Burkina Faso
Geographic Institute of Burkina Faso

Digital Topographic Mapping Project in Burkina Faso

(Technical Cooperation for Development Planning)

Final Report

August 2014

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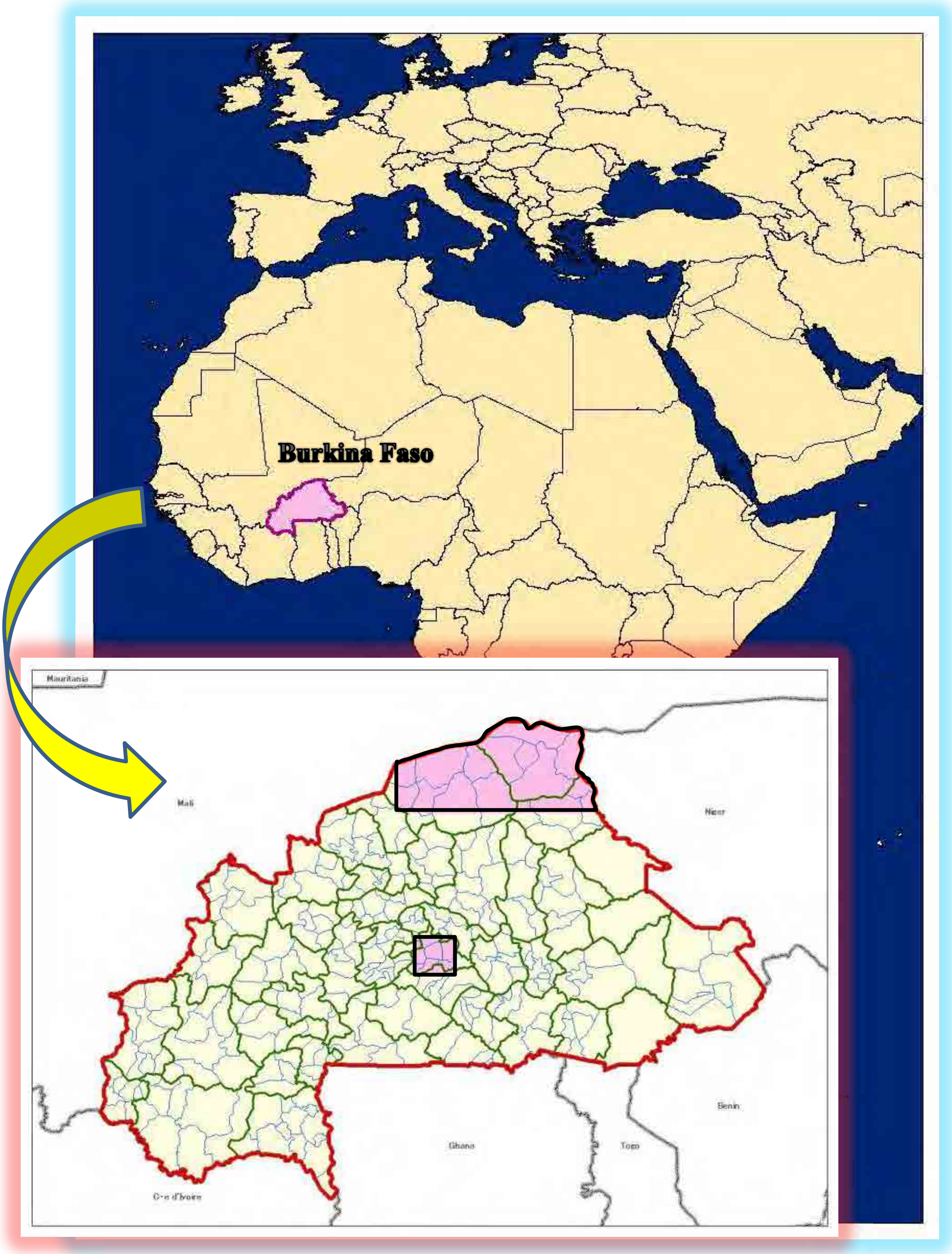
A baobab tree near the Office of the President in Ouaga 2000

“For the Future!!”
“Pour l'avenir!!”

“A Map is better than a thousand Words!!”
“Une carte vaut mieux que mille mots!!”

