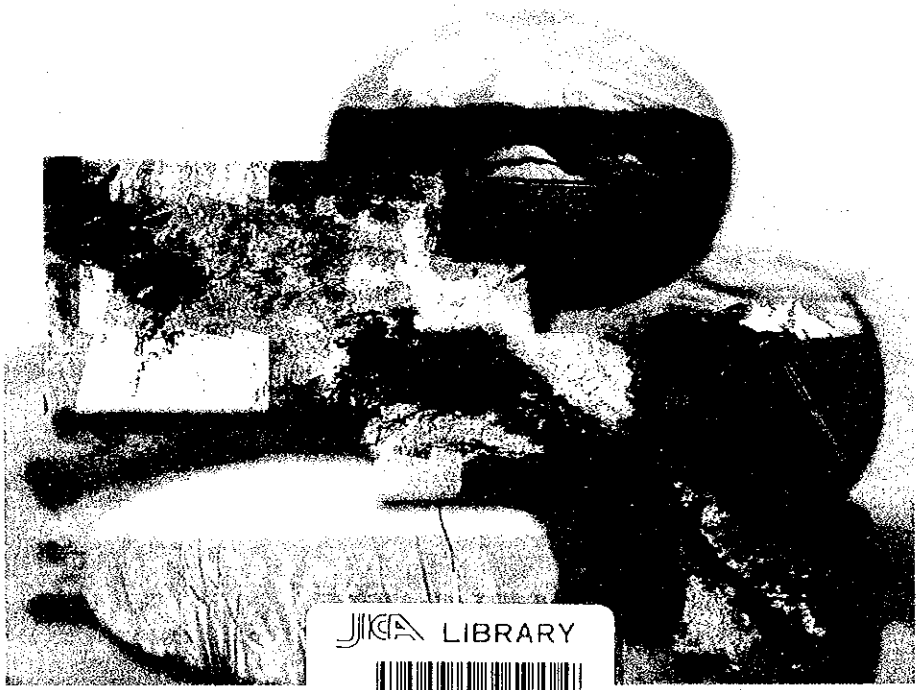
社会開発調査部報告書



Japan International Cooperation Agency (JICA)

Agency of Republic of Kazakstan
on Land Resources Management

SUMMARY REPORT

THE STUDY
ON
THE URGENT ESTABLISHMENT
OF
NATIONAL BASIC GEOGRAPHIC DATA
IN
SOUTHERN AREA
OF
THE REPUBLIC OF KAZAKSTAN

February 2000

Aero Asahi Corporation

PREFACE

In response to a request from the Government of the Republic of Kazakstan, the Government of Japan decided to conduct a study on urgent establishment of national basic geographic data in the southern area of the Republic of Kazakstan and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Shigehiko Shino of the Aero Asahi Corporation three times between January 1997 and February 2000.

The team held discussions with the officials concerned of the Government of Kazakstan and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Kazakstan for their close cooperation extended to the Team.

February 2000

Kimio Fujita
President
Japan International Cooperation Agency

February 2000

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

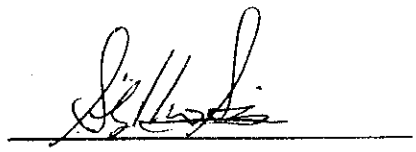
Dear Mr. Fujita,

We are pleased to submit to you the final report on the Study on the Urgent Establishment of National Basic Geographic Data in Southern Area of the Republic of Kazakstan. The report contains the results of study for establishment of geographic information data, which was conducted from January 1998 to February 2000 for three years. The area of the study covers a part of Syrdaryra River Basin in Kyzylorda and South Kazakstan provinces located in southern area of the Republic.

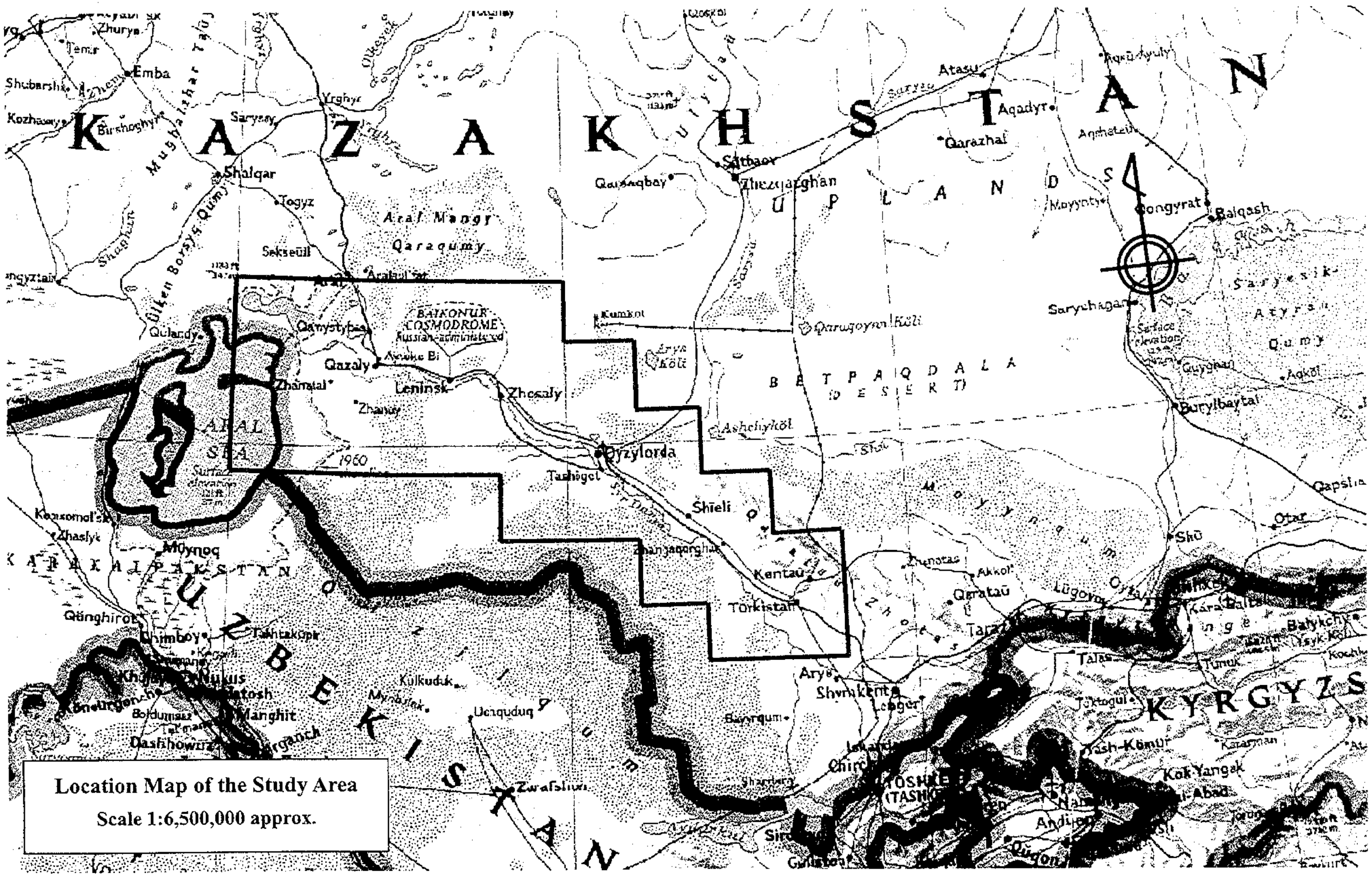
In this report, method for development of digital geographic data and printed maps corresponding to topographic map in the scale of 1:100,000, digital geographic framework data corresponding to topographic map in the scale of 1:200,000 and chronological digital land cover data, technological transfer on the development of the data to Kazakstan counterparts as well as recommendation on utilization of the results in future are mentioned. The output of this study expects to be supplied as basis for various plans in future and utilized as basic data for geographic information systems (GIS).

Finally, we greatly appreciate the persons concerned of JICA, Ministry of Foreign Affairs, Ministry of Construction as well as Geographical Survey Institute, Japan. Also we acknowledge that we have granted considerable cooperation from Embassy of Japan in the Republic of Kazakstan, Agency of Republic of Kazakstan on Land Resource Management and other organizations concerned.

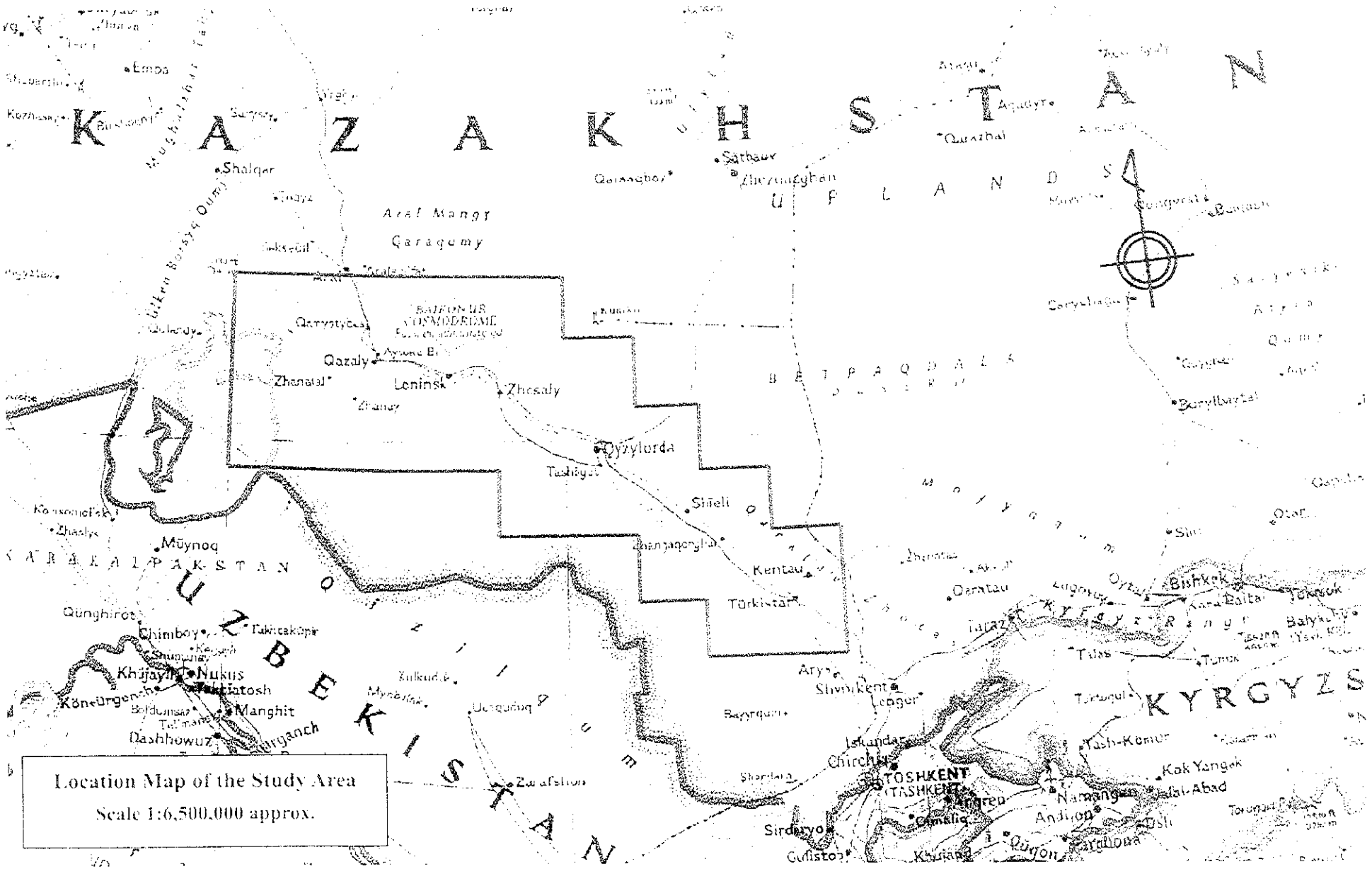
Very truly yours,



Sigehiko Shino
Team Leader
JICA Study Team

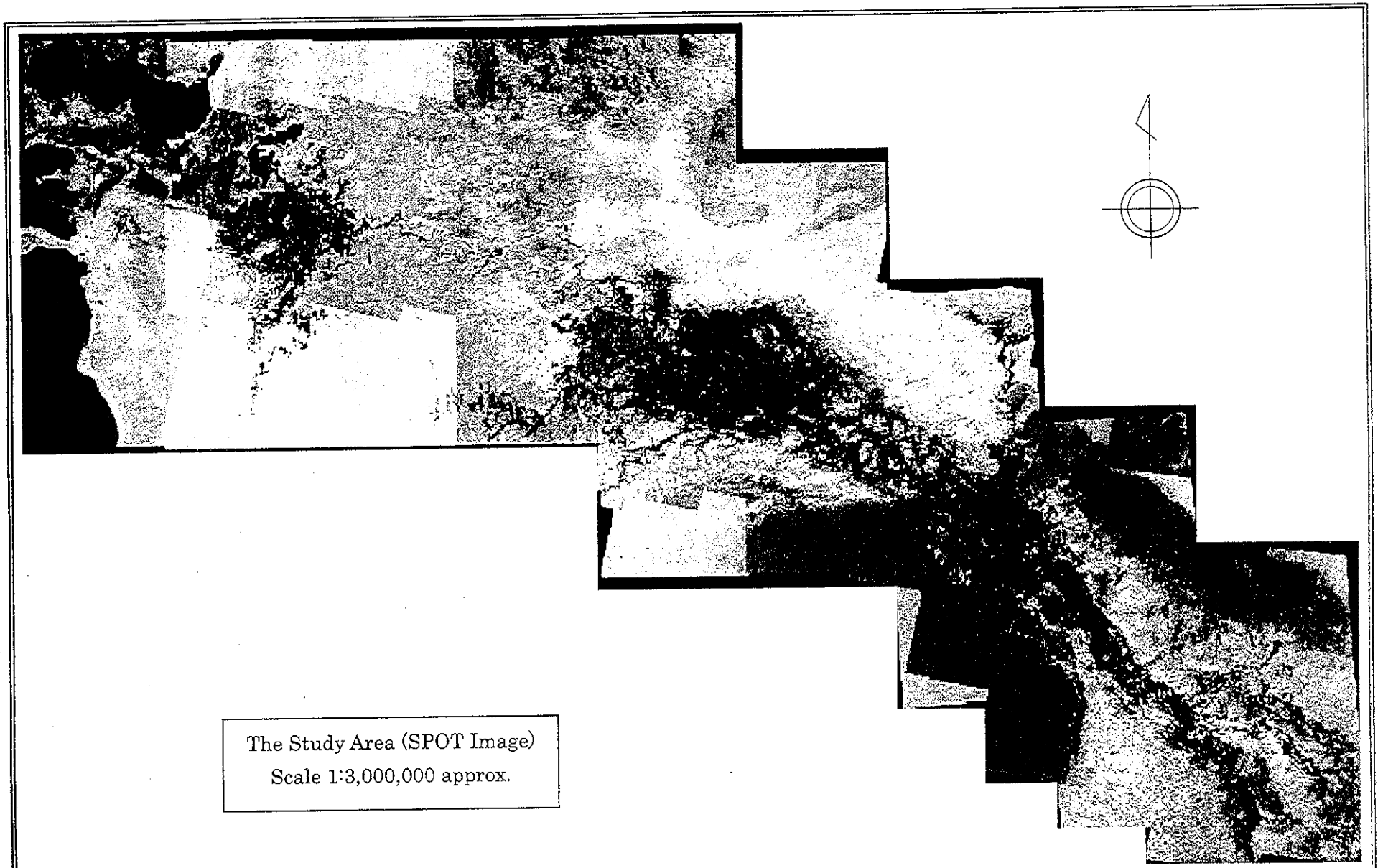


Location Map of the Study Area
Scale 1:6,500,000 approx.



