some spots are medium or dark black.
Active or Abandoned Fishpond		F	<ul style="list-style-type: none"> - Established along shorelines and estuaries. - Boundaries (i.e. dikes) are clear. - Mangrove or nipa forests grow along the boundaries. - Mangroves still remain within part of the area enclosed by the dikes. - The color tone is white to grayish white.
Others		O	- Other than M, N and F.

Subdivisions within the classification standards shown above (Table A-1-2) correspond to mangrove and fishpond classification at each Study Area (five (5) mangrove types in Aparri area, eleven (11) mangrove types in Lamon Bay area, four (4) mangrove types in Ulugan Bay area, and nine (9) fishpond types for all areas) as follows;

Aparri Area

APN : Almost entirely occupied by *Nypa fruticans* (Pure Nipa area)

ANM: *N. fruticans* are dominant but sometimes mixed with high intertidal mangrove species.

AAN : *Avicennia officinalis* with rather big crowns within *N. fruticans* or in narrow belts along the riverbanks.

ASN : Shrubs mixed with *N. fruticans* and high intertidal mangrove species such as *Excoecaria agallocha*, *Acrostichum aureum* and *Acanthus ilicifolius*.

AMN : *A. officinalis*, *Sonneratia caseolaris* and *Bruguiera sexangula* are

dominant but mixed in a few spots with *N. fruticans*.

Lamon Bay Area

LRD : Dominated by small and low-height *Rhizophora apiculata*.

LRB : Small and low height *R. apiculata* mixed with *Ceriops tagal* and *Bruguiera gymnorrhiza*.

LAS : Characterized by rather tall and recognizable crowns of *A. officinalis*, with *Scyphiphora hydrophyllacea* occupying the lower canopy. Associated with *C. tagal* and *Xylocarpus granatum*.

LHS : Dominated by medium height *Heritiera littoralis*, mixed with high tidal mangrove species such as *S. hydrophyllacea* and *E. agallocha*. Large parts of this type are commonly covered by shrubs and vines. *A. ilicifolius* and *A. aureum* often comprise most of the forest floor.

LSA : *Sonneratia alba* and/or *Avicennia marina* with *R. apiculata* on the outer edge of the shoreline. This type also includes:

- parcels dominated by small and low height *R. apiculata* (same as above) i.e. LRD and
- mixtures of small low height *R. apiculata*, *C. tagal*, *B. gymnorrhiza* (same as above), i.e. LRB

LAB : Medium height *A. officinalis* mixed with low height *Avicennia lanata* and *B. sexangula*.

LLX : Mixed stands of low-height *Lumnitzera littorea*, *X. granatum*, *Bruguiera parviflora*, *B. sexangula*, *S. hydrophyllacea* and *H. littoralis*.

LAX: Mixed stands of low-height *Aegiceras corniculatum*, *Aegiceras floridum*, *A. lanata*, *X. granatum*, *R. apiculata*, *B. sexangula*, *C. tagal* and *Camptostemon philippinensis*.

LAA: Medium height *A. officinalis* mixed with *A. lanata*, *S. hydrophyllacea* and *A. corniculatum*.

LBE : Bushes growing together with *E. agallocha*.

LND : dominated by *N. fruticans*.

Ulugan Bay Area

URB : Medium height stands of *R. apiculata* or *R. mucronata* and *B. gymnorrhiza* with the species mix continuously changing from seashore to mid-tidal zone.

UTR : Dominated by tall *R. apiculata*.

UXH : High intertidal mangrove species such as *X. granatum*, *H. littoralis*, *E. agallocha*.

UMR : Dominated by medium height *R. apiculata*.

Fishponds

- F-1 : Clear bank around the fishpond exists and filled with water.
- F-2 : Clear bank around the fishpond exists but only less than 50 % surface is covered by water.
- F-3 : Clear bank around the fishpond exists surface is covered by water but very shallow or mud mounds are developing.
- F-4 : Clear bank around the fishpond exists but surface is covered with mud mounds and limited water and partly covered by vegetation.
- F-5 : Clear bank around the fishpond exists but more than 50 % of surface covered by vegetation.
- F-6 : Clear bank around the fishpond exists and water also observed but partly thick vegetation same as surrounding natural mangrove stands is developed.
- F-7 : Clear bank around the fishpond exists but surface is fully covered with vegetation, same as surrounding natural mangrove.
- F-8 : Bank is not all around nor clear. Some ponds are dry, shallow water covered and/or vegetation same condition as surrounding mangrove stand covered.
- F-9 : Bank is not all around, but clear water exists in only some part. Vegetation covered is same as surrounding mangrove.

(3) Preparing Interpretation Cards

Interpretation Cards were designed to describe stereo-photographs of mangroves, nipa, fishponds and coconut palm trees, and data (tree species, height, etc.) obtained from the plot surveys and so on. These cards provide examples of the standards applied for interpreting the subdivisions of forest and fishpond types mentioned above. Utilization of these cards by different persons during photo interpretation maintains a certain level of technique consistent with the standards for interpretation of aerial photograph. The procedures for preparing interpretation cards are as follows:

- 1) Use recent aerial photographs (i.e. newly-taken).
- 2) Select randomly the survey points for the sample plot survey or points of stands representing each study area.
- 3) Draw transect lines (2 x 2 cm) with a dermatograph on aerial photos (scale: 1 to 20,000) in preparation for the stereovision of sample stands.
- 4) Enlarge photos of sample stands approximately three (3) times (scale: 1 to 6,700).
- 5) Mount the enlarged photos on cardboard in order to facilitate stereo vision and

indicate necessary items of data (tree species, height, etc.).

1-6-3 Interpretation of Aerial Photographs

The initial phase in the interpretation of aerial photographs was carried out during the Second Study in the Philippines. This work included pre-interpretation, field verification, and formulation of the standards for interpretation. Thereafter, the interpretation of aerial photographs continued in the Third Study in the Philippines during which the work expanded to include final confirmation of forest stand conditions such as crown density, tree height, and the main species. These steps were applied for each sub-compartment (i.e. sub-compartment by sub-compartment). To carry out these tasks efficiently, the following work is required and was accomplished during the study.

- 1) After pre-interpretation, the aerial photographs was re-examined based on field verification using information obtained from field survey work such as implementation of plot surveys.
- 2) Final delineation of the boundaries of compartments and sub-compartments.
- 3) Discussion with other analysts in order to arrive a consensus on the results of interpretation.
- 4) Preparation of the forest inventory book.

Methodologies used in the study for delineation of the compartment and sub-compartment boundaries, and for preparing the forest inventory book are described.

(1) Delineation of Compartment and Sub-compartment Boundaries

Final establishment of the compartment and sub-compartment boundaries within the mangrove forest study areas was based on the interpretation of aerial photographs conducted during the Third Study in the Philippines.

The general procedures were as follows:

- 1) Each study area (Aparri, Lamon bay, and Ulugan bay) was divided into several zones based principally on boundary lines of large municipalities.
- 2) Each zone was divided into several compartments based on topographical lines such as a river or road, or on other easily-recognizable objects.
- 3) Each compartment was divided into sub-compartments based on categories

such as parts of the forest having similar conditions and/or distinguishable fishponds. For the sub-compartments, five (5) categories were established: i.e. "Mangrove forests", "Nipa areas", "Nipa mixed with Mangroves", "active or abandoned fishponds", and "other land use".

The following standards were used for delineation of compartment and sub-compartment boundaries:

- 1) The size of one compartment should be approximately 100 ha (about the same size that a hand will cover on a map scaled at 1/10,000). One hundred hectares (100 ha) is considered to be a suitable and practical size for a management unit. However, the size of compartments will ultimately depend on the forest conditions and management policy. If the areas are intended for use by many people working in small units, the compartment size may be smaller.
- 2) The minimum size of a small sub-compartment should be approximately one (1) ha. This is equivalent to 1 cm x 1cm on a 1:10,000 scale map. Anything smaller would be hard to see on the map, and too many sub-compartments would make management difficult.
- 3) In principle, no compartment boundary should go beyond the boundary of a municipality. Likewise, the boundary of a sub-compartment should not go beyond the boundary of a barangay.