IGB

Study Area



Photos taken in Burkina Faso

Full view of IGB

Signing the Inception Report

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Discussion about specifications

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Guidance on GNSS observation
(using GNSS equipment owned by IGB)

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Ground control point pricking work GCP03

Opening seminar attended by Japanese ambassador

Opening seminar: Mr. Tapsoba, Director General of IGB

Meeting of topographic map data users after opening seminar

Participants in 1st UEMOA Seminar for wide-area collaboration

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Pupils studying a map in the Lecture Tour

Team Leader of the JICA Study Team interviewed during the Lecture Tour

2nd UEMOA technical seminar for wide-area collaboration: Representatives of JICA, Embassy of Japan, Ministry of Transport and IGB

2nd UEMOA technical seminar for wide-area collaboration: Closing address by His Excellency, Ambassador Plenipotentiary of Japan, Mr. Futaishi

Participants in 2nd UEMOA Technical Seminar
Representatives of 8 countries of UEMOA and Guinea, JICA, JICA Study Team

Abbreviations

No.	Abbreviation	Description	
1	ALOS	ALOS (Advanced Land Observing Satellite "Daichi")	
2	AVNIR-2	Advanced Visible and Near Infrared Radiometer type 2	Advanced visible and near infrared radiometer installed on the ALOS: It can create multipurpose color images using a total of four wavelength bands, *i.e.* blue, green, red and near-infrared.
3	BDOT	Base de Données d'Occupation des Terres	Land Occupation Database
4	BFTM	Burkina Faso Transverse Mercator	
5	BNDT	Base Nationale de Données Topographiques	National Topographic Database
6	BUMIGEB	General Directorate of Mining, Geology and Quarries	
7	BUNASOLS	National Institute of Soil	
8	CCD	Charge Coupled Device	Charged coupled device, a type of solid state image sensor
9	DCIME/CONNED	Division of Capacity Development, Information and Environmental Monitoring/National Council for Environment and Sustainable Development	
10	DEES/ MEDD	Department of Environmental Economics and Statistics/Ministry of Environment and Sustainable Development	
11	DEM	Digital Elevation Model	
12	DGN	Design File	A CAD file format supported by MicroStation
13	2iE	International Institute of Water Environmental Engineering	
14	DWG	Drawing File	A drawing data file format supported by Autodesk
15	DXF	Drawing Exchange Format	A file format for drawing data created with CAD software
16	EU	European Union	
17	ECOWAS	Economic Community of West African States (Communauté économique des États de l'Afrique de l'Ouest)	
18	FAO	Food and Agriculture Organization	
19	FCFA	Franc Communauté française d'Afrique	Common currency unit used in many West African countries
20	GCP	Ground Control Point	
21	GIS	Geographic Information System	
22	GLONASS	Global Navigation Satellite System	
23	GNI	Gross National Income	
24	GNSS	Global Navigation Satellite System	
25	GPS	Global Positioning System	
26	GRS	Geodetic Reference System 1980	One of the reference ellipsoids constituting the World Geodetic System
27	HDD	Hard Disk Drive	
28	IGB	Institut Géographique du Burkina	Geographic Institute of Burkina Faso
29	IMF	International Monetary Fund	
30	INERA	Institute of Agricultural Environment	

31	ITRF	International Terrestrial Reference Frame	
32	INSD	Institute of Demography	
33	ISO	International Organization for Standardization	
34	JICA	Japan International Cooperation Agency	
35	JBcarte	Japan, Burkina Faso Mapping Project	
36	KML	Keyhole Markup Language	A file format developed to display geographic data on Google-based browsers: It is supported not only by Google-based browsers but also by various GIS applications.
37	KMZ	Keyhole Markup Zip	A zipped KML text file format
38	LGO	Leica Geo Office	Software to analyze GPS observation results
39	LPS	Leica Photogrammetric Suits	Software for photogrammetric data extraction from images
40	MCA	Millennium Challenge Account	
41	MMS	Mobile Mapping System	
42	NMO	National Mapping Organization	
43	NSDI	National Spatial Data Infrastructure	
44	OJT	On the Job Training	Acquisition of technologies and knowledge from practical working experience
45	PDF	Portable Document Format	A file format for electronic documents developed by Adobe Systems
46	PDOP	Position Dilution of Precision	Indicator for appropriateness of geometry of satellite positions
47	PRISM	Panchromatic Remote-sensing Instrument for Stereo Mapping	Optical sensor using the visible wavelength bands of ALOS capable of observing the ground surface with 2.5 m spatial resolution
48	RPC	Rational Polynomial Coefficients	Coefficients of rational polynomials describing relationship between satellite images and topography
49	SHP	Shape File	A data file format supported by GIS
50	SONABEL	National Electricity Company of Burkina Faso	Société Nationale Burkinabé d'Electricité
51	UEMOA	Union économique et monétaire ouest-africaine	West African Economic and Monetary Union
52	UPS	Uninterruptable Power Supply	
53	UTM	Universal Transverse Mercator	
54	WFP	World Food Program	
55	WGS84	World Geodetic System 1984	One of the reference ellipsoids constituting the World Geodetic System