Location Map of the Study Area

Scale 1:6,500,000 approx.



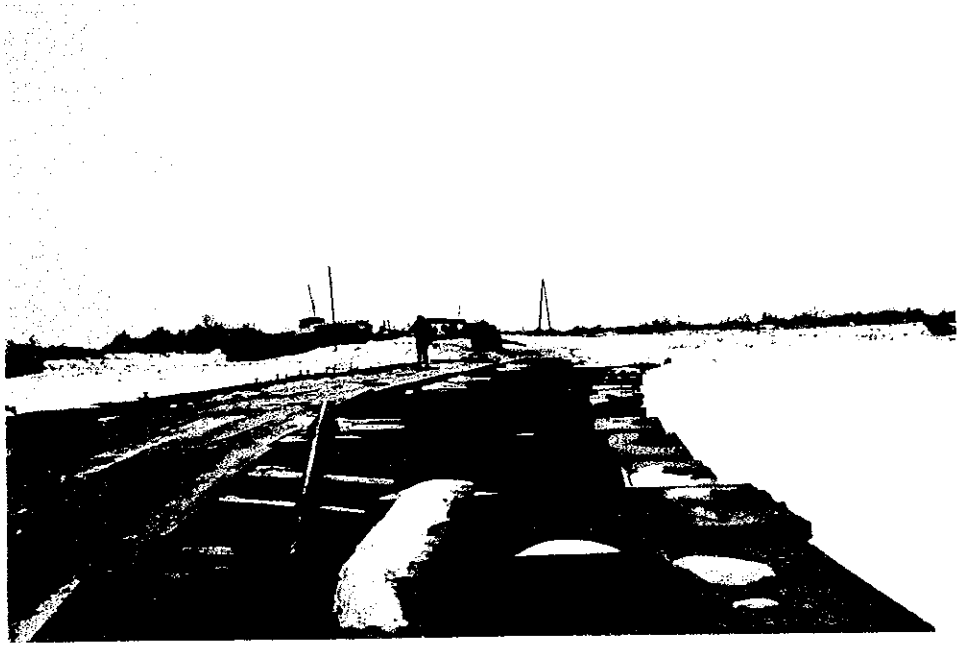
The Study Area (SPOT Image)
Scale 1:3,000,000 approx.

Explanation and discussion on the draft final report in Astana City

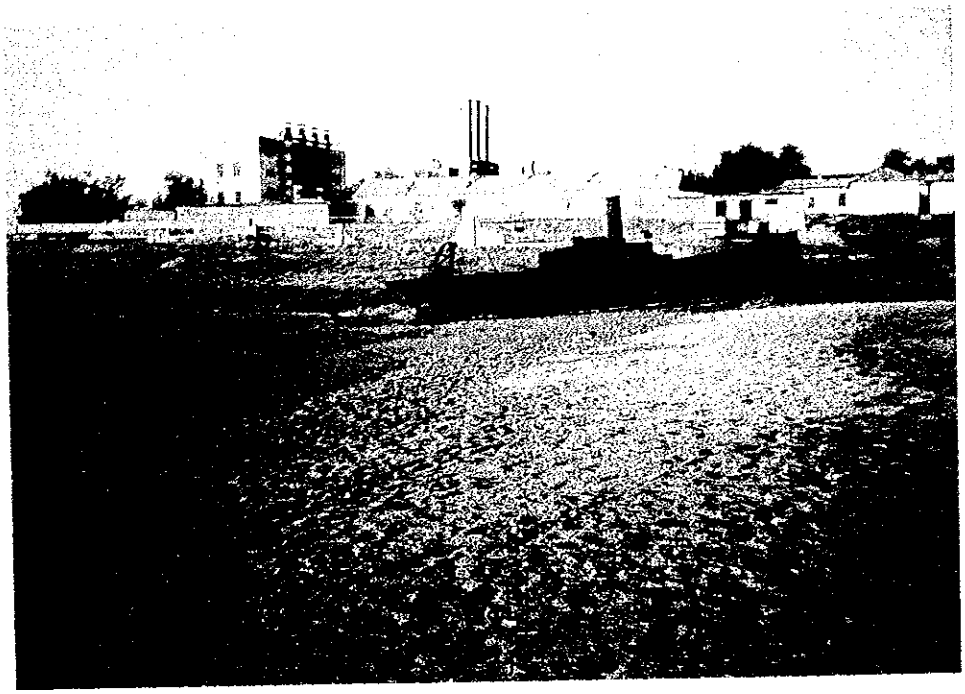
Takyr and Solonchak

The Aral Sea(Right side; the Small Aral, left side; the Large Aral

Syrdarya River (Summer)



Pontoon bridge over Syrdarya River (Winter)



Aralisk Port

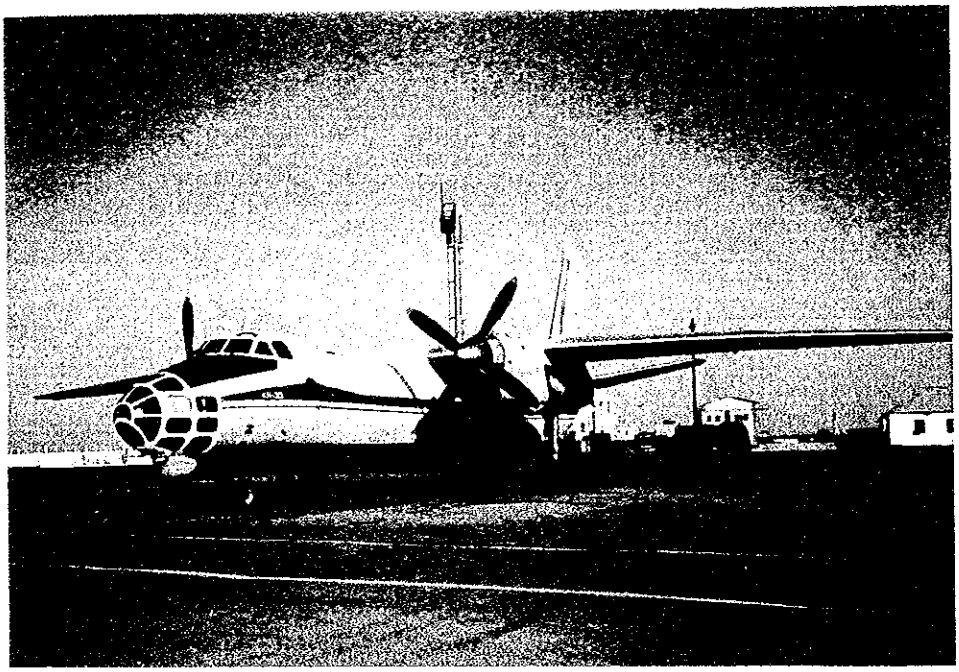
Shoreline of the Aral Sea

Cotton field

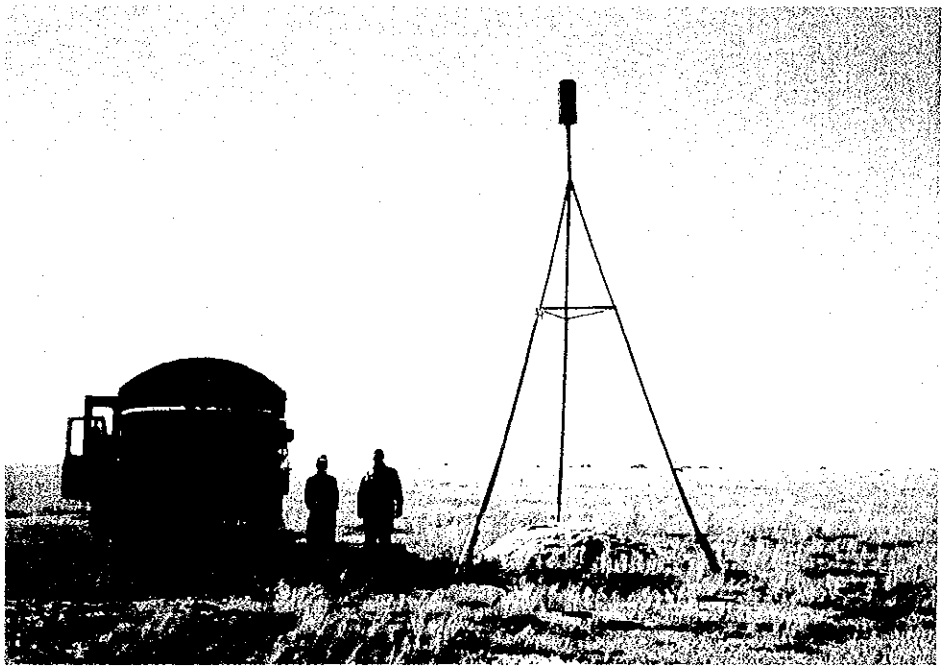
Watermelons (Local products)

A reservoir in marshy land

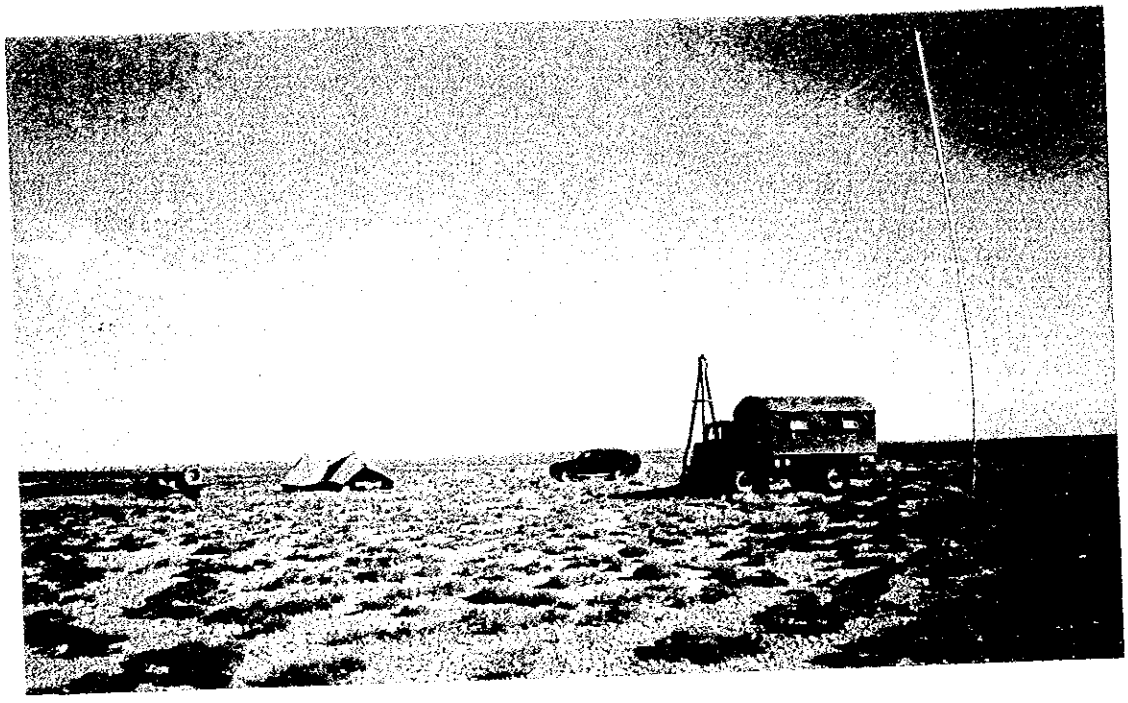
Wheat field



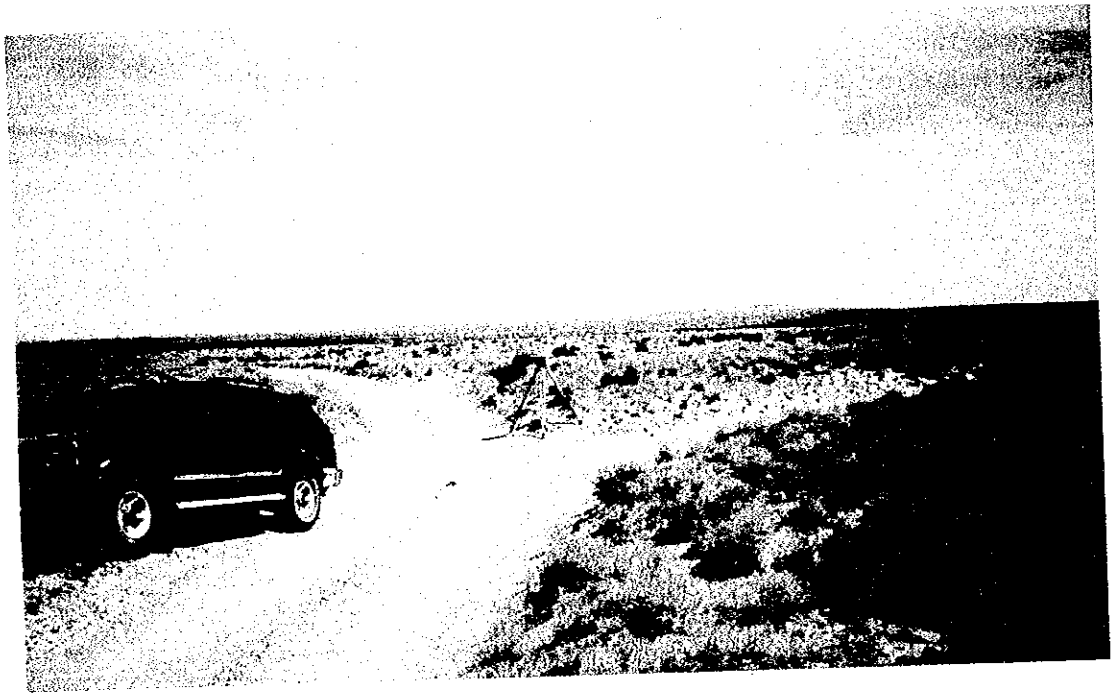
Antonov AN30 (Survey aircraft)