The methods applied for numbering of compartments and sub-compartments were as follows:

- 1) Compartments were assigned three (3) digit numbers. Thus, compartment 101 as the first compartment of the first zone, compartment 102 as the second compartment of the first zone, and compartment 201 as the first compartment of the second zone.
- 2) For sub-compartments in each compartment, the identification codes were M-1 to M-n for Mangrove forests, N-1 to N-n for Nipa areas, Nm-1 to Nm-n for Nipa mixed with Mangroves, F-1 to F-n for active or abandoned fishponds, and O-1 to O-n for other land use categories. The numbering of each sub-compartment followed a clockwise sequence starting from northeast to southwest.

After delineation of compartment and sub-compartment boundaries on the

aerial photographs, the compartment and sub-compartment lines on the photographs were transferred onto base maps having the same scale as the aerial photographs. The procedures for transferring compartment and sub-compartment lines onto base maps were as follows:

- 1) Laid an aerial photograph under a base map drawn on transparency paper.
- 2) Traced the lines previously entered on the aerial photographs onto the Base map transparency. Slanting has an affect on the information presented by aerial photographs. The slanting is minimal at the center of the photograph and increases as one moves to the frame (edge) of the image. Therefore, to avoid the distortions due to slanting, tracing was confined to the central part of the photograph.

Results of the delineation of compartments and sub-compartments are presented in Appendix-2-9 which is a table showing numbers of the compartments and sub-compartments.

(2) Preparing the Mangrove Forest Inventory Book

Forest inventory books are generally prepared in order to clearly document forest conditions such as species, crown density, tree height, tree number, volume etc on each forest lot. These books also document the land conditions such as site quality, soil condition and geological structure on each forest lot. For the Study, the form of the Mangrove Forest Inventory Book (hereinafter referred to as “the Book”) was designed in consideration of; (1) utilization of the data in the future when formulating plans for the conservation of mangrove forests and (2) to determine whether or not it is possible to utilize aerial photographs to reliable information. The format of the Book is shown in Table A-1-3.

During the third Study in the Philippines, information on the situation and condition of every sub-compartment in the Study areas was recorded on forms using data obtained through the interpretation of aerial photographs. This information was then entered into the data base for GIS.

Table A-1-3 The Form of Mangrove Forest Inventory Book

The forms of the Book were filled out as follows:

Philippine Mangrove Assessment Mangrove Forest Inventory Book		Name of the Area		Name of the Zone		Name of Municipality			Main Species	Remarks										
		Barangay Name	Municipality Name	Zone Name	Area Name	Compartment	Sub Compartment	Forest Situation of Each Class			Area (ha)	Mangrove Area within Fishponds (%)	Aerial Photo Interpretation Category							
		Upper class	Middle class	Lower class	Low	Middle	High	Down Stream	Inter mediate	Upstream	Others									
		Crown Density	Crown Density	Crown Density																
		Mean Height (m)	Mean Height (m)	Mean Height (m)																

1) Name of the Area

The full name of each Study Area (Aparri, Lamon Bay and Ulugan Bay) was entered near the top of the outside portion of the form. The three (3) letter codes were entered on the form.

2) Name of the Zone

The full name of the Zone was entered near the top of the outside portion of the form. The three (3) letter codes were entered on the form. The Study areas were divided as follows:

Aparri Area - six (6) zones, i.e. - Pamplona, Abulug, Linao, Buguey West, Buguey East, and Santa Teresita;

Lamon Bay Area - nine (9) zones i.e. - Binactocan, Santa Cecilia, Santo Angel Bay, Tiniguiban, Basiad, Makahadok, Kabibihan, Calauag, and Lopez;

Ulugan Bay Area - four (4) zones, i.e. - Taronayan Bay, Tagabinit, Macarascas and Bahile.

3) Name of the Municipality

The full name of the Municipality was entered near the top of the outside portion of the form. The three (3) letter codes were entered on the form. There are five (5) municipalities in the Aparri area, five (5) municipalities in the Lamon Bay area, and one (1) municipality in the Ulugan Bay area.

4) Numbering

Serial numbers for each sub-compartment were assigned and entered on the form.

5) Barangay Name

Barangay names were entered with a three (3) letter code. There are 32 Barangays in the Aparri area, 45 Barangays in the Lamon Bay area, and five (5) Barangays in the Ulugan Bay area.

6) Compartments

Compartments are identified by three (3) digit numbers which were entered on the form. For the numbering, please see 1-6-3 (1) in this Appendix 1.

7) Sub-Compartments

Symbols and numbers of sub-compartments were entered on the form as shown in 1-6-3 (1) in the Appendix 1.

8) Crown Density Class

Three canopy height categories were applied in the study: "Upper" for the height of more than 15 meters (m); "Middle" for height ranging from 10 to 15 m

and “Lower” for the height of less than 10 m. Crown density classes were identified for every canopy height category existing in each sub-compartment except for “Fishpond” and “Others”. After determining the density class, this information was entered on the form by the following symbols;

Crown density symbol and meaning

- D4 : “Density ” of 70 % or more
- D3 : “Semi-dense” between 40 % and 70 %
- D2 : “Open” between 10 % and 40 %
- D1 : “Very Open” under 10 %
- 0 : 0 %
- + : Density could not be accurately determined on the aerial photos.

In cases where interpretation indicated that the crown density might be higher than the numbers stated above due to other layers, the symbol “+” was added. The only exceptions was “D4” where addition of a “+” symbol was impractical or unnecessary. For example, when the crown density in the lower layer was estimated as “D2” but additional crowns in that layer might be hidden by crowns existing in the middle or upper layers, the symbol used was “D2+”. In addition, when the all area in a sub-compartment was covered by the crowns of the “Upper” canopy category, the symbol of just “+” was used (“0+” was not used) for the “Middle” and “Lower” canopy categories.

9) Mean Height

The mean tree height for each canopy height category except for the “Middle” layer was indicated in meters on the form.

10) Tidal Class

Three tidal classes (Low, Middle and High) were used to indicate the tidal conditions in each portion of a sub-compartment. The proportions in each class were indicated by percentage. Thus, the total of all portions must be 100 %. No tidal class was indicated for sub-compartments consisting of “Fishpond” and “Others”.

11) Estuarine Location

Estuarine Location refers to the extent that conditions in a sub-compartment are influenced by the inflow of fresh water. The categories used were “Downstream”, “Intermediate”, “Upstream” and “Others”. “Others” in the categories was used for the location where estuarine factors are irrelevant. The proportionate area falling within these categories was indicated by

percentage. Thus, the total of all portions must be 100 %. This estuarine location was not indicated for sub-compartments of “Fishpond” and “Others”.

12) Area

Areas were calculated in the data base for GIS. The area(s) would be used as one of the methods for estimating mangrove resources.

13) Mangrove area within Fishponds

The portion of mangrove vegetation in each fishpond sub-compartment was expressed in percentage.

14) Aerial Photo Interpretation Category

As previously discussed in 1-6-2 (2) in this Appendix 1, different classification types were identified in each Study area: five (5) types in the Aparri area, eleven (11) types in the Lamon Bay area, four (4) types in the Ulugan Bay area for mangrove vegetation, and nine (9) types for fishponds. The type class of each sub-compartment was determined through photo interpretation, based on the features of each type listed in 1-6-2 (2). Type class chosen for each sub-compartment is indicated by the three (3) letter code.

15) Main Species

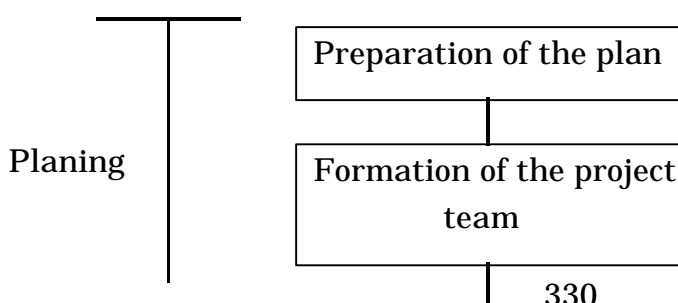
One (1) to five (5) mangrove species in a sub-compartment were listed in the order of their high dominance and identified by abbreviation symbols for each species as shown in Appendix 2-5.

16) Remarks

Any unique or special features or conditions in a sub-compartment were noted in the remarks.

1-7 Establishment of the GIS

The “ Mangrove Forest Resources Information Management System (MAFRIMS)” has been established in accordance with following work flow.



