No.

Geographic Institute of Mali,
Ministry of Equipment, National Development, the Environment
and Urban Planning, Republic of Mali(IGM)

# THE NATIONAL TOPOGRAPHIC MAPPING OF THE REPUBLIC OF MALI IN THE KITA AREA

# FINAL REPORT

**OCTOBER 2001** 

S S F J R 01-146

ASIA AIR SURVEY CO., LTD.

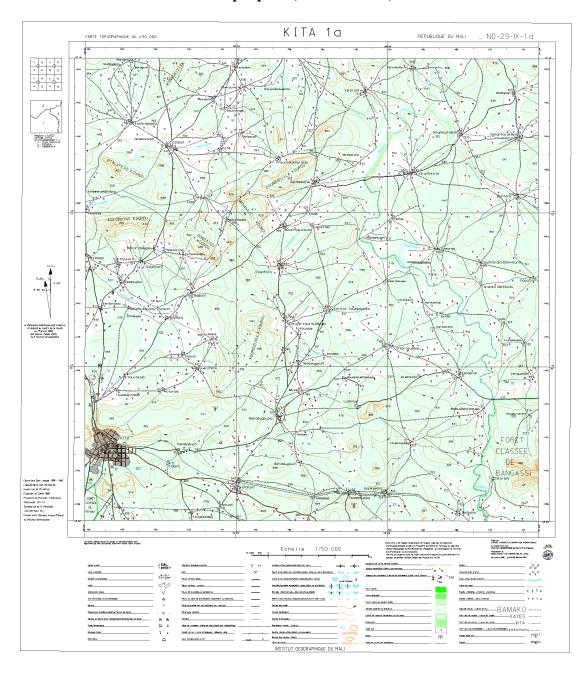
For currency conversion, in case necessary, Exchange rate in August 2001 may be applied:

100JPY=612.745F CFA

# Project site location map



# **Sample print(reduced scale)**



**PREFACE** 

In response to the request from the Government of the Republic of Mali, the Government of

Japan decided to conduct the study on The National Topographic Mapping of the Republic of Mali in

the Kita area and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Junichi Koseki of Asia Air Survey Co.

Ltd. to Mali, four times between October 1998 and August 2001.

The team held discussions with the officials concerned of the Government of Mali 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 Mali for their close cooperation extended to the team.

October 2001

Takao Kawakami

W上隆朗

President

Japan International Cooperation Agency

LETTER OF TRANSMITTAL

October 2001

Mr. Takao Kawakami

President

Japan International Cooperation Agency

Dear Mr. Kawakami:

It is my great pleasure to submit herewith the Final Report of the Study of National Topographic

Mapping in the Kita area of the Republic of Mali.

The study team which consists of the Asia Air Survey Company Limited (AAS) conducted

surveys in the Republic of Mali over the period between October 1998 and October 2001 as per the

contract with the Japan International Cooperation Agency.

The findings of this study, which are compiled in this report, were fully discussed executed with

Geographic Institute of Mali (IGM) of the Republic of Mali.

On behalf of the study team, I would like to express my heartfelt appreciation to the IGM, the

Ministry of the Equipment, National Development, the Environment and Urbanization of the

Republic of Mali, for diligent cooperation and assistance and for the heartfelt hospitality which they

extended to the study team during our stay in Mali.

I am also greatly indebted to the Japan International Cooperation Agency, the Ministry of

Foreign Affairs, the Ministry of Land, Infrastructure and Transport, the Embassy of Japan in Senegal,

JICA Senegal office for giving us available suggestion and assistance during the preparation of this

report.

Vours faithfully,

Junichi Koseki

古断, 純一

Team Leader for the Study Team

### PHOTOGRAPHS (14 leaves)

- 1. View of IGM building
- 2. JICA Vehicle
- 3. Training work or meeting with the counterparts
- 4. Signature of MM
- 5. Monumentation
- 6. Leveling
- 7. Inspection of aerial photographs
- 8. Photo interpretation
- 9. Pricking work
- 10. GPS calculation
- 11. Field identification
- 12. Field completion (by use of handy GPS)
- 13. Plotting/compilation work (by use of lap-top PC)
- 14. Structuralization/compilation work (by use of procured equipment)

# **CONTENTS**

Project site location	ı mar	)
-----------------------	-------	---

Sample print(reduced scale)

Preface

Letter of transmittal

Photographs (14 leaves)

				Page
Ρl	REFAC	E		i
1.	Outli	ne of tl	ne Study	1
	1.1		ground of the Study	
	1.2	Objec	ctives of the Study	1
	1.3	Outli	ne of Study Area	2
	1.4	Consi	derations for Implementation of the Study	4
	1.5	Speci	fications of the Study	4
	1.6	Yearl	y Work Schedule	5
	1.7	Work	Types and Volumes	7
	1.8	Plans	and Implementation	9
	1.8	.1	Plans and Implementation of the Study	9
	1.8	.2	Study Period	11
	1.8	.3	Technical Meetings	12
	1.8	.4	Cooperation with and Training of Counterparts	13
	1.8	.5	Individual Training of Counterparts	14
	1.8	.6	Role of JICA Study Team and Period of Dispatch	15
	1.8	.7	Significance of the Results Obtained in the Study	16
2.	Techr	nical R	eport	18
	2.1	Work	Plans	18
	2.2	Discu	ssions on Symbols and Marginal Information	19
	2.3	Acqu	isition of SPOT Images and Aerial Photography	19
	2.4	Photo	Interpretation	23
	2.5	Field	Identification	25
	2.6	Geoid	l Survey	26
	2.6	.1	Transformation of Ellipsoid	26
	2.6	.2	Geoid Elevation.	27
	2.7	Groun	nd Control Point Survey	36
	2.8	Surve	y of Supplementary Elevation Points	40
	2.9	Spatia	al Triangulation	40