Triangulation station



Field camp



Geodetic control point survey by using GPS

Contents

Chapter 1. Introduction

1. Background of the Study

The total extent of the Republic of Kazakstan is approx. 2,717,500 km^2 which is covered by national base maps that were produced in the time of the former USSR. These base maps used to be corrected and revised every five to eight years. However, since the latter part of 1980-s such revision has not been undertaken due to practical reasons of financial stringency within the USSR. The situation after the independence of the Republic has also remained much the same as before.

The excessive development of arable lands in the Syrdarya River basin, in the southern part of the Republic, has been ensued in a short period of time since 1950 under the agricultural policy imposed by the USSR. As a result of the development, substantial deterioration of agricultural productivity and rural environment has occurred, including such changes as alternative land use development through civil works for irrigation, drying up and desertification of agricultural lands, lowering of ground water level and salinization of soils.

These environmental changes have focused world attention on the ecological problems of the Aral Sea with the appeal "Save the Aral Sea!" Under the current situation a lot of projects have been proposed, such as restructuring of agricultural land use, improvement of actual environment etc., by the neighboring countries, World Bank, UNDP, UNEP etc. The realization of these multi-framework environmental resources management programs and long-term projects however has in many instances becomes very difficult due to the lack of up to date base maps.

Taking into consideration serious deterioration of environment, the Government of Kazakstan requested a technical cooperation for urgent revision of 1:200,000 topographic maps covering approx. 150,000 km^2 of the Syrdarya basin in the southern part of the Republic and 1:100,000 topographic maps covering approx. 22,500 km^2 where substantial environmental changes can be observed.

In response to the request of the Government of Kazakstan, Japan International Cooperation Agency (JICA) dispatched a contact mission to Kazakstan from March to April 1997 to confirm the background and scope of work for the study. In June 1997 the preparatory study mission organized by JICA visited Kazakstan to conduct the preparatory study and to sign the Scope of Work (S/W) for "Urgent Establishment of National Basic Geographic Data in the Southern Area of Kazakstan". (Appendix 1)
The Study was carried out by Aero Asahi Corporation who were appointed and authorized by JICA as a trustee, from January 1998 to March 2000 in accordance with the determined scope of work.

2. Objective of the Study

The Study was implemented by using satellite images and new 1:50,000 aerial photography covering 150,000 km^2 of Study area. The Study was thus include:

(1) Development of digital geographic data and printed maps corresponding to national topographic maps at the scale of 1:100,000 (area: approx. 22.500 km^2)

(2) Development of digital geographic framework data corresponding to national topographic maps at the scale of 1:200,000 (area: approx. 150,000 km^2 including the above mentioned 22,500 km^2)

(3) Development of chronological digital land cover data (area: approx. 150,000 km^2)

(4) Technology transfer by OJT to the Kazakstan counterpart personnel engaged in the respective stages of the Study.

3. Relevance of the Study

(1) Location

The selected study area of 150,000km^2 has many problems to be needing in depth study and urgent solutions. Foremost of these are such ecological problem of the diminishing Aral Sea, desertification of the most vital irrigated agricultural lands of the Republic.

(2) Satellite image digital mapping

The Study enables Kazakstan to develop new geographic data for other priority areas of the Republic by using new satellite image data and the latest digital mapping technology. This was achieved through technical transfer and supply of relevant equipment to Kazakstan whereby new map information can be generated of vast area in a short period of time.

(3) Digital geographic framework data and its future utilization in Geographic Information System

The digital geographic framework data covering 150,000km^2 in Syrdarya River basin is a geo-referenced one. Which thereby makes it possible to develop topographic maps, various thematic maps as well as Geographic Information Systems by adding data from the Kazakstan beneficiary. This is significantly different to analogue paper maps which now obviously have a more limited value. The digital geographic framework data can therefore provide a strong tool for administrations to appreciate the current status, undertaking planning and analysis and conduct decision-making in specific areas of interest.

(4) Output from the Study will also contribute to planning and implementation of various projects of interest to concerned organizations in the Republic and international organizations and should open the digital data produced by the study to the public.

Chapter 2. Outline of the study area

1. Physical Condition of the Area

(1) Topography

The Study area is situated in an alluvial plain spreading out to Syrdarya River basin. Ground elevation from the mean sea level in the headwater of the Study area is about 200 m and at the river-mouth in the Aral Sea is 40m. The area is almost flat except Karatau mountain range located in the eastern part of the Study area whose elevation varies from 1,500 to 2,000m.

(2) Climate

The climate of the Study area is temperate continental and characterized by intense heat in summers and relatively cold in winters.

(3) Hydrology

The observed value of annual average flow (1970-1993) of SyrDarya river at Kyzylorda headworks is 180 m^3/sec. The fluctuation of water flow through the year is extremely small, between 133 m^3/sec. (October) and 459 m^3/sec. (May).

(4) Soils

Soils of the Study area belong to the arid grassland type which contain alkali salts. The accumulation of such salts in the soil makes cultivation impossible while insufficient drainage facilities and poor water management give rise to soil salinization.

(5) Agricultural land use

Throughout the entire nation about 80% of land use is devoted to agriculture and within the study area nearly half of the total area is occupied by agricultural lands. The proportion of agricultural lands in the study area is therefore much lower than the whole country. Grassland (12.7 million ha in Kyzylorda oblast) occupies the greater part of those lands used for agriculture, while the area under arable cultivation is extremely small (0.26 million ha in Kyzylorda oblast). Rice, wheat and corn are the main farm products of the study area and the greater part of the non-agricultural lands consists mainly of desert and steppe with some marshy areas.

2. Aral Sea Environmental Issue

Although the Aral Sea once existed as the fourth largest inland water surface area in the world, presently the water surface area has shrunk from two thirds of its former volume due primarily to decrease in river inflow. The decline of the water surface level is about 15m and as a result, the Aral Sea is divided into Large Aral (Amudarya river basin) and Small Aral (Syrdarya river basin).

Chapter 3. Plan of the Study

1. Components of the Study

(1) Development of digital geographic data and printed maps corresponding to topographic maps at the scale of 1:100,000 (area: approx. 22.500 km^2)

Numbers of Map : L-41-105, 106, 107, 108, 117, 118, 119, 120, 131, 132, 143, 144
L-42-109, 121, 133 Total 15 sheets

(2) Development of digital geographic framework data corresponding to topographic maps at the scale of 1:200,000 (area: approx. 150,000 km^2 including the above mentioned 22,500 km^2)

Numbers of Map: L-41-XIII, XIV, XV, XVI, XVII, XIX, XX , XXI, XXII, XXIII, XXIV
XXV, XXVI, XXVII, XXVIII, XXIX, XXX, XXXV, XXXVI
L-42-XXV, XXVI, XXXII
K-42-I, II, III, VIII, IX Total 27 sheets

(3) Development of chronological digital land cover data (area: approx. 150,000 km^2).

(4) Technology Transfer by OJT (On the Job Training) to Kazakstan counterpart personnel for the respective stages of the study.

2. Annual Plans

The study was performed out over three years and the activities of the respective phase were as follows. (Note: fiscal year (F/Y) of Japan starts from 1st of April and ends on 31st of March.)

The Study was planned so that Phase I started from January 1998 (F/Y 1997) and Phase III, the final stage of the entire study was to be completed by March 2000 (F/Y 1999). The total period for the Study therefore planned as twenty-seven (27) months.

Chapter 4. Description of the Study

1. Technical Principles for Study Implementation

Key aspects of the Study:

(1) The following standards were used for the surveying and mapping:

Reference Ellipsoid	: Krassovsky 1940
Semi-Major Axis	: 6378245.00
Flattening	: 1/298.26
Projection	: Gauss-Kruger conformal projection
Coordinate System	: CK1942 Zone11(Central meridian E 63 degree) Zone12(Central meridian E 69 degree)
Scale Factor	: 1.000 on the central meridian
Elevation	: from 1/100,000 and 1/200,000 topographic-map's elevations, those were derived from Baltic Mean Sea Level
Contour Interval	: 20 meter
Unit	: Meter

(2) Images and topographic maps used:

- 1:50,000 Aerial Photographs taken in June and July 1998
- SPOT Panchromatic Image Data acquired in June, July and August 1997 (71 scenes)
- SPOT Multispectral Image Data acquired in May, June and July 1998 (31 scenes)
- Printed maps and reproduced positive films of the latest old series topographic maps of scale 1:50,000, 1:100,000 and 1:200,000
- Historical topographic maps at scale of 1:100,000 and 1:200,000 (from 1950s and 1970s through to the 1980s)

(3) Digitizing of collected data/materials

Field identification and verification survey were not carried out, due to their onerous consumption of time and manpower resources and limited amount of time available for completion of the whole study. It was agreed therefore with the Kazakstan beneficiary that the digitizing of collected data would be undertaken by local sub-contractors using the most up to data and old series maps. Kazakstan beneficiary was thus responsible for data supply to the Study team. Those data included geographic names, administrative boundaries, ground objects, structures, data on water use, etc., that could be displayed by means of maps.

(4) Ground control points for geometric correction of satellite images

Well defined planimetric features on old series topographic maps and those which could be clearly interpreted on satellite images were adopted as "ground control points derived from a map" (GCP-MAP). Coordinates of these points were measured on the reproduced printing plates.

Where significant planimetric features did not exist on a map, ground control points were defined on the basis of accessibility by GPS locationing. On SPOT images ground control points were selected as "ground control points derived from GPS"(GCP-GPS). GPS observations were carried out by placing GPS antenna at selected point locations.

(5) Geographic names, names of facilities and administrative boundaries

Geographic names, including those of facilities, administrative boundaries and their location were provided by the Kazakstan counterpart as part of their responsibilities to the project. Special attention was paid to official orthography as some changes had been made since the Republic became independent.

(6) Map symbols and their representation

Map symbols and their application were based principally on Kazakstan specification, currently in effect. However due to computer mapping technology, some modifications and simplifications were adopted.

(7) Interpretation Keys

In consideration of such a vast project territory, field verification survey of the entire area were not physically possible. Interpretation keys were therefore required for typical landmarks, features, facilities, vegetation and topography of the project area so as to make possible objects identification from satellite images and/or from aerial photographs.

(8) Indistinct features on satellite images and aerial photographs

Features, which could not be recognized on satellite images and aerial photographs by size or by width, were neither digitized or shown on the map. If a small feature had an importance and to be represented on a map at a respective scale, it was digitized with data provided by the Kazakstan counterpart after conforming its existence.

(9) Digital map data equivalent to the 1/100,000 topographic map

Digital map data were produced which enabled the possible output of new topographic maps, from which topographic map printing was undertaken in Kazakstan.

(10) Digital geographic framework data equivalent to 1/200,000 topographic mapping

This data can provide Geographic Information System (GIS) framework information and be processed with any topical data in a GIS environment for applications interests.

(11) System construction

The computer mapping system is constructed so that the Kazakstan specialists will be able to use it easily in future.

(12) Chronological (temporal) land cover classification feature
Level 1 classification : Urban Area, Vegetation, Bare Land and Hydrology
Level 2 classification : Contains more detailed features which were classified in relation to the land cover characteristics of the study area.

(13) Acquisition of ground truth data
Analysis with satellite images (panchromatic and color), acquisition of ground truth data in the field.

2. Acquisition of Satellite Images and Aerial Photographs

Seventy-one scenes of panchromatic images taken by SPOT Image in June and July and August 1997 were utilized for image interpretation and digital mapping. Thirty-one scenes of multispectral images taken by SPOT Image in June, July and August 1998 were used for analysis in land cover type classification.

The purpose of undertaking aerial photograph was to supplement the identification and interpretation of features at mapping scales of 1:100,000 and 1:200,000 which could not be interpreted on satellite images due to their limited spatial resolution. B/W aerial photograph at the scale of 1:50,000 was executed by the sub-contractor - JS "BURUNDAYAVIA". The area for aerial photographic coverage was about 150,000 km^2, which constitutes the whole study territory. The photography was completed in June and July– the season of maximum vegetation cover.

3. Ground Control Points for Geometric Correction of Satellite Images

The control points (Ground Control Points: GCPs) needed for geometric correction of satellite image were employed. The Selection of GCPs, referenced to satellite images, was conducted as indicated in below:

- GCP-MAP, coordinates are calculated from available topographic maps
- GCP-GPS, coordinates are identified by field GPS survey in the field where calculation from available maps proved problematic

4. Geometric Correction of Satellite Images, Digital Mosaicking and Sheet-by-sheet Clipping

SPOT image data does not correspond geometrically to a topographic map. To obtain correspondence, geometric correction of satellite data was undertaken. This pre-processing proved necessary for the digital mapping, image interpretation and image analysis. Subsequently digital mosaic and sheet-by-sheet clipping were executed for effective operation of succeeding activities.