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ANNEXES

Chapter 1 Outline of Study

1.1 Background of Study

Burkina Faso, an inland country in Western Africa, became independent from France in 1960 and celebrated its 50th anniversary of independence in 2010. Despite its steady economic growth with an average GDP growth rate of 5.5% between 1995 and 2008, the GDP per capita is still as low as 536 dollars (2010) with poverty being more serious in rural areas. Under such circumstances, Burkina Faso established a new national development plan, SCADD: Strategy for Accelerated Growth and Sustainable Development (Stratégie de Croissance Accélérée de Développement Durable): 2011 – 2015, and is pursuing agricultural development, education, and resources development according to the basic policy of “poverty reduction through economic growth.”

In this operation, the National Base Map serves as basic information for national development closely related to important issues such as development planning and border demarcation, and is therefore handled as important data for planning of mining development, environment, agriculture, stockbreeding, etc. In particular, the National Base Map is highly important for the northern area aiming at systematic and strategic planning from the viewpoint of development of mineral resources such as manganese and gold, promotion of stockbreeding, and preservation of environment. Therefore, development of topographic maps in Burkina Faso is considered to be a priority area.

The development of the 1/50,000 National Base Map of Burkina Faso has been promoted by the Geographic Institute of Burkina Faso (Institut Géographique du Burkina: IGB) on its own with national budget and other funds using the outcome of the technology transfer conducted in the development study, “Study for National Topographic Mapping of Southwestern Area in Burkina Faso,” implemented by JICA with IGB as the counterpart organization from 1998 to 2000. However, only 36% of all the 1/50,000 topographic maps have been created up to the present, and their preparation is being delayed due to the financial circumstances of Burkina Faso. In the northern area, the delay of map development is having a negative impact on the development of mineral resources, water resources, etc.

IGB has acquired basic technology for digital topographic mapping and is creating topographic maps. However, it still has technical problems in some processes such as plotting and compilation. Thus, there are also problems in the substantial production system because, for one, the creation and updating of topographic maps incurs cost and time due to use of aerial photographs in topographic mapping. This is part of the cause of the delay in development of the National Base Map. Recently, however, the introduction of technology for medium-scale topographic mapping using satellite images has enabled quick and inexpensive creation of digital topographic maps of a required area. Therefore, it has been confirmed that the construction of a system for mass production through the acquisition of this technology is an important support for Burkina Faso for the sake of the development of the

National Base Map and consequently the promotion of national land development.

Against the above background, the Study Team for detailed planning was dispatched in October 2011. The Study Team discussed with the Government of Burkina Faso on digital topographic mapping of the northern area of the country and the technology transfer, and signed a Record of Discussion (R/D) for this project.

1.2 Geographic Institute of Burkina Faso (Institut Géographique du Burkina)

1.2.1 Organizational Structure and Personnel

The Geographic Institute of Burkina Faso (Institut Géographique du Burkina, hereinafter referred to as IGB) was established in 1976 as a department of the Ministry of Public Works. In accordance with the government ordinance issued in 1987, it became an administrative public institution which was to be operated with revenue from its services.

The organizational structure of IGB is as follows:

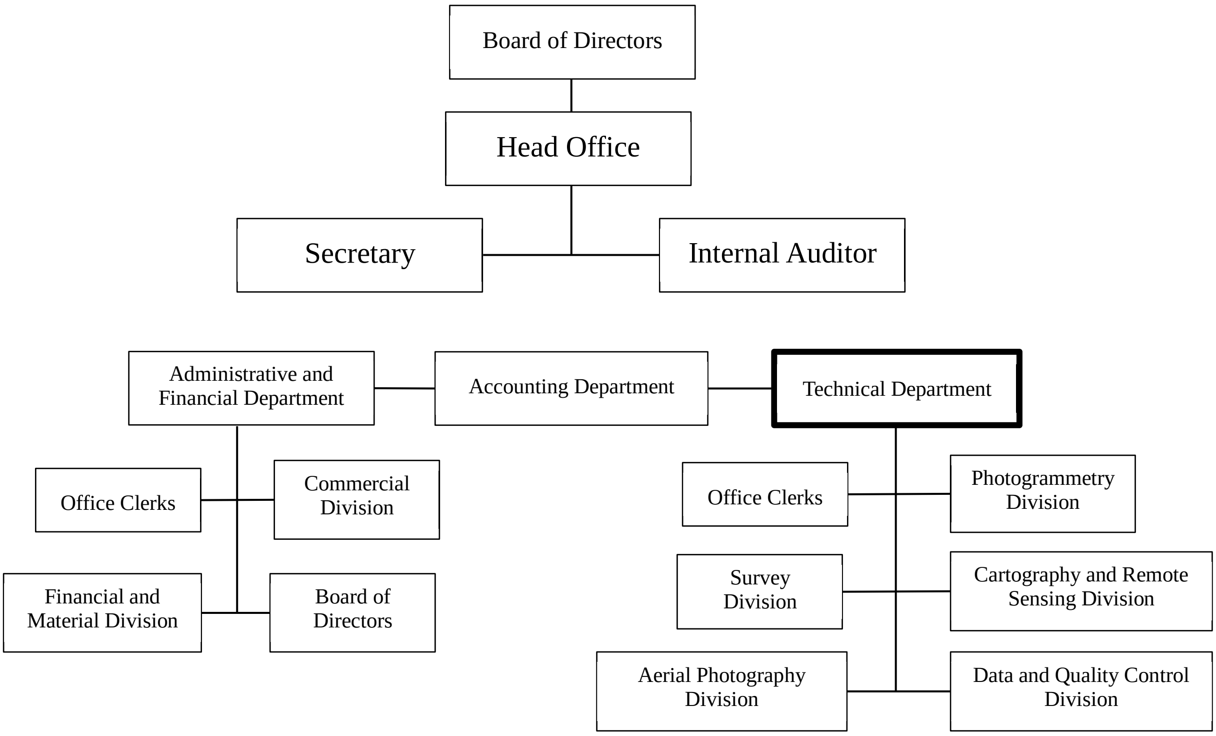

Figure 1-1 Organizational structure of IGB

At present, IGB has 67 staff members and 38 of them (including Mr. Tapsoba, the Director General, Mr. Belem, the Director of the Technical Department, Mr. Compaore, JICA Project Manager and EU Project Manager are technicians.

The staff list obtained by the Study Team describes the number of the staff members and responsibilities assigned to each division in the Technical Department as follows:

- Photogrammetry Division 5: aerial triangulation, plotting and field identification
- Survey Division 7: ground control point survey, leveling and field identification
- Cartography and Remote Sensing Division 14: compilation, GIS and remote sensing
- Aerial Photography Division 4: aerial photography and photo processing
- Data and Quality Control Division 4: data and quality control of survey data

1.2.2 Financial Affairs and Budget

The government ordinance of 1987 stipulates that IGB should be operated with the revenue from its services. However, in practice, it had been operated with subsidies for service provision and purchase of equipment provided by the government in accordance with an agreement between the government and IGB.

While 50% and 30% of the amount stipulated in the said agreement were allocated by the government to IGB in 2008 and 2009, respectively, the government did not provide subsidies to IGB in 2010 and 2011.

Table 1-1 shows the budgets and settlement of accounts for the five-year period from 2007 derived from the data provided by IGB. The amounts of the budget were between 2 and 3.5 billion FCFA in the period between 2007 and 2009. The effect of the termination of subsidies from the government is clearly seen in the reduction of the budget to 1.3 and 0.6 billion FCFA in 2010 and 2011, respectively. The similar trend is also seen on the settlement-based figures.

In the period between 2007 and 2010, the personnel cost (120 – 140 million FCFA) and office supplies, fuel and light expenses and purchase of equipment such as an aircraft (0.8 – 2.8 billion FCFA, with the exception of 2007) accounted for a large proportion of the expenditure in the settled accounts. This is because the government provided subsidies to IGB in the period between 2007 and 2009 and IGB used them for renewal of survey and mapping equipment, *e.g.* purchase of an aircraft for photography in 2008 and GNSS survey equipment in 2009.

This upgrading of equipment was to increase sales of map products and revenue from commissioned work. In fact, revenue from the sales and commissioned work were to account for most of the revenue in the budget of IGB for 2011. Against this background, the EU project (a project to create 1/200,000 maps of the entire Burkina Faso) was launched in July 2011. This project is scheduled to complete in July 2014. JICA launched a full-scale study in 2012 with the scheduled completion date of March 2014.