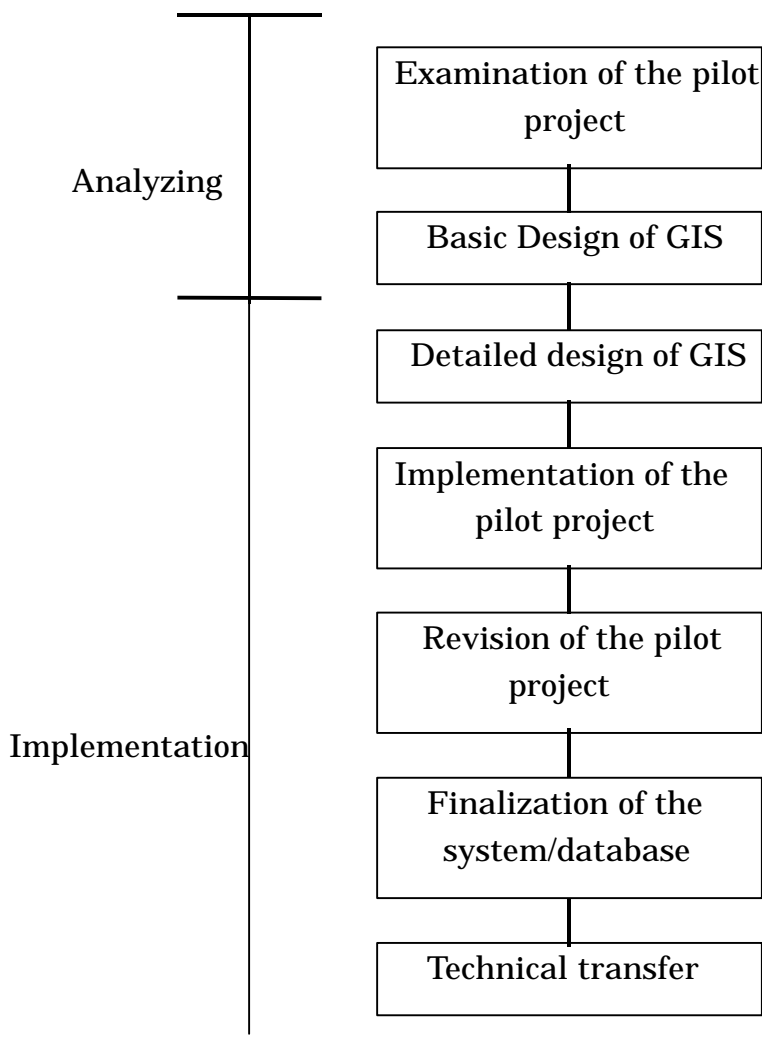


Fig. A-1-7 Flow chart for establishment of the GIS

1-7-1 Basic Design of GIS

In order to delineate the basic design of the MAFRIMS, the research on the availability of application software in the Philippines, the current situation of its circulation, the existing resources of computer facilities in NAMRIA, etc. on was made.

On the basis of the basic design to establish and operate the MAFRIMS, two PCs, one for system operation software and the other for graphic data editing software were used. Both PC were connected by the LAN to carry out easy data conversion between them.

Specification of selected hardware and software are as follows:

- (1) Hardware
 - 1) PC

CPU Pentium 300 MHz, RAM 96MB, Hard Disk Drive 6.4GB, Floppy Disk Drive 1.44MB, CD-ROM Drive, VRAM 4MB, 10/100 Base LAN Card, Enhanced Keyboard, 2 Buttons Mouse, Os Windows NT 4.0

2) Monitor

17' Color Monitor

3) Accessory

1000VA UPS, LAN Cable, ZIP 100MB Driven and Interface Cable

(2) Software

Microsoft Office 97

(Business application package including Word, Excel, etc)

ArcView GIS 3.0a for Windows 95/NT

(Ready – made GIS as the basic system for MAFRIMS)

The AVENUE is employed as the computer language with ARC VIEW 3.0.

1-7-2 Detailed Design of GIS

The required data and functions for MAFRIMS were listed to prepare detailed database specification. Contents of data managed by MAFRIMS are classified as follows:

(1) Graphic data

Graphic data represented on the maps such as coastline, river, residential area, road, administrative boundary, etc., were classified in accordance with the items of the data and those data were stored in separate layers respectively in the data base. With respect to acquisition of the graphic data, maps were stuck on the drawing board and the elements of the data were digitized by means of tracing with mouse cursor.

The map data were classified more detail into point, linear and polygon data and stored respectively. Point data such as annotations and map symbols consists of single-point coordinates. Linear data consists of combined plural-point coordinates, by which length of lines can be calculated. Polygon data is closed in which the beginning and ending point are coincided at same point, by which circumference and area of polygons can be measured. For instance, if the function for the measurement of mangrove forest area is required in the GIS of this project, it was necessary that the mangrove forest area is stored as polygon data.

(2) Attribute data

Attribute data are not graphic data but connected with the map data. For instance, administrative boundaries were stored as graphic data but administrative names, population, average temperature, etc., for the respective boundaries were stored as attribute data connected with them.

(3) Image data

The image data was acquired by scanning of the photographs taken in the field. Comparing with the graphic data, preparation of the image data is easier. However the volume of the data is bigger than the graphic data and it is impossible to add coordinates and attribute data to the data.

(4) Contents of data

In accordance with classified data items mentioned above, layer structure to form the data base in the MAFRIMS are shown in following tables.

Table A-1-4 General Map of the Philippines (Index Map to search project area in the country)

Data Item	Details	Data Type	Representation
Coastline		Graphic	Painted shape
Administrative boundary	Regional and Provincial boundary	Graphic	Linear
Geographical name	Name of region, province and city	Graphic	
Project Site	Project area	Graphic	Linear
Map name		Graphic	Letter

Table A-1-5 1:250,000 Maps (Index Map to search 1:10,000 planimetric map in the project area)

Data Item	Details	Data Type	Representation
City / town	Main city / town	Graphic	Painted shape
Road	Main road represented on the map	Graphic	Linear
River	Main river represented on the	Graphic	Linear

	map		
Coastline		Graphic	Painted shape
Generalized built-up area		Graphic	Painted shape
Mangrove forest	Area where mangrove forest existing	Graphic	Painted shape
Administrative boundary	Regional and Provincial boundary	Graphic	Linear
Geographical name	Name of region, province, city and mountain	Graphic	Letter
Map index	Map grid of the 1:10,000 planimetric maps	Graphic	Linear
Sheet name		Graphic	Letter

Table A-1-6 1:10,000 Planimetric Maps (Planimetric Information)

Data Item	Details	Data Type	Representation
Generalized built – up area		Graphic	Painted shape
Isolated residential area		Graphic	Painted shape
Road	Single and double line	Graphic	Linear
River	Single and double line, Lake, Pond	Graphic	Linear / Painted shape
Coastline	Single line	Graphic	Linear / Painted shape
Administrative boundary	Regional, Provincial, City, Barangay boundary	Graphic	Linear
Geographical name		Graphic	Letter
Neat-line		Graphic	Linear
Principal point of aerial photo		Graphic	Symbol
Aerial photo No		Graphic	Letter

Table A-1-7 1:10,000 Planimetric Maps (Land Use Information)

Data Item	Details	Data Type	Representation
Arable land		Graphic	Painted shape
Forest		Graphic	Painted shape
Sand / gravel		Graphic	Painted shape
Waste land		Graphic	Painted shape
Fishpond		Graphic	Painted shape

Mangrove forest		Graphic	Painted shape
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Table A-1-8 1:10,000 Forest Type Maps

Data Item	Details	Data Type	Representation
Mangrove forest area	Area where mangrove forest existing	Graphic	Painted shape
Mangrove forest compartment	Area divided into the compartment	Graphic	Painted shape
Mangrove forest sub – compartment	Area divided into the sub – compartment	Graphic	Painted shape

Table A-1-9 Photographs (Related to the graphic information)

Data Item	Details	Data Type	Representation
Photographs taken at field which recorded view of mangrove forest and Vicinity environment condition etc	Scanned picture images, point of took picture on the map and direction of the objected forest	Picture / Graphic	Picture / Symbol
	Serial number, area name, zone name, barangay name, image file name, main species of mangrove forest for each picture	Attribute	Inventory / Letter

Table A-1-10 Mangrove Forest Inventory Book (Related to the graphic information)

Data Item	Details	Data Type	Representation
Mangrove forest inventory book	General : Serial number, area name, zone name, municipality name on each sheet Details : Mangrove forest compartment number, sub-compartment number, upper	Attribute	Inventory / Letter

	canopy crown density class, upper canopy mean height, middle canopy crown density class, middle canopy mean height, lower canopy crown density class, lower canopy mean height Tidal class low, middle and high, Estuary location at low tide, intermediate and high tide Percentage of fishponds in the mangrove area		
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Table A-1-11 Socio – Economic Inventory (Not related to the graphic information)

Data Item	Details	Data Type	Representation
Mangrove forest area	Area name, zone name, municipality name, barangay name and sitio name	Attribute	Inventory / Letter

1-7-3 Data input

Following process were conducted in order to form the data base expected to be installed in the MAFRIMS.