5. Development of Interpretation Keys and Image Interpretation

(1) Interpretation Keys

Interpretation keys were developed as a basis for the interpretation and mapping of topography, ground features, vegetation, etc. from satellite image and aerial photograph in conjunction with available collected data/materials. These units were subsequently digitized to provide the final mapping data. This methodology replaced the need for field verification surveys.

(2) Image Interpretation

Satellite image complemented by 1:50,000 scale stereographic aerial photography provided the main source of mapping information.

6. Digital Map and Geographic Framework Data

(1) Review of map symbol specifications and their applications

1) Symbols and their applications were initially studied based on the former Soviet topographic map symbols for which a JICA preliminary study team collected :

- Symbols and application for 1:100,000 topographic map
- Symbols and application for 1:200,000 framework map

2) Symbolization compatible for utilization with computers was considered necessary for symbols of 1:100,000 scale topographic maps

3) Framework objects effective for GIS use were extracted for symbolization design on the 1:200,000 scale mapping and arranged as draft study symbols which were discussed and agreed with the Kazakstan beneficiary

(2) Standardization study of digital data formats

1) Main draft items included:

- Layer construction for GIS data (Feature code)
- Data format of digitizing of collected material (vector type)
- Data format of structuralized data for GIS (vector type)
- Data format of symbolized data for printing (raster type)

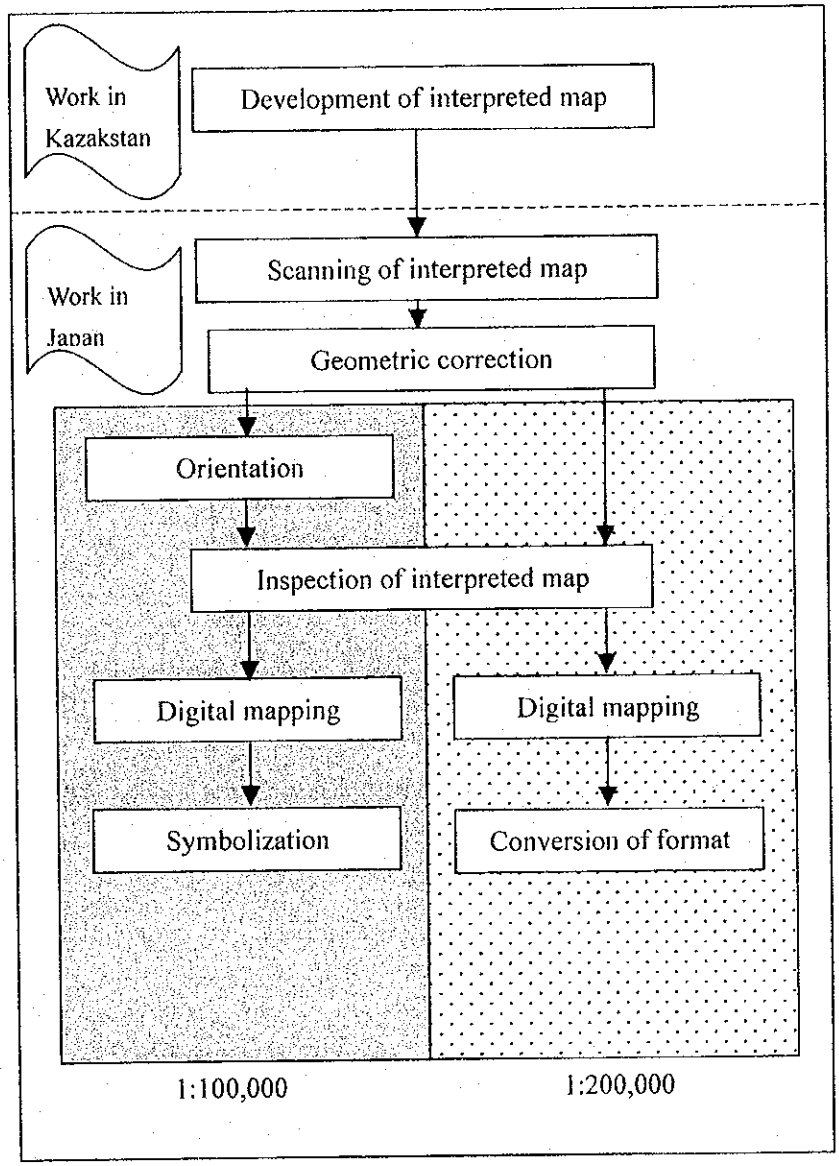
2) Digitizing of contour lines

Map sheet contour lines, rasterized by scanners, were edited and subsequently vectorized through digitizing after which being allocated attribute information such as height data etc. they became GIS compatible and ready for utilization.

3) Digital mapping

Digitizing of map categories derived from satellite image interpretation was undertaken with CAD software.

Digital mapping procedure



(3) Quality Control

Quality Control in digital mapping process was carried out with the followings:

Item	Evaluation	Correction
Position	①Check discrepancy with geometrical corrected interpretation image and digitized data in whole sheet ②Check discrepancy partly with geometrical corrected SPOT image and digitized data	①Correct more than 1 line width (about 0.2mm) discrepancy ②Correct more than 2 pixels (about 20m) discrepancy
Height	Compare digitized elevation data with digital elevation model (DEM) generated from elevation	Correct deviation of irrelevant elevation data
Cartographic expression	Compare symbolized digital mapping data and interpretation image	Correct input error and irrelevant cartographic expression
Attribute	Compare collected data and digitized data	Check and correct unfit data
Data structure	Verify structure definition table and data	Check and correct unfit data

7. Printing of 1/100,000 Scale Topographic Maps

Printing of 1/100,000 scale topographic maps were carried out by means of sub-contract with KARTOGRAFIYA. Five hundred prints for each sheet of a topographic map were produced by offset printing. Printing plates were also prepared for respective colors.

8. Land Cover Information

(1) Preparatory work

The data/materials collected by JICA preliminary study team and relevant data/information available in Japan were collated and analyzed.

The main work included:

1) Preparation of Chronological Land Cover Digital Data

Employed data : SPOT data of 1997-1998

Old series maps : 1970-1980 and 1950s

2) Preparation of Thematic Geographic Digital Data

Employed data : Geologic map, Soil map, Vegetation map and Geomorphological map 1:5,000,000 scale from Atlas

(2) Land Cover Interpretation of past available maps

Information on such features as distribution of lands, planting area, irrigation were important for assessing chronological changes in the study area and explaining causes of environmental changes. Past conditions were studied by means of maps produced from previous decades in order to evaluate the chronological change of land cover, including irrigation.

1) Data

The following old series maps of 1:200,000 scale, taken in two different periods, were used:

A. 1943 – 1958: 27 sheets
B. 1978 – 1991: 27 sheets

2) Interpretation

Feature classification for interpretation was based on using the principle of Level 1 of Land Cover Classification. This was applied in interpretation of satellite image which also made use of supervised automatic classification method. Finally a re-evaluation of interpretation results was undertaken to show changes distinguished in the classified features studied and to emphasize issues of environmental aspect.

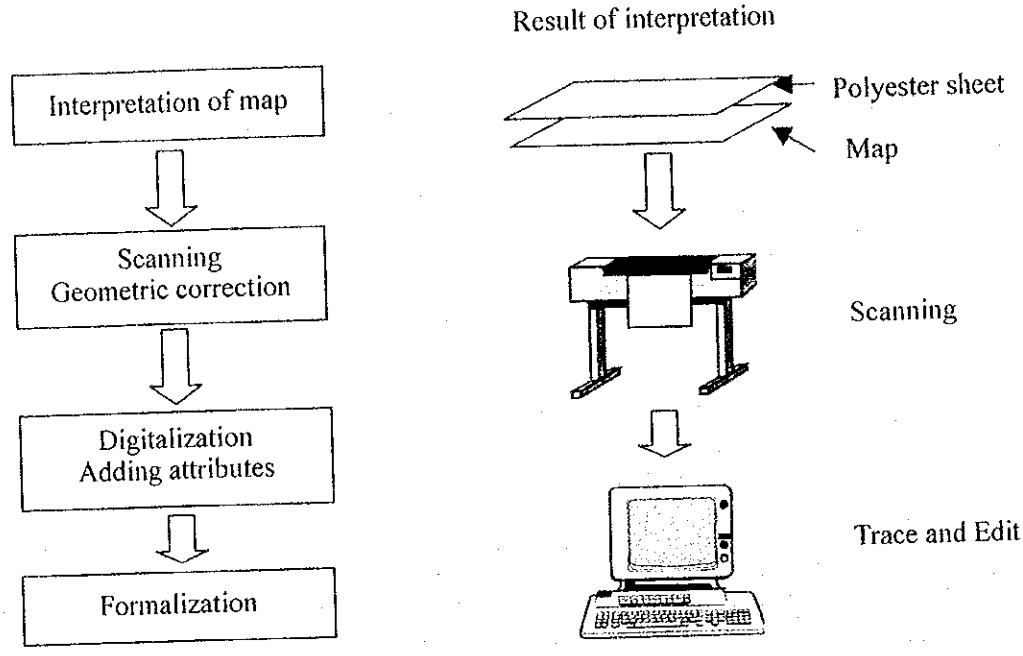
Land Cover Classification Items

Category	Level 1	Level 2
Artificial feature	1.Urban area	11.Low level housings
		12.Medium and high level buildings
Vegetation	2.Vegetation area	21.Crop land
		22.*Grass land
		23. (Bush and) Forest
Bare land	3.Bare land	31.Desert
		32.Rocky land
		33.Salinity covered land
Hydrology	4.Hydrology	41.River, Canal
		42. Lake, Reservoir, Pond, Swamp

*Includes desert with seasonal vegetation

3) Interpretation methodology and work flow

- Printed maps of each period were used as base maps.
- Polyester base was overlaid on each base map on which the coordinates at four (4) corners were traced.
- Symbols illustrating derived interpretation were traced on these overlay sheets.



Flow Chart of Interpretation

(3) Digitizing and editing of thematic maps

For decision making, planning and recognition of the present status of ecological, development and natural conditions, the following available thematic maps were digitized and edited. Four (4) thematic items were specified in consultations with Kazakstan side.

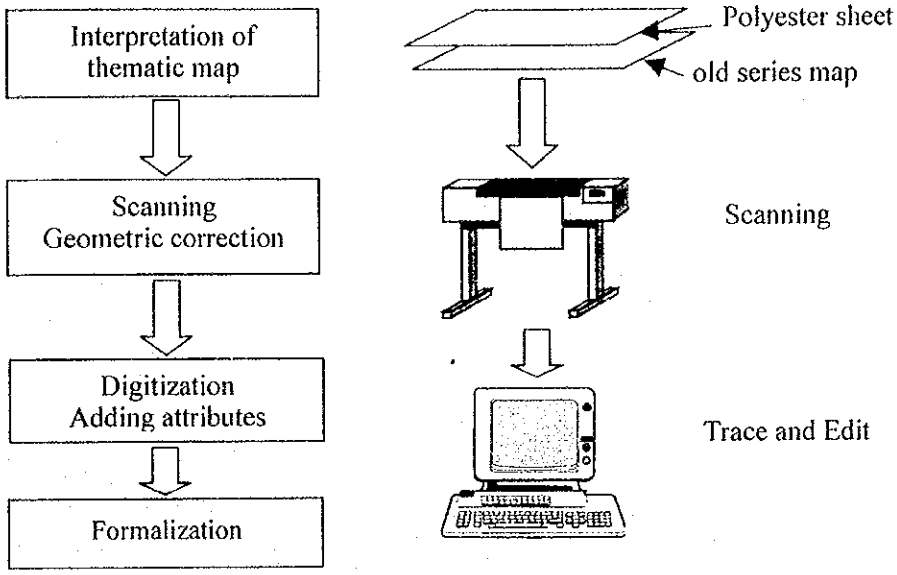
1) Digitized data

The following thematic maps were selected for digitizing from the national atlas:

- Geologic map
- Soil map
- Vegetation map
- Geomorphological map

2) Work Methodology

The traced image of a scanned map was developed as preliminary stage of digitizing. Then digitizing was done:



Flow chart of Digitizing

(4) First Stage of Satellite Image Analysis

The objective of the first stage of satellite image analysis was to improve the accuracy of current land cover classification by using SPOT Multispectral (XI) data acquired in 1998.