Table 1-1 Financial situation of IGB – Budget from 2007 to 2012

(Unit: FCFA)

	Item	2007	2008	2009	2010	2011	2012
Revenue		2,618,950,000	3,515,706,444	1,788,793,282	1,340,194,080	639,624,016	989,527,204
	Sales, commission	563,950,000	401,110,000	519,550,000	472,000,000	597,000,000	575,500,000
	Subsidies	2,000,000,000	3,000,000,000	945,000,000	0	0	50,000,000
	Miscellaneous	55,000,000	114,596,444	324,243,282	868,194,080	42,624,016	364,027,204
Expenditure		2,618,950,000	3,515,706,444	1,788,793,282	1,340,194,080	639,624,016	989,527,204
	Personnel cost	160,000,000	149,600,000	171,200,000	155,200,000	166,400,000	198,300,000
	Supplies, stocks, utilities cost	112,500,000	100,000,000	132,000,000	135,454,013	137,200,000	141,500,000
	Cost relating to services (maintenance, insurance, PR, telephone, bank, etc.)	88,350,000	77,850,000	130,700,000	162,731,284	200,000,000	236,000,000
	Goods, equipment, software, vehicles, aircraft, etc.	2,085,000,000	3,122,056,444	1,285,293,282	823,971,058	60,124,016	327,512,816
	Miscellaneous	173,100,000	66,200,000	63,600,000	62,837,725	75,900,000	86,214,388

Table 1-2 Financial situation of IGB – Settlement from 2007 to 2012

(Unit: FCFA)

	Item	2007	2008	2009	2010	2011	2012
Revenue		2,366,609,961	3,283,312,432	1,352,531,912	1,100,816,591	364,294,994	1,024,880,749
	Sales, commission	341,392,186	250,436,570	282,300,590	232,792,455	309,148,292	598,671,236
	Subsidies	2,000,000,000	2,981,479,418	792,037,215	0	0	75,319,220
	Miscellaneous	25,217,775	51,396,444	278,194,107	868,024,136	55,146,702	350,890,293
Expenditure		321,426,039	3,009,643,294	1,318,861,989	1,042,721,784	289,885,813	513,977,763
	Personnel cost	137,278,151	127,127,869	134,206,047	119,176,836	141,022,213	151,338,514
	Supplies, stocks, utilities cost	75,276,622	63,180,433	101,505,691	73,175,855	84,033,128	1,024,880,749
	Cost relating to services (maintenance, insurance, PR, telephone, bank, etc.)	24,106,071	42,978,333	24,506,072	47,303,531	46,553,802	598,671,236
	Goods, equipment, software, vehicles, aircraft, etc.	1,658,400	2,752,449,534	1,041,349,174	785,569,890	135,700	75,319,220
	Miscellaneous	83,106,795	23,907,125	17,295,005	17,495,672	18,140,970	350,890,293

1.3 Purposes of Study

This Study had the following two purposes:

(1) Creating 1/50,000 digital topographic maps of the northern area of Burkina Faso (about 23,000 km^2) and the area surrounding Ouagadougou (about 3,000 km^2) using satellite images

(2) Conducting OJT-based technology transfer to IGB in the process of creating topographic maps to contribute to enhancing their topographic mapping capability

1.4 Study Area and Satellite Image Scenes

1.4.1 Study Area

This study project covers a total area of 26,000 km^2, in which study is conducted on the northern area of Burkina Faso (about 23,000 km^2) and OJT-based technology transfer is conducted on the capital city Ouagadougou district (about 3,000 km^2). To enable learning of topographic mapping technology to be applied to various land-uses, the study was scheduled to be conducted as OJT on the two map sheets in the area surrounding Ouagadougou, characterized by urban landscapes, and the two map sheets in the northern area, characterized by natural landscapes, out of the 36 map sheets in total. Figure 1-2 shows the study area.