(1) Digitizing

Maps were put on the drawing board at first, and map coordinates on the base map and machinery coordinates on the drawing board were corresponded each other. Then map coordinates were obtained by digitizing, such that the measured coordinates coincide with the Philippines Geodetic Coordinates System. Succeedingly, graphic information drawn on the base map were digitized by using the mouse cursor as respective layers. In this process, graphic elements classified into point, linear and polygon were separately input as respective layers. Theoretical check on graphic data (closing, disconnecting, crossing, etc) were finally conducted for each layer.

(2) Attribute data input

Attribute data obtained in the field and recorded in the inventory books were input in the spread sheet in accordance with specified data format (letter, code,

number, etc).

(3) Addition of attribute data

Digitized graphic data was related to input attribute data by using an exclusive software.

(4) Image data input

Cabinet edition photographs taken in the field were scanned with a color scanner.

(5) Inspection

Digitized map data were plotted out on to paper by plotter. It was inspected if there was any difference between the base map and plotted map data.

(6) Correction

Errors or mistakes found by the inspection were corrected.

(7) Install

All inspected and corrected data with no error was installed by using the "Data Import Program". Processes from the digitizing to correction mentioned above were carried out by using PC for graphic data editing and data base install was done by PC for system operation. Data conversion between both PC was executed by LAN.

1-7-4 Subcontract

To produce all the results within scheduled period, subcontract was made with local survey company whose name is A&A GEOINFORMATICS CORPORATION (A&AG)

On 17 November 1998, the explanation of subcontract work was given to receive the technical proposal and quotation from four local surveying companies. Evaluation and selection of subcontractor was conducted by same manner for base map.

The contents of the subcontract were as follows:

(1) Digitizing of Base Map	
Lamon Bay	12 sheets
Aparri	7 sheets
(2) Digitizing of Index Map	
Lamon Bay	2 sheets
Aparri	2 sheets
Ulugan Bay	2 sheets
(3) Preparation of Data Base from Base map	
Lamon Bay	12 sheets
Aparri	7 sheets
Ulugan Bay	3 sheets
(4) Preparation of Data Base from Index Map	
Lamon Bay	2 sheets
Aparri	2 sheets
Ulugan Bay	2 sheets

1-7-5 Application development

Based on the detailed design, the application software was developed by employing the function of developmental environment of the GIS software to be the base for the development. Simultaneously, the testing data base for the operation of this application were constructed. In addition to the ready-made standard function in Arc View software, following functions were newly developed.

- (1) Region :
Index Map indication, Initial screen set-up and others.
- (2) Attributes :
Reference of Forest Inventory Book and Photograph attribute information.
- (3) Thematic map :
Production of Land Use Map and Forest Type Map.
- (4) Search :
Indication of relevant Mangrove forest sub-compartment from Forest Inventory Book and others.
- (5) Extent :
Indication range set-up.

- (6) Display :
Maximization of window, to indication or non-indication of legend and others.
- (7) Calculate :
Area calculation of Mangrove forest sub-compartment.
- (8) Document :
Map data compilation and out-put and others.
- (9) Legend :
Compilation of legend.
- (10) Option :
Arc View standard menu change and others.

1-7-6 Data base maintenance

It is indispensable for the constant analysis of latest data in GIS to conduct update of GIS data base, as map data changes day by day and hour by hour.

Method of the data update in this system is as follows.

- (1) Update by using the digitizing system

In case map data is input newly or there has occurred some large scale change in the map data already input, GIS data base can be update by the same manner for digitizing mentioned above.

- (2) Update by using the GIS functions

In case small scale change, the data base can be updated by using the editing functions supplied in the GIS.

1-8 Socio-economic Survey

The socio-economic aspect of the Study was made to grasp the condition of the human activities of the people in the Mangrove areas, especially on the condition of actual use of Mangrove by the people, and also their intention toward the conservation of Mangrove Forest. The Survey on this socio-economic aspect was conducted by two activities; 1) General Socio-economic Survey by obtaining

information from Barangay Captains and/or other Barangay Officials of the all Barangays in the three Study Areas regarding general condition of the Barangay and use of Mangrove forest, 2) Socio-economic Survey by interviewing 200 household heads sampled in each Study Area (total 600 household heads) regarding detailed information on their living condition, Mangrove use and their intention on Mangrove conservation. The detailed methodology is as follows:

1-8-1 General Socio-economic Survey

Based on the Aerial Photograph, target Barangays were initially listed. As the next step, data on the number of household, total population were obtained at the Municipality where the target Barangay located. Likewise, information on the implementation status of the environment and Mangrove related projects were obtained at the CENRO of the area.

After there pre-field activities, the Study Team proceed to each target Barangay. The target informants are Barangay Chairman of each Barangay, hence, when Chairman is not available, one of Barangay Board Members who resides in the nearest to the center of Barangay was chosen as informant. When no Board Member is available, Barangay Secretary and/or Barangay Treasurer were also interviewed.

The information obtained from each Barangay was as follows:

(1) General

- Name of Barangay Chairman (or informant)
- Number of Sitio/Purok/Zone

(2) Rural Infrastructure

- Source of domestic water
- Percentage of electrified household
- Number of facilities

(Generator, Irrigation system, Ricemill Mechanical Dryer, Solar Dryer, Multi-purpose pavement, Pier, Pier waitingshed, Storage/Warehouse<for rice, for other crops, for Nipa, for fish>)

(3) Social Infrastructure

- Number of facilities

(Barangay hall, Clinic, Day care center, Elementary school, Highschool, Church, Sports center, Basketball court)

(4) Production and Marketing

- Major Products (forestry, fishery, agriculture)
- Major Marketing Place (buying, selling)

(5) People's Organization

- Number of groups
(Cooperatives, Association, Traditional community group, Religious group, Womam's group, Senior Citizen's Group, PTCA, Others)

(6) Environmental/Mangrove Issues

- Number of fishpond (private, FLA)

1-8-2 Socio-economic Survey (Interview Survey)

The Socio-economic Survey was conducted by interviewing selected sample respondents in each purok (sub-division) of target Barangays. The Survey aimed to obtain information from the local people who are being engaged in the dairy social/economic activities directly concerned with actual use of Mangrove resources, especially on the information regarding actual use condition and intention on the conservation of Mangrove.

The Survey was objected to obtain information on the following items; 1) family composition, income/expense, 2) living condition (incl. Mangrove use), 3) actual condition of Mangrove use in the past and present, future intention on conservation, 4) use condition of Mangrove as natural disaster prevention method. The data obtained was tabulated and analyzed as the supporting data to GIS, and contributes to analyze/evaluate condition of Mangrove resources in the Study Area from the viewpoint of socio-economic aspect.

The actual Survey was conducted by using questionnaire prepared by the Study Team, and result of the Survey was tabulated on the format made by the Team during the Third Study in the Philippines. The original questionnaire used in this Survey is attached as Appendix 2-10.

The Survey was made by interviewing total 600 household heads in three Study Areas chosen by geographical distribution, occupational distribution, followed by random sampling.

Based on the information of the population of the Barangay obtained in the First and Second Study in the Philippines by the Study Team, the 600 samples (200 in each Study Area) were distributed proportionately to the target Barangays. Likewise, the total number of samples in each Barangay was distributed proportionately to the different sub-division in the Barangay based on the distribution of households in each sub-division.