1) Acquired Data

Thirty-one scenes of SPOT XI were used. Panchromatic (P) data was addopted for the area not covered with XI data. A listing of SPOT XI data is shown below:

SPOT XI Data

K_J	Year/Month/day	K_J	Year/Month/day	K_J	Year/Month/day
163_257	1998/08/11	169_258	1998/06/21	174_261	1998/07/12
164_257	1998/07/11	169_259	1998/07/22	175_261	1998/06/26
164_258	1998/07/11	170_258	1998/06/21	175_262	1998/06/26
165_257	1998/08/16	170_259	1998/06/07	177_261	1998/06/26
165_258	1998/06/25	170_260	1998/06/07	177_262	1998/06/26
166_257	1998/07/22	172_259	1998/06/07	177_263	1998/06/26
166_258	1998/06/25	172_260	1998/06/07	178_262	1998/06/27
168_257	1998/07/11	173_259	1998/07/07	178_263	1998/06/27
168_258	1998/07/11	173_260	1998/07/12	179_263	1998/06/27
169_257	1998/06/21	174_260	1998/07/07	179_264	1998/06/27
				180_264	1998/07/02

2) Area for analysis

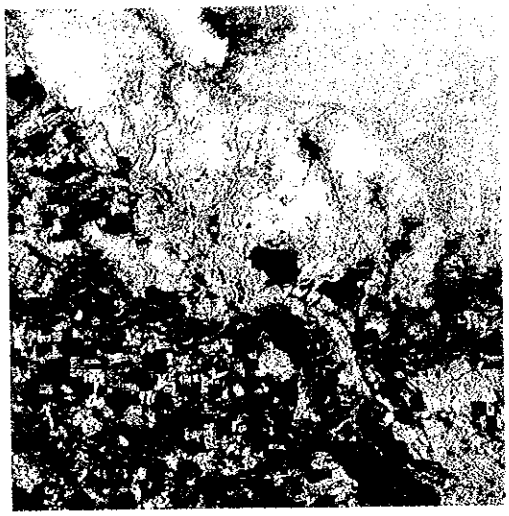
The Study area was divided into the following two parts:

- Area along Syrdarya River with significant observed chronological change (Area "A")
- Area with minor chronological change (desert, steppe, etc.) (Area "B")

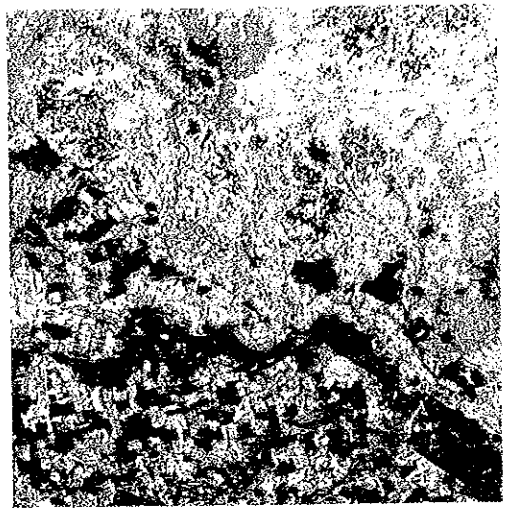
3) Employed data for analysis

- Area "A": Automatic classification of SPOT XI data
  A set of data detected on the same orbit and day was regarded as a unit for processing. Clustering was employed to classify the data into relatively homogeneous groups

- Area "B": Manual interpretation of SPOT P data
  Interpretation was carried out on the basis of Level 1items classification, with the account of other typical land cover



SPOT Multicolor (XI) data



Result of First stage satellite image analysis

(5) Second stage of satellite image analysis

The final analysis to determine land cover classification was implemented in a "Second stage of Satellite Image Analysis" based ground truth data and the "First stage of Satellite Image Analysis". On the other area where manual interpretation was carried out, confirmation and correction of the Land Cover Classification results were accomplished by reference to acquired ground truth data.

Methodology and Work Flow of Analysis

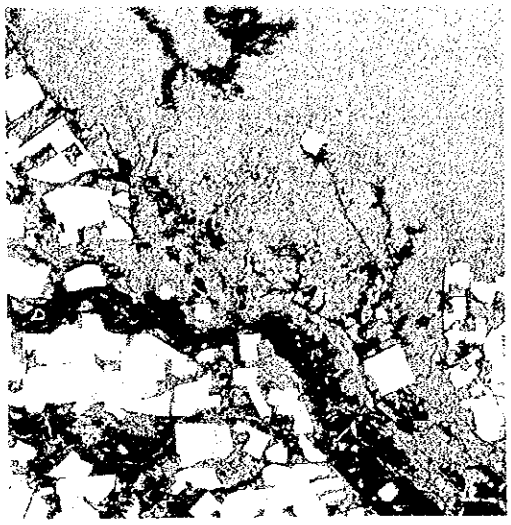
a. Supervised classification of SPOT XI data

Supervised classification was undertaken for 31 scenes of XI data. The basis of the approach was to develop a general supervised classification scheme for the whole study area thereby eliminating noise caused by observations taken at different times of day and computation between spectral bands at each processed strip.

The equations used for the computation between each spectral band were:

- (Ch.2 – Ch.3 / Ch.2 + Ch.3): NDVI generally used as vegetation index
- (Ch.2 – Ch.4 / Ch.2 + Ch.4): Enhancement of rock characteristics and soil water content

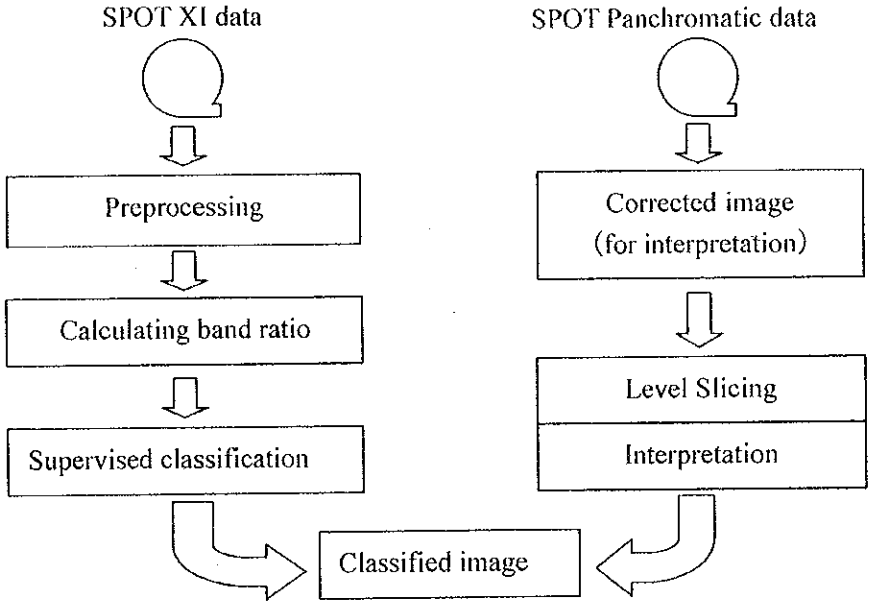
SPOT Multicolor (XI) data



Result of Second stage satellite Image Analysis

b. Interpretation of SPOT P (panchromatic)

Interpretation of SPOT-P image was based on the Level 1 Classification Standard level slicing technique applied each sheet.



Flow chart of Data Analysis

(6) Digitizing and compilation for result of analysis

Land cover classification data, generated by "Second stage of satellite image analysis" with SPOT images, was compiled in the unit of map-sheet and digitized. Land cover classification map was developed by overlaying classified land cover data on a background of a topographic map and framework map data.

(7) Chronological change comparision

Comparative land cover changes in three consecutive periods, namely the 1950's, 1980's and the present (1998), involving man-made irrigation developments and the impact of natural changes caused by these developments could be analyzed by utilizing old series topographic maps and SPOT XI images.

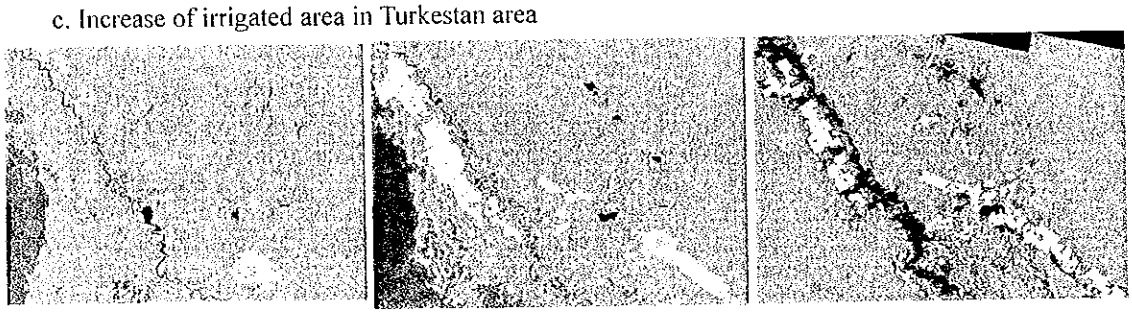
a. Shrinking Aral Sea and increase of cultivated land in the Novokazali area

*1950's　　*1980's　　Present (1998)
* Approximate

b. Decrease of swamp area and increase of irrigated area in Kyzyl Orda

*1950's　　*1980's　　Present (1998)
* Approximate

c. Increase of irrigated area in Turkestan area



*1950's　　*1980's　　Present (1998)
* Approximate

(Bush and) Forest　Grass land　Desert　Salinity covered land　River,Canal
Lake,Reservoir,Pond,Swamp　Crop land　Low level housing　Medium and high level buildings　Rocky land

(8) Preparation of CD-ROMs (Generation of structured GIS data)
CD-ROMs for the presentation of Land Cover Classification Data were produced with inclusion of other final data so as to provide convenient GIS information.

9. System Customization and Installation

(1) System customization
Various programs for customization of computers hardware and software for installation in Kazakstan, were developed to achieve effective OJT (on the job training) on digital mapping.

1) Computer languages for customization
Computer languages which can be operated on Microsoft Windows98/NT, were used for customization

Products	Purposes
MDL(Microstation Development Language)	Customization on MicroStation
MapBasic	Customization on MapInfo
Visual C++ (by MicroSoft)	Development of DLL(Dynamic Link Library)
Pro Fortran (by Absoft)	Development of program for batch processing on MicroStation

2) Development of Computer Programs for Customizing

a. for MapInfo

- Input menu
- Editing menu
- Programs for symbolization
- Programs for outlining symbols
- Programs of standard file format conversion
- Programs for conversion from standard file format

b. for MicroStation

- Input menu
- Programs for conversion to standard file format
- Programs of standard file format conversion

(2) System installation
Computer hardware and software installation and set up was carried out in Kazakstan where it was necessary for conduct OJT for the counterpart staff.
System components are:

a. Hardware:

- Personal computers
- Color ink-jet plotter (A0 version)
- MO disks
- Color laser printer (A4 version)
- Large-size scanner (A1 version)
- CD-ROM writer
- Accessories for network

b. Software:

- OrthoEngine (PCI, Canada)
- PhotoShop (Adobe, USA)
- MicroStation (Bentley, USA)
- Geovec Office (InterGraph, USA)
- MapInfo (MapInfo, USA)

10. Technology Transfer

A technology program is an indispensable part of establishing a digital mapping system capability in Kazakstan. In this extent it was considered that Kazak specialists should develop a good command of using the equipment for managing and updating the map data prepared in this study.
Implementation of OJT by state enterprises and reception of counterpart trainees in Japan were considered.
The principal items of technology transfer were the following:

- Geometric correction of satellite images
- Digital mapping using satellite images
- Compilation of digital map information
- Method for updating digital map information

The Counterpart training was conducted not only through OJT for engineers of state enterprises under Agency of Republic of Kazakstan on Land Resource Management at respective stages during fieldwork, but also for two personnel dispatched to Japan by the Kazakstan counterpart organization as JICA trainees. The training schedule outlined below was held mainly at the Technical Center of Aero Asahi Corporation.

Names	Office	Position	Period	Fields of training
Epishin V.	ALRM	Manager, Dept., Geodesy & Cartography	20,02 '99 ~ 14,03 '99	Surveying Administration Digital Mapping Satellite Image Processing Global Mapping Workshop
Orazov B.K.	KARTINFORM ALRM	Chief Expert	25,07 '99 ~ 25,08 '99	Satellite Image: Geometric Correction & Processing Digital Mapping System Customize, etc.

11. Final Products and Equipment to be donated to the Kazakstan

Principal final products are as follows :

- Final Report, System Maintenance Manual
- Printed Topographic Map (1:100,000)
- Digital Data stored in CD_ROM : Topographic Map Data (1:100,000)
  GIS Framework Data (1:200,000)
  Land Cover Data

(Appendix 6)

All the intermediate materials acquired in the study process as satellite images, aerial photographs, interpretation key, control point survey results, etc. are donated to the government of Kazakstan.

The donated equipment and software are as follows :

Item	Maker	Unit
Desk Top PC G6-400 (ENG) GATEWAY GP Series	Gateway	3
Laser Printer, LP-1800	EPSON	1
MO Disc, MOS341ST, 640MB TURBO II	Olympus	1
CD-ROM Writer, CRW4416SX-VK	YAMAHA	1
Color Plotter, TECHJET5500 5536(A0)	NS Calcomp	1
Color Scanner SCANPLUS III 510C (A0)	NS Calcomp	1
EASI/PACE Image Processing Kit	PCI	1
MICROSTATION SE (English Version)	Bentley	1
GEOVEC OFFICE SBUN6200L	Intergraph	1
MAPINFO PROFESSIONAL 5.0 (E)	MapInfo	1
Photoshop	Adobe	1

Chapter 5. Recommendations on the Use of the Study Results

1. The Present Status of the Study Areas

Field studies undertaken in 1998, land cover analysis based on satellite image analysis and comparison with previously issued topographical maps, have provided information on the current status of social infrastructure, agriculture/industry and environment.

Development of agriculture and industry affect the environment, aggravate the ecology of the region and can create social problems. Poor water management of the Syrdarya and Amudarya rivers has also contributed to the shrinkage of the Aral Sea.

Degradation of social and natural phenomenon which were observed in the process of reconnaissance on the study are as follows:

(1) Social Infrastructure

Electric power	: Lack of electricity supply /or frequent blackouts in many villages. Collapsed high-tension lines.
Drinking water	: Frequent suspension of water supply in urban areas. Many defunct water wells in rural areas and in meadows caused by polluted and saline water, low ground water table, breakage of water pumps and lack of electric supply.
Roads	: Insufficient maintenance on paved, gravel roads and floating bridges.
Health/Sanitation	: Increase of respiratory sickness, intestinal disorder, hepatitis and children's diseases. Poor status or lack of sewerage systems in rural areas.

(2) Agriculture / Industry

Agriculture	: Impact of excessive irrigation on water circulation mechanism Contamination of ground water and soils as a result of water leakage from unlined canals Irrigation systems have no return flow to Syrdarya River Increase of abandoned cultivated lands Non-observance of irrigation water norms during rice paddy cultivation Lack of agricultural machinery Shortage of young manpower
Livestock	: Decrease of livestock due to the financial problems of their holders.
Fishery	: Reduction of fisheries caused by substantial salt content increase and decrease of Aral Sea water
Industry	: Increase of closed factories

(3) Natural environment

Weather	: Extreme continental climate and desertification due to shrinking of Aral Sea
Ground water	: Degradation of water quality (pesticides / industry drainage / community waste). Decrease of communal wells
Soils	: Expansion of Solonchak (salt crusts) and Takyr
Biodiversities	: Some species of flora and fauna have been introduced to "Red Data Book" under the danger of extinction

2. Geographic Information System (GIS)

The "framework vector geographic data" formulated by the Study Team has the following attributes:

- Administrative Boundary,
- Transportation network,
- Town and Settlement,
- Public Utility,
- Topography (Relief),
- Hydrology, and
- Land Cover (Vegetation).