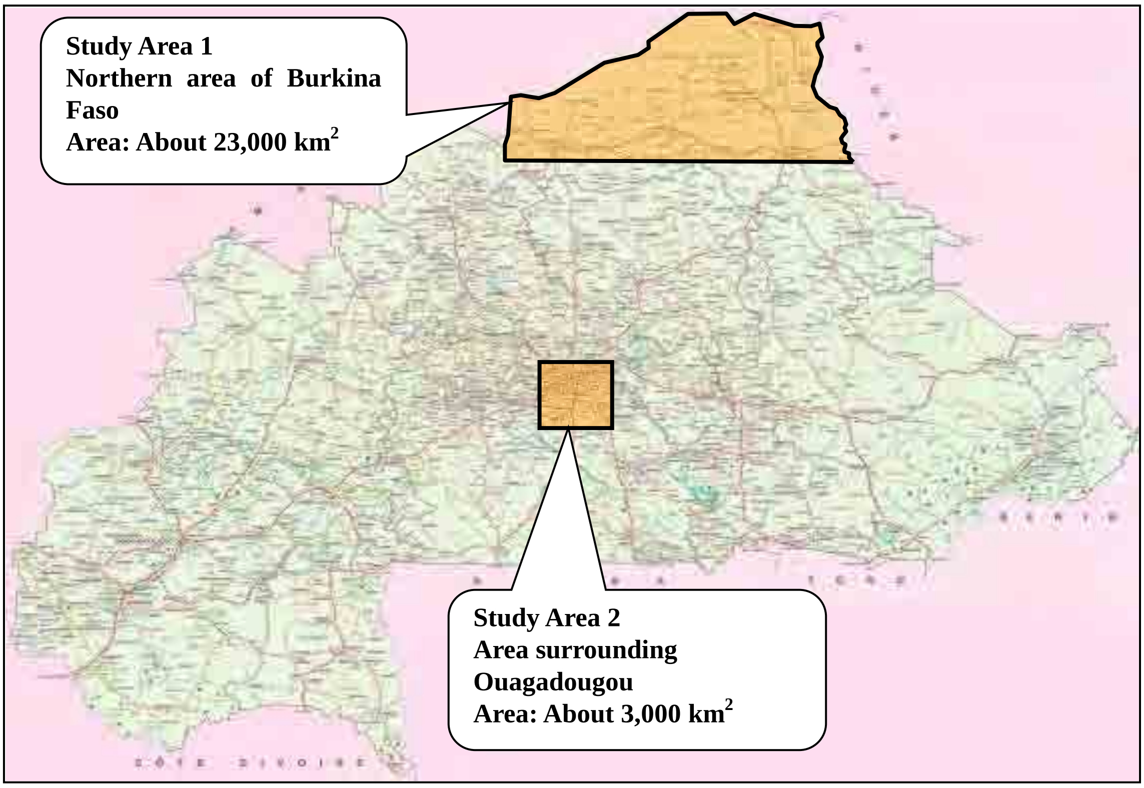

Figure 1-2 Study area positions and area covered in supplied satellite images

1.4.2 Satellite Image Scenes

As shown in the figures below, pan-sharpened ALOS/PRISM satellite image scenes of two areas, North and Ouagadougou blocks, were used in the creation of topographic maps. Thirty nine satellite image scenes were used to create topographic maps of North block and Ouagadougou block, respectively. All the used images were those which could be used for stereoscopy and required topographic map data including horizontal locations and elevations were obtained from three-dimensional (3D) spatial models.