The Survey used a multi-stage sampling design which was purposive in the initial stages and random in the final stage of respondent selection. The Survey Areas were divided into municipalities, then divided into Barangays. Subdivision was done purposively in the initial stages to focus the survey on areas which are actually affected by the presence of Mangrove areas. Each Barangay was still divided into zones, purok or sitios (hereinafter referred to as “zones”) where randomization took place. Actual number of respondents (sample) for this level was determined according to the actual number of households present in this level. Randomization was done in this final sampling stage to capture the variability of socio-economic conditions by household and to give equal chance for every household to be part of the survey. In cases where there were two dominant occupations within the zones, another purposive bias was included to give the major occupations more or less equal representations.

Randomization was done by assigning numbers on piece of papers for each house as projected on the available maps or on the list of household heads as provided by the Barangay officials. The pre-determined sampling number was drawn from this lot. The interviewers then proceeded with the pre-drawn respondents. Whenever the identified respondents are not available, the enumerators went to the next respondent, then went back to the missed informant. In a few cases where the pre-identified respondents were not really available during the time of Survey, the respondents were changed them by again, randomly drawing names from the lot of all household members in the zone.

Prior to the interview works, three (3) group leaders who would supervise field interview activities in each Area were instructed to have several pre-survey discussions so as to unify the interview manner in all Study Areas as well as to unify the supplemental explanations on specific items of questionnaire expected for the better understanding of respondents. By doing such, the differences of the understanding on the questionnaire by each respondent in the different Study Areas were minimized.

By selecting 200 households from each Study Areas, the sampling percentage resulted as follows:

Aparri Area	56.93
Lamon Bay Area	23.98
Ulugan Bay Area	52.49

The raw data from answered questionnaire was tabulated on the worksheet of Microsoft Excel, then calculated in the following manner:

- 1) Basically, figure from each respondent is calculated its percentage by Sitio/Purok basis, then average figure of each Sitio/Purok is calculated its percentages by Barangay. Same manner was made for the percentage by Study Area.
- 2) For question which is asking "Yes" or "No", and also asking number of selected answer, calculation was made simply by percentage.
- 3) For question which is to be answered by specific words, the majority was adopted as the average answer of each Sitio/Purok.

Moreover, correlation of plural questions was also made for specific items, such as between the question on the sense of benefit on Mangrove forest to prevent natural disaster and the question on the sense of granting Mangrove cutting as the way to improve living condition. Respondents who replied specific answer were extracted, then the extracted group is also classified by the answer for different question.

1-9 On the Job Training (OJT)

The OJT was executed based on the Technology Transfer Plan submitted and accepted at the same time of the discussion for the Inception Report of the Study on December 1997. Name of the OJT participants are listed in Appendix 2-11

1-9-1 Aerial Photography

In the period from 10 Jan. till 30 Mar. 1998, the OJT for aerial photography was carried out by using a chartered aircraft from AIRSPAN Corporation. Through the aerial photography, technical transfer to the two counterpart personnel was made. As the training, the mobilization of the camera, handling the films and operational skills of using the camera system were carried out in OJT.

1-9-2 Uncontrolled Mosaic Photographs and Base Maps

(1) Uncontrolled Mosaic Photographs

From 26 Feb. till 30 March and from 13 April till 4 May 1998, the OJT was conducted in the office of NAMRIA. As the technical transfer, the mosaicking of enlarged photographs by manual method was made. The counterpart who had been participated in the OJT during the first year through second year, were six (6) counterparts.

(2) Base Map

From 5 May till 22 May 1998, the first term of the OJT was taken place in NAMRIA for the preparation of Base Maps (Compilation manuscript) by fair drawing of the roads, rivers, lakes, coastal line, buildings, arable land, fish pond, sand, and forest. The OJT was concentrated on the method of using practical tools for preparing Planimetric maps.

Also, during 13 July till 23 July 1998, the compilation of the original manuscript based upon the results of the field work was carried out as OJT by means of fair drawing method. The three sheets consists of Ulugan Bay area were assigned to the counterpart members. Three (3) counterparts were participated in the OJT.

1-9-3 Interpretation of Aerial Photograph

(1) Mangrove Forest Inventory

1) Transect Survey

During the periods from 5th to 10th February 1998 in Ulugan Bay area, from 13th to 18th February 1998 in Aparri area, from 24th February to 2nd March 1998 in Lamon Bay Area, The OJT on the field work for the transect survey was executed. Each three (3) participants from NAMRIA were dispatched for each study area. The methods of the OJT were as follows:

- a. method of levelling e.g. deciding direction, selecting turning point and setting up level
- b. method of tree measurement e.g. methods of sketching
- c. methods to measure DBH and tree height
- d. method of soil survey e.g. selecting place of the survey
- e. methods of use of the survey equipment
- f. methods of viewpoint for sample of soil and soil water.

2) Sample Plot Survey

During the periods from June 15th to June 25th 1998 and from August 5th to August 7th 1998 in Lamon Bay Area, June 30th to July 9th in Aparri Area, from July 17th to July 29th in Ulugan Bay Area, the OJT on the field work for the sample plot survey was executed. Each four (4) participants from NAMRIA were dispatched for each study area. The methods of the OJT were as follows:

- a. method of establishment of a sample plot
- b. method for proceeding of sample plot survey
- c. method for grasping stands structure of mangrove forest
- d. method of field verification with aerial photograph.

(2) Standardization for Interpretation of Aerial Photograph

During the periods from June 3rd to June 11th 1998 in the office of NAMRIA and from August 3rd to August 4th 1998 in the field of Lamon Bay area, the OJT on the work of standardization for the interpretation of aerial photographs was executed with sixteen (16) participants from NAMRIA. The methods of the OJT were as follows:

- a. Method for seeking principal point on a aerial photograph and transferring

the point to aerial photographs which were taken before and next of the aerial photograph.

- b. Method for drawing photo base line.
- c. Method for use of a mirror stereoscope
- d. Method of stereo vision e.g. use of center part of a aerial photograph to avoid distortion part of a aerial photograph.
- e. Method for drawing boundary line based on forest and land use condition.
- f. Method for marking difficult portion of the interpretation, for field verification.
- g. Method of the field verification.

(3) Interpretation of Aerial Photographs

During the period from Nov. 4 to Nov. 20 1998, the OJT work on the interpretation of aerial photographs was executed at NAMRIA with five (5) participants from NAMRIA. The methods of the OJT were as follows:

- a. Method for final establishment of boundary of compartment and sub-compartment
- b. Method for final confirmation of forest stand conditions such as crown density, tree height, and the main species
- c. Method for filling out the form of the Book through the interpretation of aerial photographs.

1-9-4 Data processing for GIS

During the period from Nov. 25 to Dec. 22 1998, the OJT work on the data processing for GIS was executed at NAMRIA with two (2) participants from NAMRIA. The contents of the work for the OJT were as follows:

- a. Method of preparatory work for map digitizing
- b. Methods of digitizing

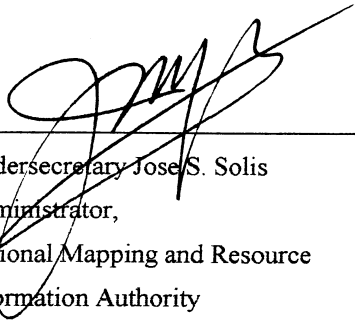
Digitizing has been carried out in accordance with following process:

- i) Digitizing of frame-work data
- ii) First layering of digitized data
- iii) Plotting
- iv) Inspection of edited data
- v) Digitizing of land use and sub-compartment boundary
- vi) Digitizing of other data such as annotations, symbols, marginal information

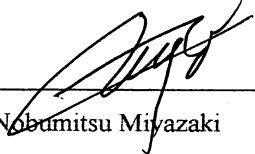
**MINUTES OF MEETING
ON
THE INCEPTION REPORT
FOR
THE STUDY ON MAPPING AND LAND COVER ASSESSMENT
OF
MANGROVE AREAS
IN
THE REPUBLIC OF THE PHILIPPINES**

Manila

December 1st, 1997

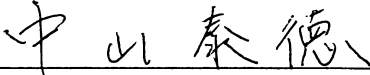


Undersecretary Jose S. Solis
Administrator,
National Mapping and Resource
Information Authority
Department of Environment and
Natural Resources,
Republic of the Philippines



Mr. Nobumitsu Miyazaki
Team Leader of the Study Team,
Japan International Cooperation Agency

Witnessed by:



Mr. Yasunori Nakayama
Forestry and Fisheries Development
Study Division,
Agriculture, Forestry and Fisheries
Development Study Department,
Japan International Cooperation Agency

In pursuance to the objectives of the Implementation Arrangement (I/A) for the Study on Mapping and Land Cover Assessment of Mangrove Areas (hereinafter referred to as "the Study"), agreed upon between the Preparatory Study Team of Japan International Cooperation Agency (hereinafter referred to as "JICA") and National Mapping and Resource Information Authority (hereinafter referred to as "NAMRIA"), Department of Environment and Natural Resources (hereinafter referred to as "DENR") on February 19, 1997, JICA sent a Study Team (hereinafter referred to as "the Team") headed by Mr. Nobumitsu Miyazaki who conducted the first phase of the Study starting from November, 1997.