This "framework vector geographic data" with 1/200,000 scale positional accuracy and map like attributes can provide a basis for developing Geographic Information Systems (GIS) by adding and manipulating particular spatial information required to meet specific applications interests.

For the readers who are unfamiliar with GIS, it may be useful to provide the following definitions of GIS by which several geographers have attempted to capture the nature of GIS:

"A system for capturing, storing, checking, manipulating, analyzing and displaying data which are spatially referenced to the Earth." DoE

"A decision support system involving the integration of spatially referenced data in a problem-solving environment." D.J.Cowen

"An information technology which stores, analyses, and displays both spatial and non-spatial data." H.D.Parker

"A form of MIS [Management Information System] that allows map display of the general information." H.A.Devine and R.C.Field

To summarize the above, GIS can be said to be an information system that is used to store and analyze geographically referenced data in order to support management and decision making process.

Generally application of GIS can clarify the following basic questions.

· Location — *What is in ---------- ?*
What exists at a particular location?
Examples: location of irrigation facilities, agricultural land

· Condition — *How is it like in -----?*
Which locations satisfy certain conditions?
Example: the North of ---- *is classified as* Saxaul (desert vegetation) zone.

· Trend — *How has it changed --------- ?*
Identify geographic trends in the process of changing.
Example: the saxaul zone has been changed to the irrigation area

· Relation — *Which data is related to a particular point?*
Analyzes the spatial relationship between objects of geographic features.
Example: Extension of agricultural land is related to decrease of water area, causing drying area

· Modeling — *What will happen if ----------?*
Model based questions; computes and displays an optimum path, suitable land, risky area against disasters etc. based on a model.
Example: Appropriate decision making on land use of further cultivation or preservation

In its history GIS has experienced the following three development stages, namely, inventory applications, analytical applications, and management applications. This is summarized in the followings:

· The first stage ; Inventory Applications
Database, which enable to extract, to combine and to update necessary information for inventory.

· The second stage ; Analytical Applications
To analyze the data based on the present and/or the past information on each specialized field from *Trend* information and/or to analyze various phenomenon form complex data.

· The third stage ; Management Applications
This application is for administration or management. Based on the first and second stage application, the application to support administrative decision for finding most sustainable solution, priority and etc.

The world trend of GIS development now shifts toward further applications of both second and third stages. A high quality GIS facility, however, can only be developed with viable data of good quality in a digital format. In the first stage the cost of inputting such data will form major costs. The second and the third stages of GIS development will be reliant therefore on good quality data acquired in the first stage.

3. Recommendations on the Use of the Study Results

The results of "The Study on Urgent Establishment of National Basic Geographic Data in the Southern Area of Kazakstan" are summarized as follows:

- 1/200,000 scale framework data covering approximately 150,000 sq. km
- 1/100,000 scale topographic and digital map data covering approximately 22,500 sq.km
- Chronological land cover data
- Provision of Personal Computers with peripheral equipment
- Provision of software for digital mapping, satellite image processing, operating manuals, etc.
- Technology transfer related to the study.

The 1/100,000 scale topographic and digital map data covering approximately 22,500 km^2, around Kyzylorda city, can be used immediately for various administrative and development purposes, as it is a revised version of the existing 1/100,000 scale paper maps.
The 1/200,000 scale digital geographic framework data formatted in a CD-ROM, covers the area about 150,000 km^2 along the Syrdarya River (part of South Kazakstan Oblast and Kyzylorda Oblast,).
This can provide a fundamental basis for Geographic Information Systems development in this area which can be utilized for various user interests and applications as basic spatial data.

The study team recommends that the Kazakstan Government create a unified database by adding necessary information on the framework data provided by JICA study team.
This unified database should be developed for both analytical and management objectives in the next stage. The expected GIS databases for the area of East Aral and Syrdarya River is summarized in Table.

No.	Fields and Purposes	Advantages	Input data	Availabilities of input data
1	Water resources management Purpose: To implement appropriate water control (inlet-outlet and quality of water)	-Data are maintained in a standard format -Revision and updating are easier -Data and information are easier to search, analyze and represent -Data are more value added products -Data can be shared and exchange freely -Productivity is improved and more efficient -Time and money are saved	-River flow quantity (Average and extreme record)	yes
			-Subsurface water quality and water level	yes
			-Seasonal water quantity of irrigation and drainage	yes
			-Quality, capability and water level of wells	to be updated
			-Pollution	unknown
			-Soil classification and water permeability	unknown
2	Agricultural land use Purpose: To evaluate and determine acceptable arable land	- do -	-Irrigation lands and rainfed lands	yes
			-Crops, cropping pattern and production statistics	yes
			-Abandoned fields and causes	unknown
			-Land ownership	no
3	Environment and ecology Purpose: To restore natural environment and ecology	- do -	-Land use classification	unknown
			-Land cover classification	yes
			-Wildlife distribution and classification	yes
			-NOAA NVI image	yes
			-Hydrological data	yes
			-Contamination in water bodies	unknown
			-Solonchak and Takyr distribution	no
			-Micro-topography/ detailed vegetation classification of the Aral Sea exposed land	no
			-Soils of the Aral Sea	yes
4	Social environment Purpose: To acquire and maintain minimum civilization (living) standard	- do -	-Population statistics	yes
			-Social infrastructures	to be updated
			-Public health	yes
			-Education	yes

Central/local government organizations, research institutions and international organizations seem to have already acquired and studied many of the above-mentioned data.

Some data however needs to be updated and oriented as geo-referenced data. But there is also a need for new data acquisition and analysis.

To develop a viable Geographic Information System (GIS) for the East Aral and Syrdarya River Basin, the following conditions are recommended to be established and observed:

(1) Open framework data relationships with other agencies, experts and a wide range of private users

The input data for the expected GIS database should be digitized at one central organization, for instance, the Agency of Land Resources Management, which is a major counterpart agency in this study. The digitized data can be utilized on the framework data and shared by concerning organizations. Also updating of the data should be managed by such organizations.

(2) Cooperation between various agencies and experts for exchanging existing data in different field

An inter-agent committee should be established which makes coordination effective and also makes development of the inventory, analytical and management GIS applications less redundant. Regular meetings should be held by the experts of various fields to exchange their topics and opinions about updating input data, method of analysis, etc. For instance, in Japan, Information Exchange Organ has established in order to facilitate information exchange.

(3) Sound user interests in GIS applications

Some further concrete applications of GIS in such fields as water management, agricultural land use, environment and ecology and social environment should be demonstrated for users.

(4) Important factors for a sustainable GIS

1) Data input

The cost of data input will occupy about 80% of the total cost in GIS. More attention should be given to selection and classification of required Geo-spatial data by taking the digitizing method into consideration. To minimize the cost, detail assessment of available data should be done, because it is quite expensive to develop new Geo-spatial data. For a country like Kazakstan which has vast territory, satellite image data is recommended to be employed for development and updating of the input data effectively, because it can cover wide area at lower cost than aerial photographs.

2) Maintenance of data base

In Kazakstan routine maintenance of the database is carried out by limited professional personnel and with equipment. Therefore, it can be suggested to concentrate such work at one central organization.

3) Education

Not only top management but also other administrative staffs and engineers should support the GIS project. Therefore, GIS education has to be extended to all the hierarchies in a GIS user organization.

4) Data sharing

Data sharing is one of the important keys to minimize the total cost of data input and also to maximize the use of the database. Political and administrative problems should be solved to promote the data sharing for successful GIS.

Appendix

Appendix

SCOPE OF WORK
FOR
URGENT ESTABLISHMENT OF NATIONAL BASIC GEOGRAPHIC DATA IN THE SOUTHERN AREA OF THE REPUBLIC OF KAZAKSTAN

AGREED UPON BETWEEN
COMMITTEE OF LAND RESOURCES MANAGEMENT
MINISTRY OF AGRICULTURE
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

ALMATY, JUNE 19, 1997

Bakhyt Sagyndykovich Ospanov
Chairman,
Committee of Land Resources Management,
Ministry of Agriculture

M. Nagaoka

Masatoshi Nagaoka
Leader,
Preparatory Study Team
Japan International Cooperation Agency

1.INTRODUCTION

In response to the request of the Government of the Republic of Kazakstan(hereinafter referred to as "Kazakstan"), the Government of Japan (hereinafter referred to as "Japan") decided to conduct "The Urgent Establishment of National Basic Geographic Data in the Southern Republic of Kazakstan (hereinafter referred to "the Study")in accordance with relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of Japan, will undertake the Study in close cooperation with the authorities concerned in Kazakstan.

The Committee of Land Resources Management, Ministry of Agriculture (hereinafter referred to as "CLRM"), the official agency responsible for survey and mapping in Kazakstan, shall act as an executing agency for to the Japanese Study Team (hereinafter referred to as "the Team") and also as a coordination body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

The present document sets forth the Scope of Work with regard to the Study.

2.OBJECTIVES OF THE STUDY

In order to tackle the environmental problems along Syrdar'ya River basin towards the east bank of the Aral Sea, the objective of the Study is set as follows : i)to prepare the digital geographic data whose positional accuracy is corresponding to 1:100,000 topographic maps which covers approximately 21,000km2, ii)to prepare the 1:100,000 topographic maps using the former data, iii)to prepare the basic digital geographic data whose positional accuracy is corresponding to 1:200,000 topographic maps which cover approximately 150,000km2 and iv)to prepare the chronological digital land cover data approximately covering 150,000km2.

3.STUDY AREA

Following geographic data shall be prepared and the approximate covering areas are shown on the Appendix-1. Positional accuracy of the following digital data is corresponding to the scale of the existing topographic maps shown in the round brackets.

(1) Digital geographic data (1:100,000)	21,000km2
(2) Digital geographic framework data (1:200,000)	150,000km2
(3) Chronological digital land cover data	150,000km2

4. SCOPE OF THE STUDY

In order to achieve the objective mentioned above, the Study will cover the following items.

(1) Aerial photographs

1:50,000 aerial photographs shall newly be taken covering the approximate area of 150,000km2.

(2) Preparation of digital geographic data whose positional accuracy is corresponding to existing 1:100,000 topographic maps covering the approximate area of 21,000km2

(2)-1 Digital geographic data

The digital geographic data will be acquired from the newly obtained satellite images and 1:50,000 aerial photographs, referring to the existing 1:100,000 topographic maps.

(2)-2 Horizontal control and GPS Survey

The horizontal control of the satellite images and aerial photographs will basically be carried out on the existing 1:100,000 or 1:50,000 topographic maps. GPS survey, however, to establish horizontal ground controls may be carried out in necessary areas.

(3) Preparation of the printed 1:100,000 topographic maps

Revised 1:100,000 topographic maps shall be printed with the digital geographic data whose contents and accuracy are nearly equivalent to those of existing 1:100,000 maps.

(4) Preparation of digital geographic framework data whose positional accuracy is corresponding to the existing 1:200,000 topographic maps covering the approximate area of 150,000km2

(4)-1 Digital geographic framework data

The digital geographic framework data which covers approximately 150,000km2 will be acquired from the newly obtained satellite images, referring to the existing 1:200,000 topographic maps, as well as the newly taken aerial photographs.

As for the area where the existing 1:100,000 topographic maps have been digitized, these digital geographic data will effectively be applied instead of 1:200,000 data.

(4)-2 Horizontal control and GPS survey

The horizontal control of the satellite images and aerial photographs will basically be carried out on the existing 1:100,000 or 1:50,000 topographic maps. GPS survey, however, to establish horizontal ground controls may be carried out in necessary areas.

(5) Preparation of chronological digital land cover data covering 150,000km2

Interpretation of digital land cover data (land use, vegetation, water surface, etc.) will be carried out by use of existing maps and satellite images by computer analysis, through which the chronological data, being chosen in some three times around the 1950s,the 1970s and the latest, shall be prepared. The availability of the usable maps in 1950s and 1970s, however, is expected to be limited, data sources shall possibly be alterable. Some thematic maps such as geological maps, soil maps and vegetation maps etc. shall effectively be utilized to be digitized.

5.STUDY SCHEDULE

The whole study shall be conducted in accordance with the attached tentative schedule. (Appendix -2)

6.REPORT AND FINAL PRODUCTS

JICA shall prepare and submit the following reports in English and Russian every fiscal year and final products to Kazakstan.