	2.10	Creation of Digital Terrain Models	42
	2.11	Creation of Ortho-Photo Images	43
	2.12	Digital Mapping	44
	2.13	Digital Compilation	47
	2.14	Field Completion Survey	47
	2.15	Structuralization and Compilation Based on Field Completion	48
	2.16	Production of Printing Films and Printing of Topographic Maps	49
	2.17	Production of Topographic Map Data Files	49
3.	. Cons	iderations and Recommendations	50
	3.1	Use of Ground Control Points	50
	3.2	Use of Mapping Data	50
	3.3	Use of Supplied Equipment	51
	3.4	Technology Transfer and Future Response of IGM	51
	3-5	Present Status of IGM	54
	3.6	Recommendations to IGM	

### Appendices

- Appendix 1: Minutes of Meeting for the preparation of the study and scope of work
- Appendix 2: Minutes of Meeting on the progress
- Appendix 3: Documents of aerial photography and reproduction
- Appendix 4: Final design of Map Symbols and Application Rule
- Appendix 5: Final design of marginal information
- Appendix 6: Samples of photo interpretation key
- Appendix 7: Presentation slides of the draft final report
- Appendix 8: The list of products delivered to IGM

# **List of Table**

		Page
Table 1.3.1	Climate around Kita City	3
Table 1.5.1	Specifications of the study	4
Table 1.6.1	Yearly work schedule	5
Table 1.7.1	List of study contents	7
Table 1.8.1	Comparison table of planned and implemented works	9
Table 1.8.2	Training of counterparts in Japan	14
Table 2.3.1	Satellite image data	19
Table 2.3.2	Specifications of camera used	21
Table 2.4.1	Control sheet for aerial photos	24
Table 2.6.1	Calculations of parameters for transformation between ellipsoids	27
Table 2.6.2	New benchmarks and elevations	30
Table 2.6.3	Benchmarks and heights above ellipsoid (Clarke 1880 ellipsoid) by GPS	
	survey	32
Table 2.6.4	Calculations of geoidal elevations from height difference between height	
	above ellipsoid and leveled elevations	33
Table 2.7.1	Coordinate of ground control point and elevation	37
Table 2.9.1	Results of adjustment computation by aerial triangulation	41
Table 3.5.1	Budget and personnel by year	55
Table 3.5.2	Main IGM revenue sources	55
Table 3.5.3	Equipment possessed by IGM	55

# **List of Figure**

	Page
Fig. 1.3.1 Overview of study area (digital topographic model)	2
Fig. 2.3.1 Index map of SPOT image	21
Fig. 2.3.2 Aerial photography area	22
Fig. 2.4.1 Example of photo interpretation keys (railway and station)	23
Fig. 2.4.2 Inspection of aerial photos	24
Fig. 2.6.1 Model diagram of transformation between ellipsoids	26
Fig. 2.6.2 Height above ellipsoid and geoid elevation	28
Fig. 2.6.3 Index of new and existing benchmarks	29
Fig. 2.6.4 Leveling.	30
Fig. 2.6.5 GPS survey	31
Fig. 2.6.6 Geoidal undulating map (contour lines at 10 cm intervals)	35
Fig. 2.7.1 Location map of ground control points	39
Fig. 2.11.1 Ortho-photo (Kita City)	43
Fig. 2.12.1 Basic map for measuring	44
Fig. 2.12.2 Digital plotter	46
Fig. 2.13.1 Digital compilation system	47
Fig. 2.14.1 Field completion map	48
Fig. 3. 4.1 Working flow, technology transfer had be done by this study	52

### **Abbreviation**

IGM GEOGRAPHIC INSTITUTE OF MALI

DNCT THE NATIONAL DIRECTION OF THE CARTOGRAPHY AND TOPOGRAPHY,

MINISTRY OF THE URBANIZATION AND THE HABITANT

GPS GLOBAL POSITIONING SYSTEM

SPOT SATELLITE FOR THE EARTH OBSERVATION

DTM DIGITAL TERRAIN MODEL

DEM DIGITAL ELEVATION MODEL

TIN TRIANGULATED IRREGULAR NETWORK

UPS UNINTERRUPTIBLE POWER SUPPLY

EPS ENCAPSULATED POSTSCRIPT

DMA US DEFENSE MAPPING AGENCY

GIS GEOGRAPHIC INFORMATION SYSTEM

UTM UNIVERSAL TRANSVERSE MERCATOR

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

WGS84 WORLD GEODETIC SYSTEM 84

A/D ANALOGUE/DIGITAL

OA OFFICE AUTOMATION

LCD LIQUID CRYSTAL DISPLAY

PC PERSONAL COMPUTER

LAN LOCAL AREA NETWORK

IT INFORMATION TECHNOLOGY

### **Report organization**

This report is Volume 1: Main Report of the Final Report on The National Topographic Mapping of the Republic of Mali in the Kita Area.

The Final Report consists of two volumes and executive summary as shown below:

1. Executive Summary

2. Volume 1: Main Report

3. Volume 2: Operation Manual