The Team submitted 20 copies of Inception Report of the Study and conducted a series of discussion on the Inception Report with Mr. Virgilio F. Basa, Director of Remote Sensing and Resource Data Analysis Department, NAMRIA, as well as technical staff member of NAMRIA and DENR. The list of participants in the meeting is shown on Appendix-1 attached hereto.

The results as well as comments in the meeting are as follows.

1. The Team explained the components and method for the implementation of the Study based on the Inception Report. The Philippine side and the Team discussed and both sides agreed on the contents of the Report.
2. The Philippine side explained the needs for Navigation System. The Team explained the difficulties to include the application of Navigation System at this stage of the Study. The Team, however, also recognized that the Navigation System is effective to increase accuracy, minimize errors to set the flight courses, and at the same time it makes works easier for NAMRIA's personnel with the limited experiences to undertake aerial photography on their own, therefore, the Team assured to convey the request to JICA Headquarters.
3. The Team mentioned that the GIS system to be used for preparation, operation and maintenance of data base, shall be able to cope with basic function such as map editing, reference of attribute data, preparing of thematic map, printing and data compilation, and the Team requested NAMRIA to prepare such kind of system. The Philippine side explained that it would be difficult to prepare such system due to the constrained budget. Thus, the NAMRIA requested the Team to provide the equipment. The Team recognized the necessity of the equipment and assured to convey the request to JICA Headquarters.

4. The Team explained the survey areas described on the Inception Report 3-1 is specified on the attached maps with considerable flight courses. The Philippine side accepted that the attached maps is showing the real target aerial photography areas approximately 40,000 ha.
5. The Philippine side explained their difficulty in acquiring their budget to implement the project. Both the Team and the Philippine side agreed that Item No. VII.2 of the Implementing Agreement signed both by DENR and JICA dated 19 February 1996 in Manila, Philippines shall be understood to mean as follows "The Government of the Philippines (GOP) shall provide the necessary counterpart expenses including procurement of photogrammetric system equipment and suitable office space through construction of an extension office with an approximate area of 200 square meters located at the NAMRIA Annex Premises. Further, the GOP shall provide the Japanese Study Team with the following, if necessary, in cooperation with other agencies concerned;
 - a. Available data and information related to the Study
 - b. Counterpart personnel
 - c. Credentials and identification cards for the members of the Japanese Study Team."
6. The Team requested NAMRIA to secure the entry of the members of the Team into the Mangrove areas and also to secure the right for the members to cut small amount of Mangrove in the course of the field survey. The Philippine side basically agreed on the preparation of necessary permission from the authorities concerned to mangrove conservation in each study area. The Philippine side requested to the Team that cutting of Mangrove shall be limited only to minimum unavoidable cases. The Team conveyed, with its understanding on the importance of the remaining Mangrove forest, that the cutting shall be avoided except for the case that the Team would not be able to conduct land survey without removing leaves or branches.
7. The Team explained a draft of the Technical Transfer Plan. The Philippine side basically agreed that the technical transfer would be carried out by OJT based on the draft Technical Transfer Plan, and also accepted the draft plan.
8. The Team inquired NAMRIA the expected number of OJT participants. The Philippine side replayed that the number would be determined at the time the Philippine side submit proposals which indicates how many person will attend the OJT by January 1998 through JICA Philippine Office.
9. The Team requested NAMRIA to prepare the instruments necessary for the OJT, such as stereoscope for each participants, one (1) notebook type personal computer for every two (2) participants for interpreting photo-imagery data.

The Philippine side informed the Team of its difficulties in preparation of such instruments

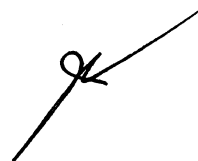
exclusive for the OJT participants, therefore, with mutual understanding of the difficulties on such instruments, the Team assured to convey the request for such instruments to JICA Headquarters. Also, both sides agreed that the number of participants of the OJT shall be discussed with the consideration of availability of said instruments prior to the first study in the Philippines

10. The Team requested NAMRIA to utilize NAMRIA's existing facilities necessary in other department and units for the On-the-Job Training (OJT), such as photo processor and printer, digitizer, hardware and software. The Philippine side assured the Team to make arrangements for the use of these facilities so that will not conflict with priorities and projects of the department/units concerned. On it's part, the Team agreed to supply the necessary materials such as printing papers, drawing sheets and other consumable supplies and materials that will be needed in the OJT.

NAMRIA reiterated the justification of their request for the provisions of mapping equipment and basic photo-laboratory system that will be greatly needed when the project will be fully operational nationwide. It was mentioned that these equipment will also serve the mapping an aerial photo requirements of all agencies in the Government and private agencies, hence, it should not depend on the facilities of others where there will be conflicts of interest.

The Team promised to convey these request to JICA Headquarters as stipulated in Minutes dated 19 February 1997.

11. The Team requested NAMRIA to provide communication instruments to be used by the Field Survey Teams especially in the Lamon Bay area where in some occasions there are reported security problems. NAMRIA assured the Team that, they will request for additional communication instruments, clearance and connections with the existing radio communication network of the DENR in the area. NAMRIA further asked the Team to consider procurement of portable communications equipment for use by the Study, in the event that NAMRIA is unable to provide such equipment.
12. The Team requested the Philippine side to assign Philippine counterpart personnel which are listed on 10 (1) of the Inception Report. The Philippine side assured to assign such personnel, and also assured that the name list of such counterpart personnel shall be submitted to the Team through JICA Philippine Office by the end of January, 1998.



LIST OF PARTICIPANTS

I. Philippines Side

National Mapping and Resource Information Authority (NAMRIA)

Mr. Jose S. Solis	Administrator
Mr. Ricardo T. Bina	Deputy Administrator
Mr. Virgilio F. Basa	Director, Remote Sensing and Resource Data Analysis Department
Mr. Jesus Dela Cruz	Chief, GIS Division
Mr. Virgilio I. Fabian, Jr.	Chief, Land Classification Division
Mr. Genaro I. Espiritu	OIC Chief, Land Resource Division
Ms. Rijaldia N. Santos	Chief, Physiography & Aquatic Division
Mr. Mariano D. Farrales	Supervising Remote Sensing Technologist
Ms. Olivia R. Molina	Supervising Remote Sensing Technologist
Ms. Nancy D. Vasquez	Senior Remote Sensing Technologist
Mr. Romeo P. Vasquez	Senior Remote Sensing Technologist
Mr. William Manuel	Senior Remote Sensing Technologist
Mr. Zosimo Andres	Senior Remote Sensing Technologist
Mr. Reyanldo Ganacias	Senior Remote Sensing Technologist
Ms. Rosita Fabian	Senior Remote Sensing Technologist
Mr. Alred Zuraek	Senior Remote Sensing Technologist
Ms. Alita D. Sangalang	Remote Sensing Technologist

Department of Environment and Natural Resources (DENR)

Mr. Melchor Magsanoc	Regional Executive Director, Region IV
Mr. Apolinio Salanga	Land Evaluation Party Coordinator, Region IV
Mr. Ricardo Calderon	PENRO, Quezon
Mr. Rufo f. Lorenzo	CENRO, Calauag