(1)Plan of Operation 1

20 Copies : at the commencement of the Study

(2)Plan of Operation 2

20 Copies : the second fiscal year

(3)Plan of Operation 3

20 Copies : the third fiscal year

(4)Final Report

50 Copies : At the end of the Study

(5)Digital Geographic Data

100 copies of each digital geographic data file(eg. CD-ROM) shall be prepared as follows :

i) Digital geographic data whose positional accuracy is corresponding to the existing 1:100,000 topographic maps

ii) Digital geographic framework data whose positional accuracy is corresponding to the existing 1:200,000topographic maps

iii) Chronological digital land cover data

(6)Printed 1:100,000 topographic maps

500 Copies : at the end of the Study

(7)Negative films of 1:50,000 scale aerial photographs

7-4. CLRM shall, at its own expense, provide the Team with the following items, in connection with other organizations concerned:

(1) available data and information related to the Study;

(2) counterpart personnel;

(3) Suitable office space with necessary equipment in Almaty;

(4) vehicles with drivers;

(5) credentials or identification cards;

(6) administrative and technical support

(7) information on necessary administrative boundaries and geographical names to be shown on the maps. The correctness of such information is the responsibility of CLRM

8. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take the following measures:

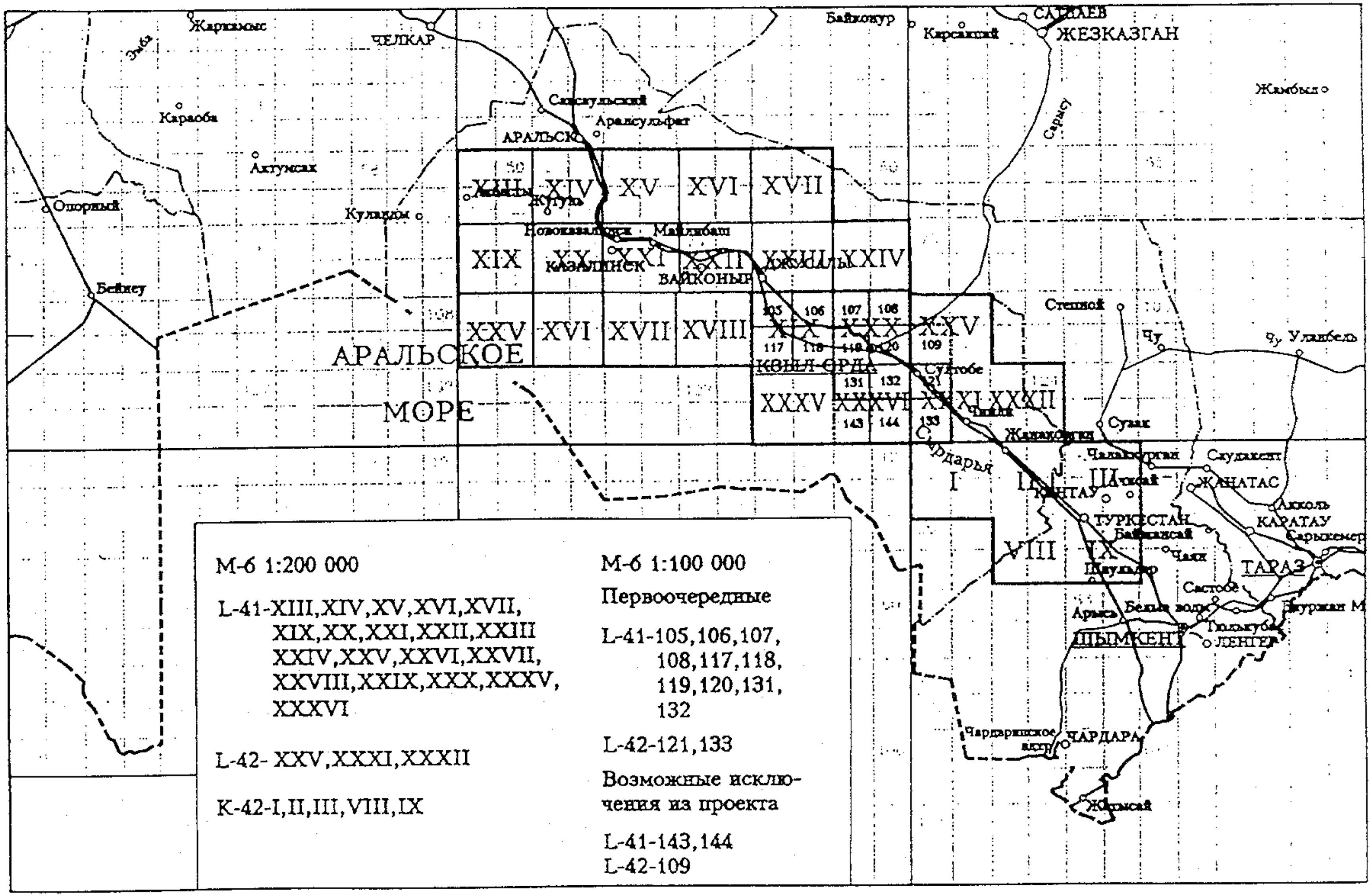
(1) to dispatch, at its own expense, the Team to the Republic of Kazakstan; and

(2) to pursue technology transfer to the Kazakstan counterpart personnel in the course of the Study.

9. CONSULTATION

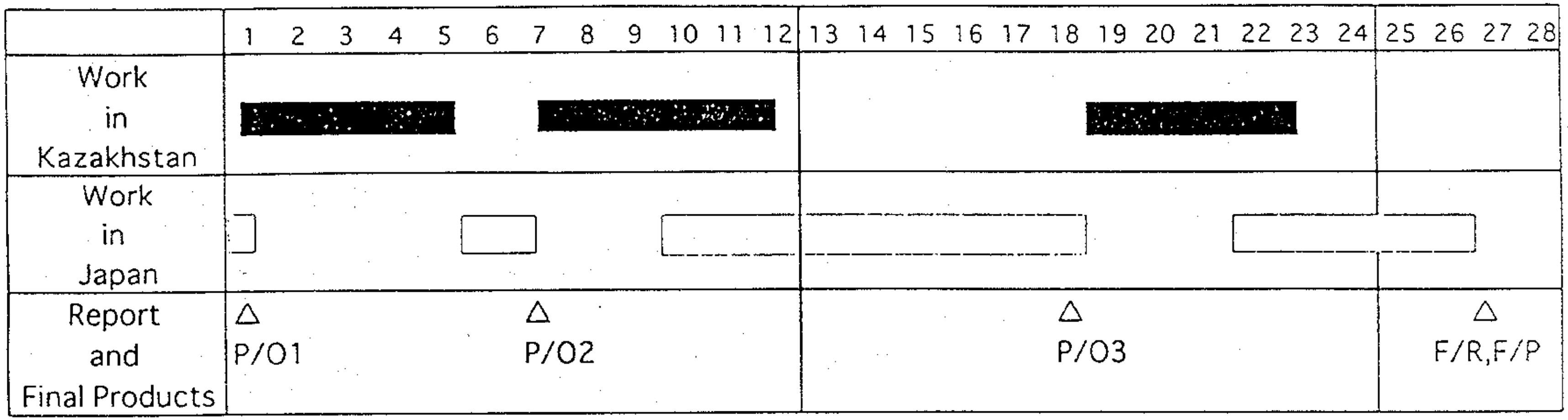
CLRM and JICA shall consult with each other in respect of any matter that may arise from or in connection with the Study.

Приложение 1



Appendix-2

TENTATIVE SCHEDULE OF THE STUDY



Kazakstan Key Persons

Name	Position	Organization
A.ANDRYUSHENKO	Vice-Minister	Ministry of Economy of RK
E.ARYNOV	Deputy Director	Ministry of Economy of RK Department of Investment Policy and Foreign Policy Management
B. OSPANOV	Chairman	Agency of the Republic of Kazakstan on Land Resources Management (ALRM)
A. SIZOV	Deputy Chairman	ALRM
V. EPISHIN	Head of the department	Dept. Geodesy & Cartography, ALRM
M. SAGANDYKOVA	Chief specialist	Dept. Geodesy & Cartography, ALRM
S. MAKHADIL	Chief specialist	Dept. Geodesy & Cartography, ALRM
S. OZHYGOVA	Director	SE. "CENTRAL MAP LAND SURVEYING FUND"
A.MUKHAMEDGALIEV	Director	SE "KARTINFORM"
A. ZENKOVSKY	Chief engineer	SE "KARTINFORM"
B. ORAZOV	Head of the department	SE "KARTINFORM" Department of geo-informational technology
K. ZHOLDYBAYEV	Director	SE "KARTOGRAFIYA"
T. BADMAEVA	Chief Engineer	SE "KARTOGRAFIYA"
L.SELEZNYEVA	Head of the department	SE "KARTOGRAFIYA" Photogrammetry department
S. OSPANOV	Director	SE "ZHAMBYLGEODESIA"
G. PROKOPYUK	Chief engineer	SE "ZHAMBYLGEODESIA"
V. PETSOLD	Head of expedition	SE "ZHAMBYLGEODESIA"
T. AKHMETOV	Director General	JSC "BURUNDAYAVIA"
V. KHAN	Head of aerial photo survey department	JSC "BURUNDAYAVIA"
E. SEROV	Pilot-Instructor	JSC "BURUNDAYAVIA"
V. CHERNYSHOV	Chief of Photo-Lab	JSC "BURUNDAYAVIA"

Tomiichi INAGAKI – adviser (JICA expert) – Ministry of Economy, Agency on Strategic Planning and Reforms.

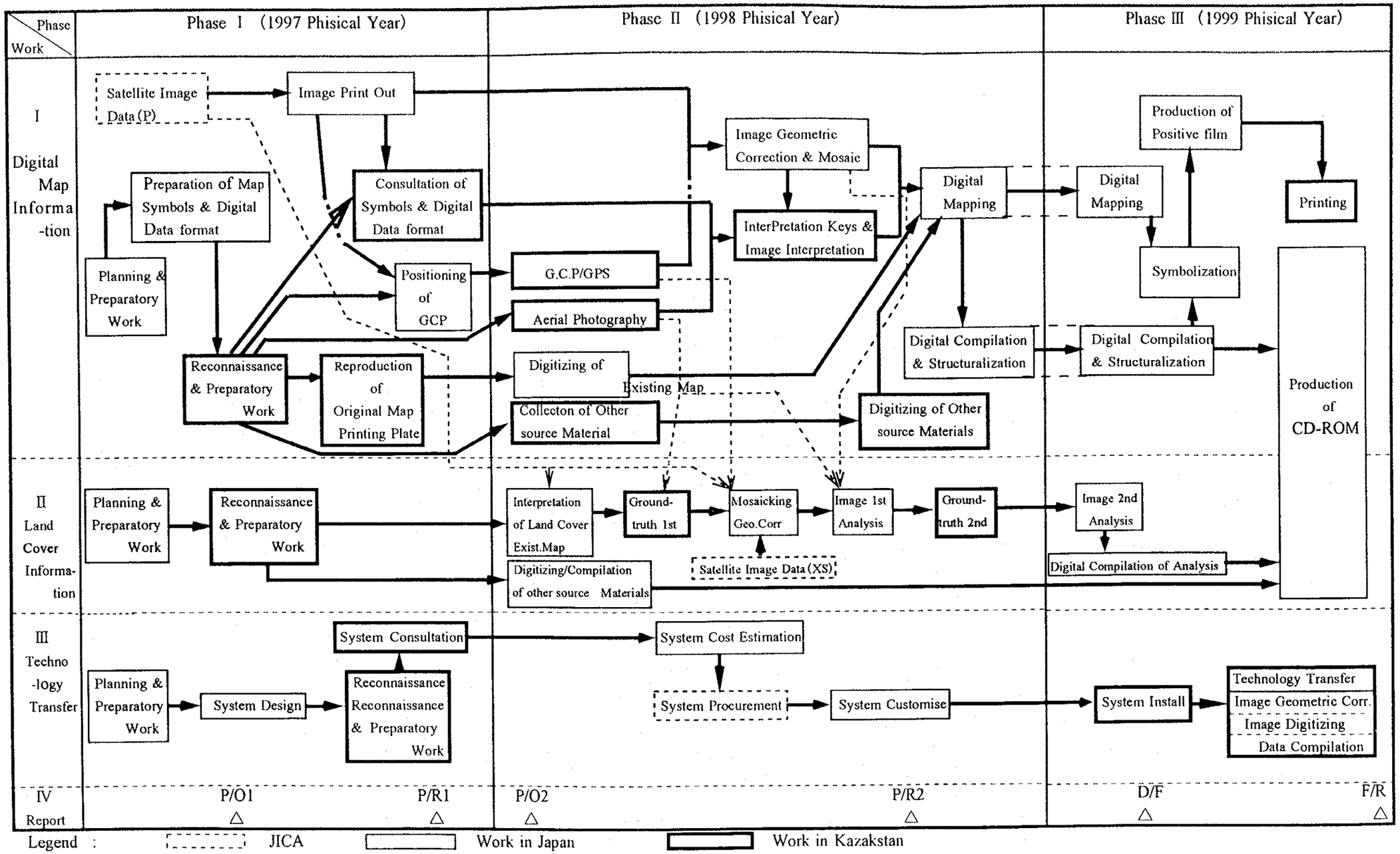
List of the Study Specialists

Name	Task	Organization
Shigehiko SHINO	Team Leader	Aero Asahi Corp.
Takashi HARADA	Deputy Team Leader	AAC
Hisao TAKIMOTO	Aerial Photography Supervision	AAC
Hiroshi SUZUKI	Ground Control Supervision Digital Mapping Supervision	AAC
Kentaro USUDA	Interpretation Key Supervision	AAC
Toshiya FURUKAWA	Interpretation Key Supervision	AAC
Shoji SAKAINO	Land Cover Classification and Satellite Image Processing	AAC
Hideo SUZUKI	Land Cover Classification and Satellite Image Processing	AAC
Kosuke TSURU	Digital Mapping Supervision & System Design	AAC
Naoki GOTO	System Design & System Install	AAC
Atsushi OKUIZUMI	General Coordination	AAC
Junko SUGIMORI	Coordinator & Digital Mapping	AAC
Toshimasa AOKI	Land Cover Classification and Thematic Mapping	AAC
Kan XU	Digital Mapping and Thematic Mapping	AAC
Mai SASAKI	Digital Mapping and Thematic Mapping	AAC
Tsuyoshi TAKENOUCHI	System Customizing	AAC
Kazuya NAKANO	System Customizing	AAC
Shinichi KONO	Ground Control Planning Report Control	AAC
Toshio HORIUCHI	Interpreter and Translator	AAC
Raushan KALIKOVA	Office Manager and Translator	AAC

List of JICA Technical Advisory Team

Name	Task	Organization
Toshitomo KANAKUBO	Evaluation on Technology Transfer Planning	Infrastructure Development Institute (IDI)
Hisashi MORI	Evaluation on Technology Transfer Planning	Infrastructure Development Institute (IDI)