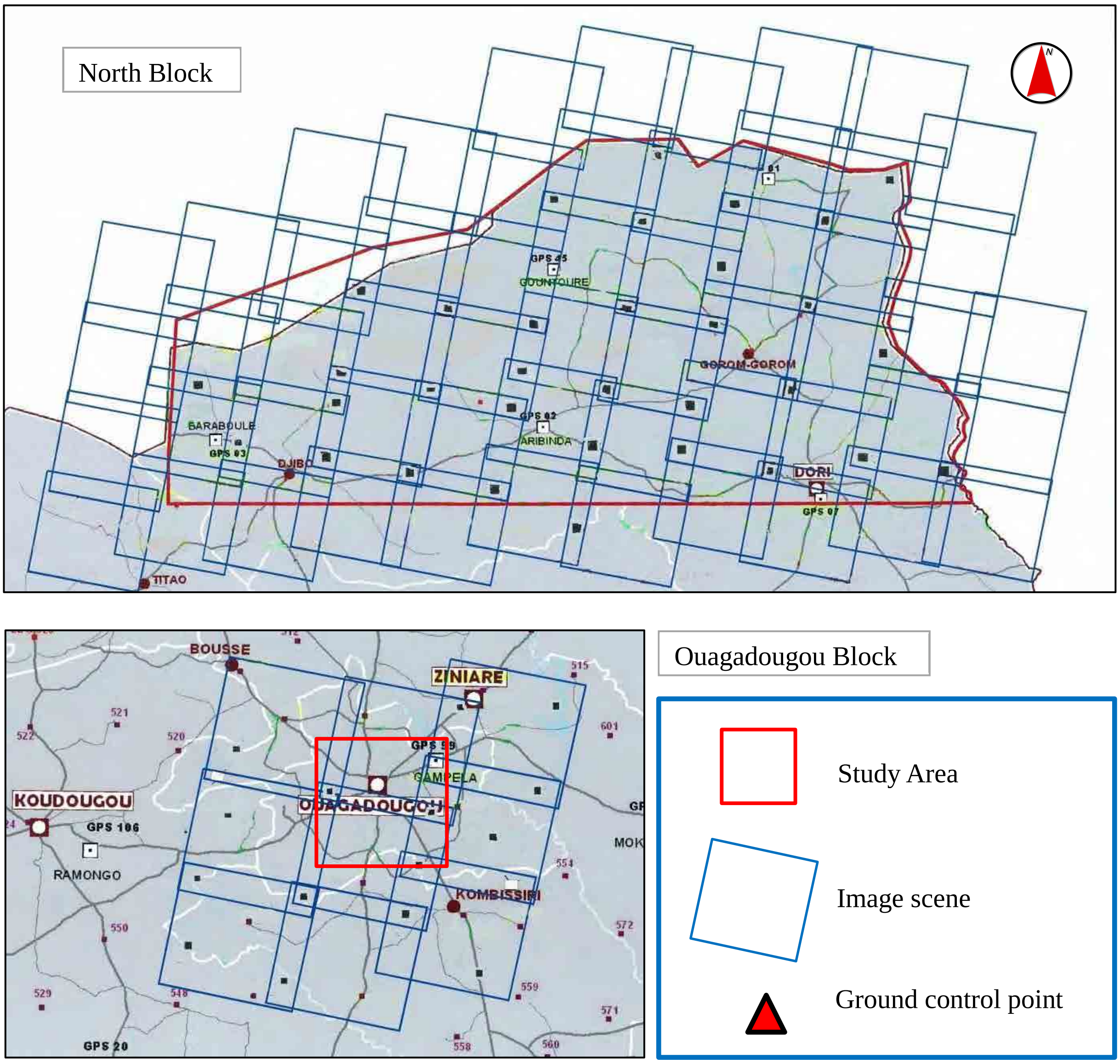

Figure 1-3 Ground control point arrangement scheme and scene layout

1.5 Basic Project Policies

1.5.1 Basic Technical Policies

Based on the background and purposes of this study, particular technical considerations are required for the following items.

Basic technical policy 1: Technology transfer focused on quality management

The counterpart organization IGB created medium-scale maps on its own based on the technology transfer conducted by JICA in 1998 to 2000. Additionally, it has abundant experience in control point survey covering also ground control points and field identification such as updating of 1/200,000 topographic maps by MCA and EU, already having a certain technical capability level. However, our verification found that IGB has acquired basic-level plotting and compilation technology but does not yet have sufficient skills, which needs improvement. Our verification results, the details of which are described in the preliminary study report, are summarized below.

- Representations in topographic maps
    - Very difficult to read because contour lines are not edited.
    - Planimetric features on lines (power lines) are not connected.
    - Roads, motorable tracks, etc., are not connected to anywhere.
- GIS data construction
    - Power lines are not connected.
    - Roads are not linked sufficiently.

The Geographic Institute of Burkina Faso (Institut Géographique du Burkina: IGB), an organization in charge of survey and mapping, has established the mapping technology using aerial photographs as a result of technology transfer conducted in the last JICA project but has no experience in creating medium-scale topographic maps using satellite images, which came into wide use recently. Therefore, the latter technology is also transferred.

The goal of this technology transfer was to be able to create topographic maps according to the standard specifications created in this study after the completion of the survey and work on creating and updating topographic maps in an advanced way such as implementation of accuracy control to understand the check and correction methods in the processes. In the OJT-based technology transfer to be conducted, IGB made approximately one map sheet in total, for the northern area and will continue to conduct to create topographic mapping of two for the area surrounding Ouagadougou and one for northern area based on the transferred technology.

The following describes the basic policies of the technology transfer based on the preliminary study results and our own study results. The technology transfer was conducted based on the understanding of the status quo of IGB.

(1) Challenges encountered by IGB

IGB has to overcome the following challenges:

- Insufficient quality of medium-scale 1/50,000 topographic maps currently created by IGB, although it can create these maps so on its own
- Lack of awareness for accuracy control, as sometimes observed in other countries
- Shortage of technicians and survey equipment
- Old age of technicians (recruiting new technicians now)

(2) Advantages of IGB

IGB has the following advantages:

- After JICA transferred the technology for creating medium-scale 1/50,000 topographic maps, IGB created topographic maps on its own, achieving some positive results. Therefore, it has the basic technical capabilities for topographic mapping.
- IGB owns a certain amount of equipment due to a 1/200,000 topographic map update project implemented by the government and EU.
- IGB, having experience in using topographic mapping software, has no problem in using new software.
- IGB, owning an aerial photography aircraft, seems to understand sufficiently the overall workflow of topographic mapping, starting from shooting using photogrammetry technology.

(3) Technology transfer to IGB

Based on the above circumstances and the consideration that a sufficient period of time could not be secured for the technology transfer, the basic policies were as follows:

- In view of the small number of technicians, person-to-person technology transfer was conducted wherever possible, and the improvement of outcome was pursued.
- In view of the old age of technicians and the past implementation of JICA's topographic mapping project, it was assumed that there were technicians who experienced the past project in IGB. With these technicians assigned as leaders, the technology transfer was conducted with an eye to secondary technology transfer.