II. Japanese Side

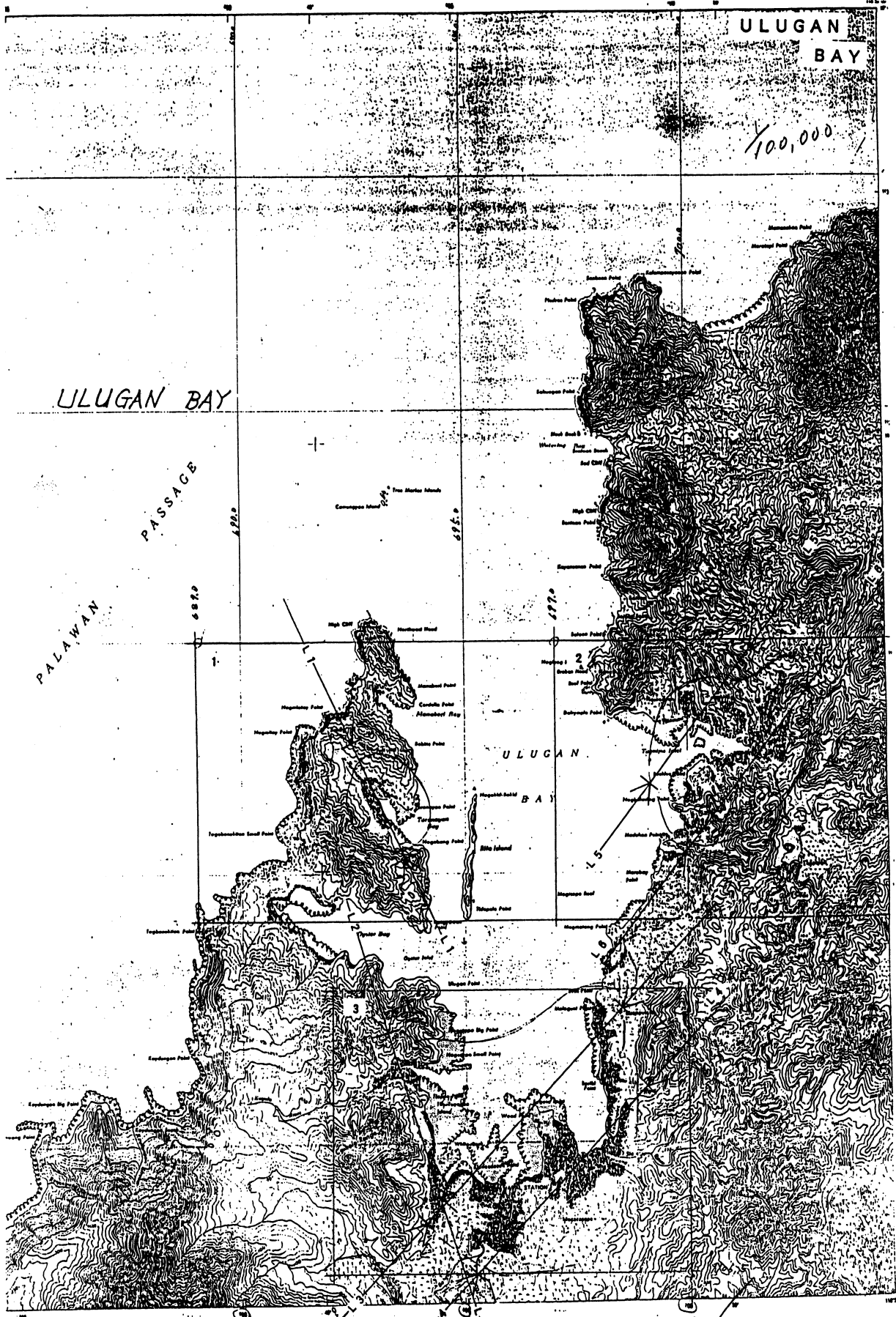
JICA Representatives

Mr. Yasunori Nakayama	Forestry and Fisheries Development Study Division, Agriculture, Forestry and Fisheries Development Study Department, JICA Headquarters
Mr. Makoto Taira	JICA Expert, DENR

JICA Study Team

Mr. Nobumitsu Miyazaki	Team Leader
Mr. Kazuhisa Kato	Mangrove Forest Inventory
Mr. Akira Sudo	Socio-Economy
Mr. Kenichi Suzuki	Aerial Photography
Mr. Shingo Otomo	GIS Engineering (System Design)
Mr. Takayuki Okubo	Coordinator





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ULUGAN BAY

PALAWAN PASSAGE

PALAWAN

ULUGAN BAY

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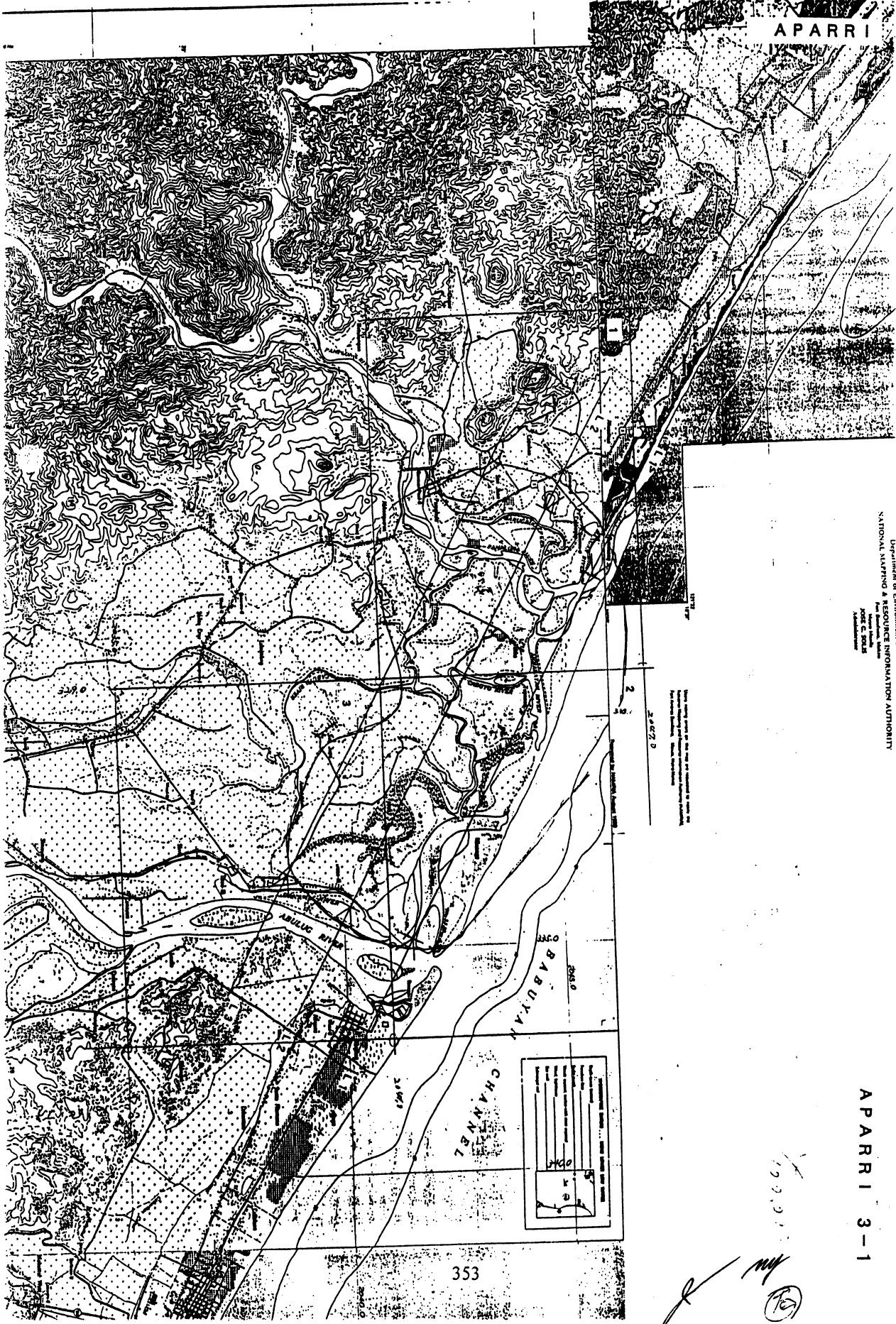
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BASED ON AIRBORNE PHOTO