PROJECT WORK FLOW

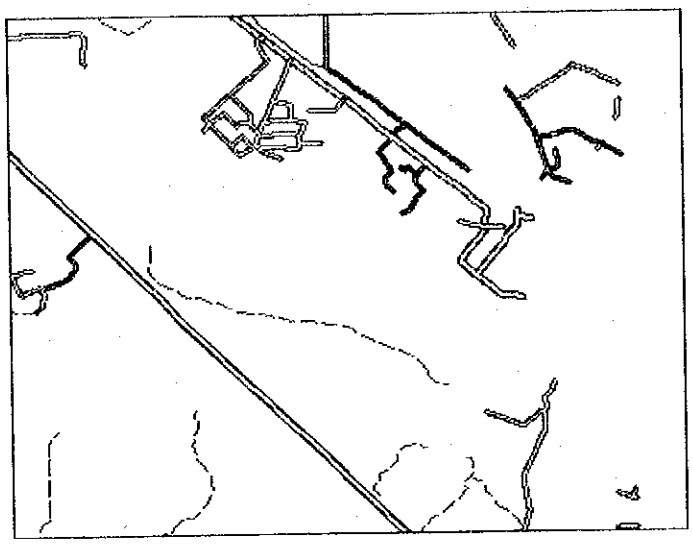


Adopted number of Symbols by Layer

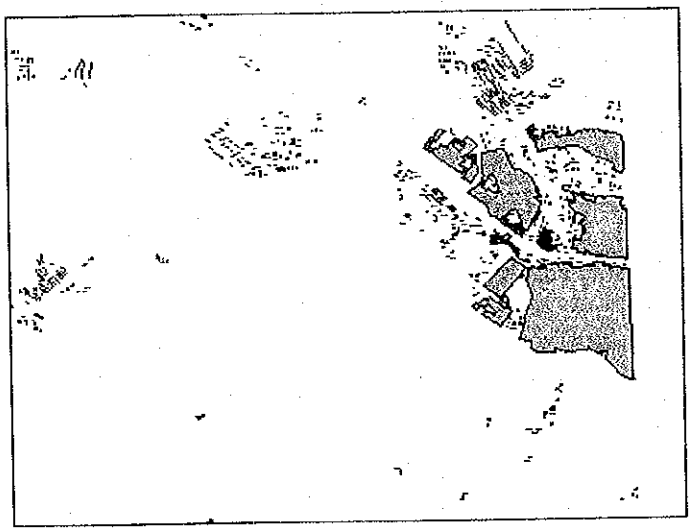
No.	Name of Layer	Contents	1/100,000	1/200,000
1	GeoPointK	Control Point	6	6
2	ResidentJ	Residential Area	12	2
3	InstituteJ	Facilities for Manufacture, Industry, Agriculture, Society and Culture	35	2
4	RailwayK	Railway(input Kazakstan)	8	0
5	RailwayJ	Railway(input Japan)	11	3
6	RoadJ	Road	14	7
7	HydroK	Water related objects etc. (input Kazakstan)	26	2
8	HydroJ	Water related objects etc. (input Japan)	40	16
9	ReliefJ	Topographic features	16	10
10	VegeJ	Vegetation	46	-
11	AdditionJ	Additional Map Symbol	13	1
12	Boundary	Boundary Line	0	2
13	Boundary	Boundary Annotation	10	10
14	Text	Annotation	22	14
15	Border	Marginal Information	2	2
16	Gridmetr	Grid Line	1	1

Example of Structured Data Layer

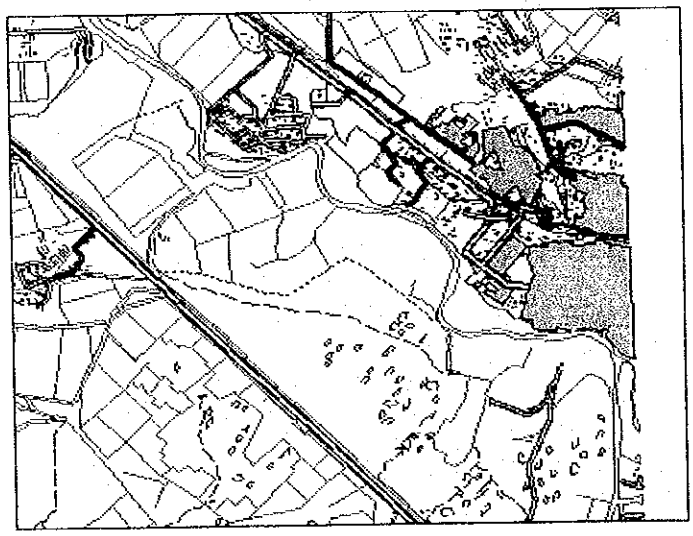
RoadJ



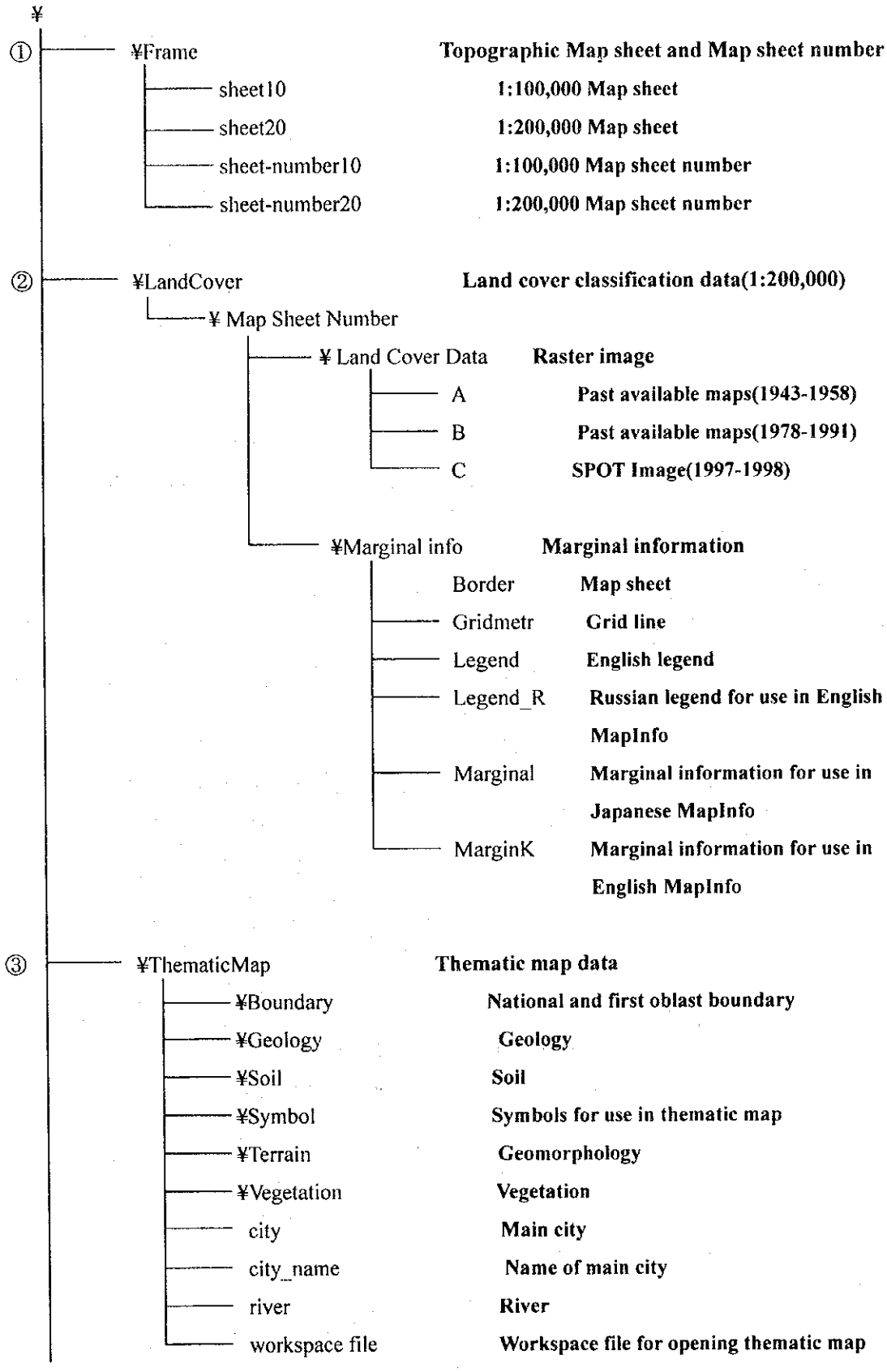
ResidentJ

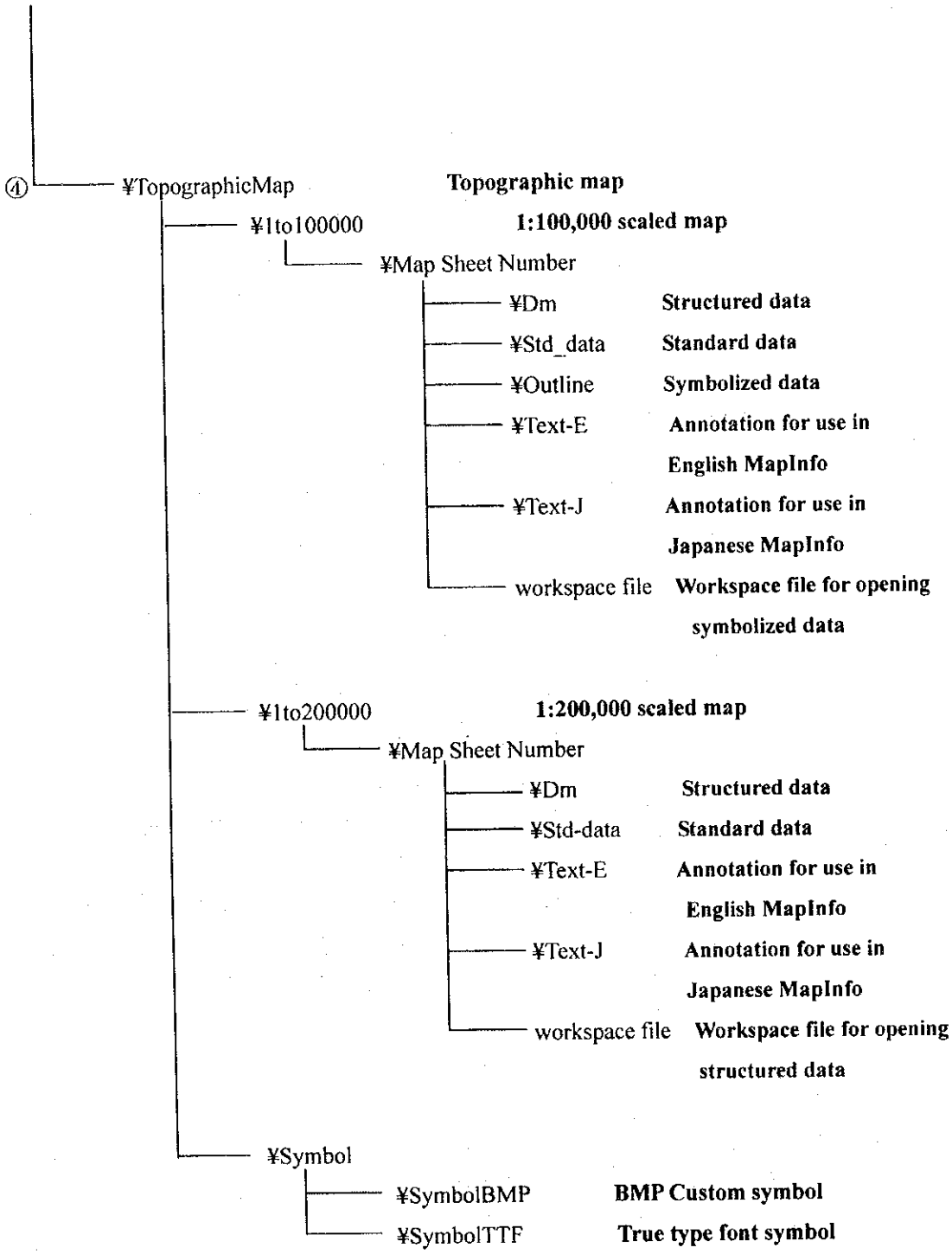


RoadJ, ResidentJ, RailwayJ,K
HydroJ,K and ReliefJ



Structure of CD-ROM




④
¥TopographicMap
Topographic map
¥1to100000
1:100,000 scaled map
¥Map Sheet Number
¥Dm
Structured data
¥Std_data
Standard data
¥Outline
Symbolized data
¥Text-E
Annotation for use in English MapInfo
¥Text-J
Annotation for use in Japanese MapInfo
workspace file
Workspace file for opening symbolized data
¥1to200000
1:200,000 scaled map
¥Map Sheet Number
¥Dm
Structured data
¥Std-data
Standard data
¥Text-E
Annotation for use in English MapInfo
¥Text-J
Annotation for use in Japanese MapInfo
workspace file
Workspace file for opening structured data
¥Symbol
¥SymbolBMP
BMP Custom symbol
¥SymbolTTF
True type font symbol

Data format list[*1]

1st directory	2nd directory	3rd directory	Data format
¥Frame			MapInfo table file[*2]
¥LandCover	¥Land Cover Data		MapInfo table file
	¥Marginal info		
¥ThematicMap	¥Boundary		MapInfo table file
	¥Geology		
	¥Soil		
	¥Symbol		True type font format symbol
	¥Terrain		MapInfo table file
	¥Vegetation		
	city		
	city_name		
	river		
	workspace file		MapInfo workspace file[*3]
¥TopographicMap	¥1to100000	¥Dm	MapInfo table file
		¥Std_data	Digital mapping standard data
		¥Outline	MapInfo table file
		¥Text-E	
		¥Text-J	
		workspace file	MapInfo workspace file
	¥1to200000	¥Dm	MapInfo table file
		¥Std_data	Digital mapping standard data
		¥Text-E	MapInfo table file
		¥Text-J	
		Workspace file	MapInfo workspace file
	¥Symbol	¥SymbolBMP	BMP format symbol
		¥SymbolTTF	True Type Font format symbol

*1 In 1st directory of ThematicMap, city, city_name, river, and workspace file are MapInfo files.
In 2nd directory of 1to100000 and 1to200000, workspace file is MapInfo file.

*2 MapInfo table file:
Digital mapping data using MapInfo in MapInfo table file format

*3 MapInfo workspace file:
Opening several MapInfo files in regular sequence