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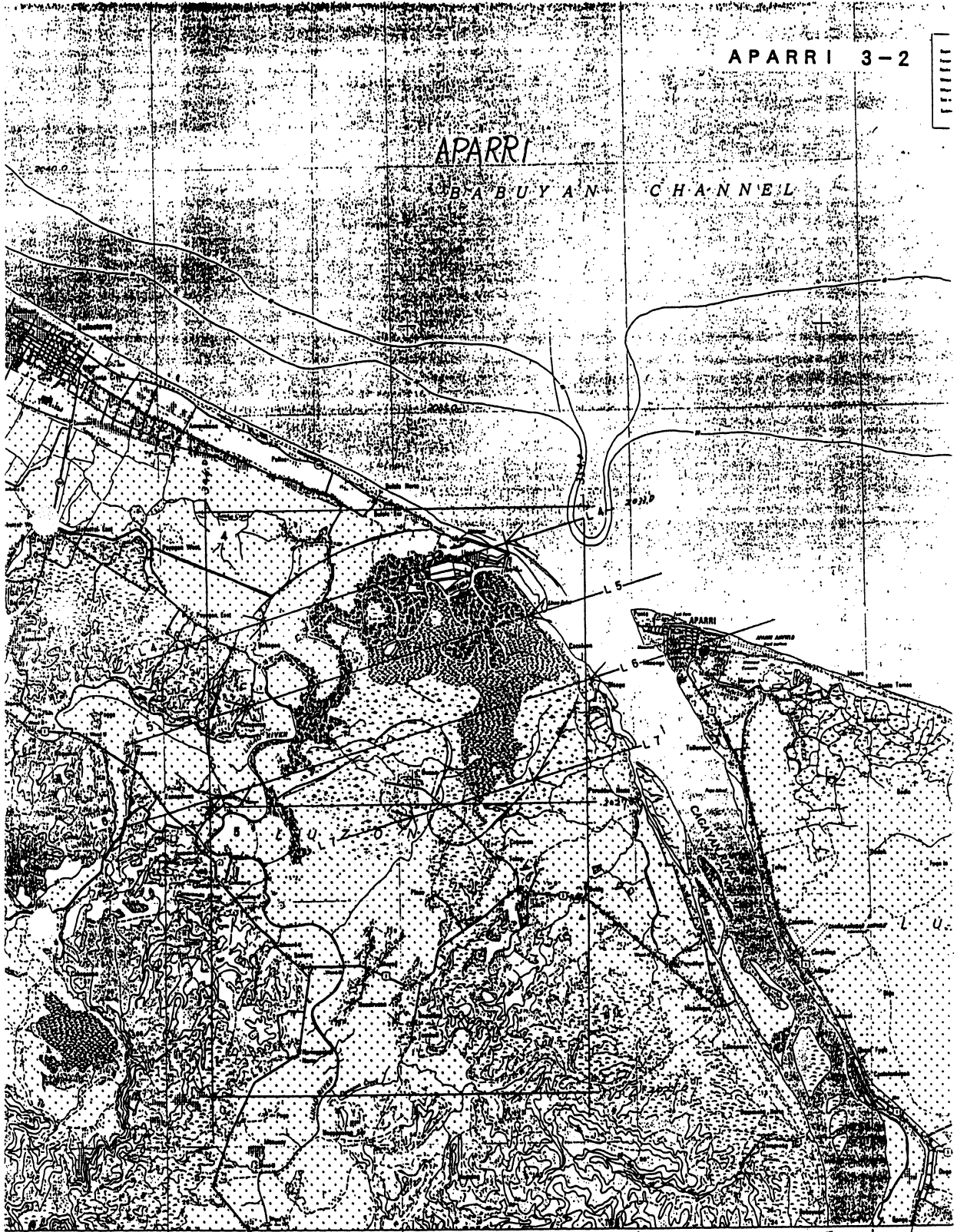


Department of Environment and Natural Resources
 NATIONAL MAPPING & RESOURCE INFORMATION AUTHORITY
 Project Director: JOSE C. SOLIS
 Project Engineer: [Name]
 [Name]

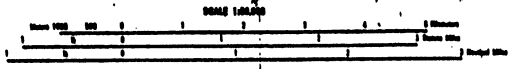
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LEGEND	
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[Symbol]	Infrastructure



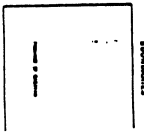
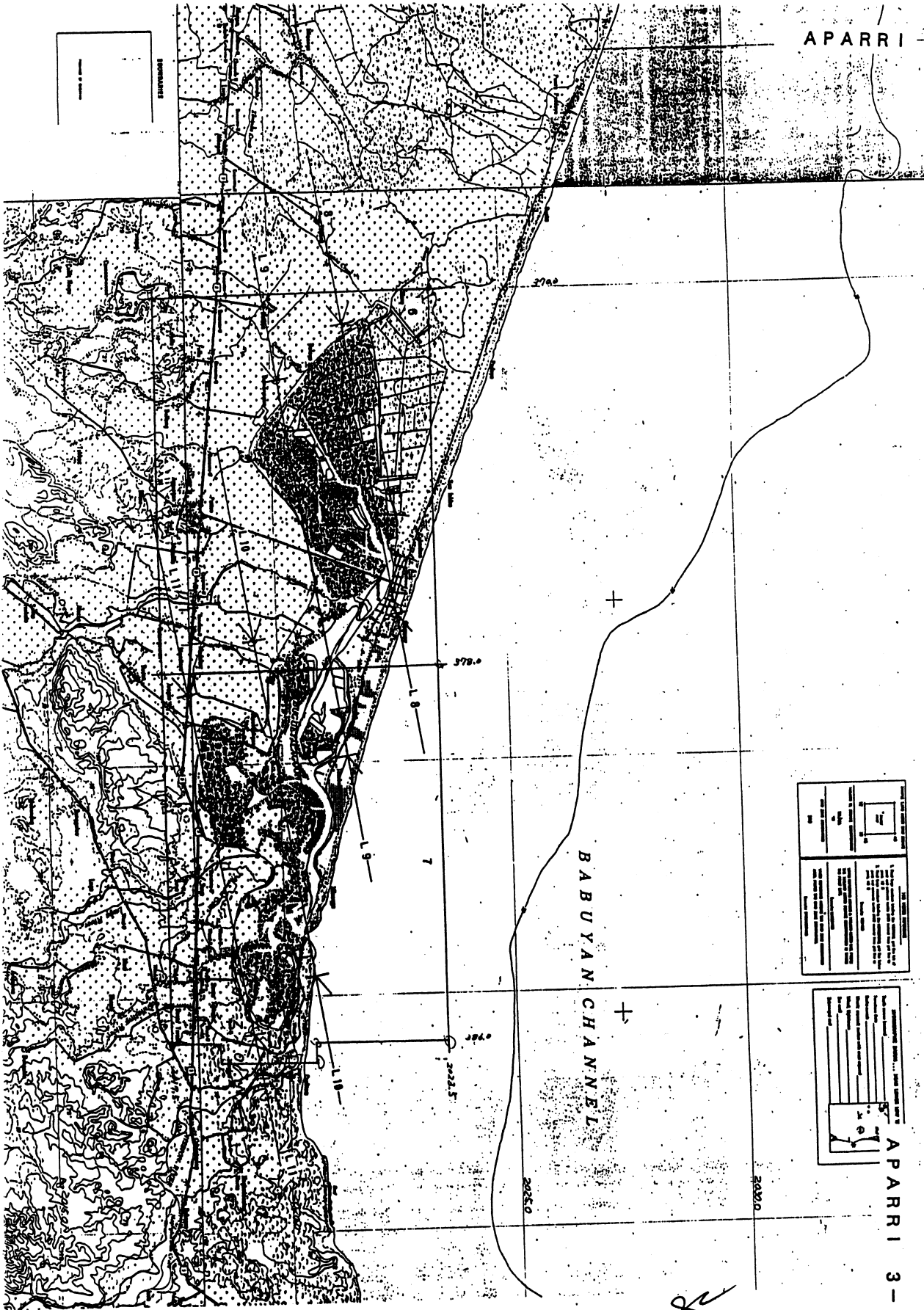
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CONTINUED SURVEY TO WESTERN BOUNDARY OF APARRI

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APARRI



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