Basic technical policy 2: Survey criteria

In this study, the specifications with the recipient country were discussed after the project start and the survey work was decided to implement based on the following survey criteria:

- Map projection.................................: BFTM (Burkina Faso Transverse Mercator)
- Geographic coordinate system........ : ITRF2008/Adidan
- Reference ellipsoid.......................... : GRS80
- Reference elevation..........................: Dakar port mean sea level/existing benchmarks

- Annotation.......................................: The following annotation was provided in data files and on marginal information:

This digital map was prepared jointly by Japan International Cooperation Agency (JICA) under the Japanese Government Technical Cooperation Program and the Government of Burkina Faso.

Basic technology policy 3: Compliance with Overseas Mapping (National Base Map) Standard Specifications

The work related to creation of digital topographic maps in this study complied with the Overseas Mapping (National Base Map) Standard Specifications.

Burkina Faso has the “Burkina Faso Format Rules” compliant with the “African Standard Format Rules.” Furthermore, 1/50,000 topographic maps were created in 2001 in compliance with the “Burkina Faso Format Rules.” However, the “Burkina Faso Format Rules” were created in a period when digital topographic mapping was not yet in the mainstream. Therefore, after consultation with IGB, it has been decided to edit the operation manual to be compliant with creation of digital topographic maps, which is in the mainstream at present, and new operation manuals and format rules will be proposed to ensure efficient progress of the project.

Basic technical policy 4: Collaboration with EU project

When the project started, EU was implementing a project for creating 1/200,000 topographic maps in collaboration with IGB as the implementing agency. Since the field GNSS verification was already completed at the time of our study, aerial triangulation has been conducted using German satellite image “Rapid Eye” data followed by the start of digital plotting. Our study was conducted in close relationship with the EU project by sharing information such as acquired and created data.

Basic technical policy 5: System for sustainable human resources development

As with agencies of other developing countries, IGB is faced with aging of its technicians. Therefore, technology transfer should be focused on preparation of work manuals (work procedures in various processes), operation manuals, etc., to ensure that technicians can continue the work under any circumstances, rather than to train young technicians. This policy is expected to create the environment in which the trained staff members can conduct technology transfer to other staff members.

Basic technical policy 6: Public relations and promotion of utilization

The utilization of outputs was promoted by holding workshops and seminars, etc. Furthermore, the counterpart was encouraged to plan and implement holding workshops and seminars on its own to promote sustainability. The project inspected organizations that are likely to use topographic maps and GIS data such as government organizations of Burkina Faso and donor organizations of other countries and implement operations to promote understanding of data utilization.

Basic technical policy 7: Promotion of wide-area collaboration for topographic mapping technology

Since Burkina Faso is a leading country in medium-scale topographic mapping technology in the West Africa area, a technical seminar was held to share information about technical progress with participants invited from surrounding countries, in addition to a technology transfer seminar. This seminar was held in collaboration with the West African Economic and Monetary Union (Union Economique et Monétaire Ouest Africaine: UEMOA) to introduce the technologies used in this study to contribute to providing support for topographic map development in the West Africa region.

1.5.2 Basic Management Policies

Based on the background and purposes of this study, particular management considerations were required for the following items.

Basic management policy 1: General

As a basic policy for implementing this study, the Terms of Reference (TOR) provided by JICA was observed. Furthermore, this study was to be implemented on the premise that all the members of the Study Team should share sufficient understanding and recognition of the technical cooperation by the Government of Japan and, to ensure this premise, had communications with each other on a planned basis.

Basic management policy 2: Safety measures

The study was implemented based on safety measures specified by JICA. In view of the instability of security, the system for implementing study such as the study schedule and the assignment of Japanese experts was determined according to the latest local circumstances as of each phase. In principle, none of the Study Team members entered the northern area of Burkina Faso.

Basic management policy 3: System for implementing study

In view of the security circumstances, the ground control point survey that needs field identification in the project area and the field identification and verification were conducted in the northern area by IGB itself using the technology transferred in advance in the Ouagadougou district because IGB already has a certain level of technology as described earlier. Therefore, the Study Team supervised and managed the field identification in the northern area only. The details are described in Chapter 3.2

(22), “Technology Transfer Operation.”

Basic management policy 4: Selection of engineers

This study has the purposes of (1) Creating a geospatial information database and (2) Promoting utilization of digital data and maps and effective utilization and popularization of GIS as well as the study and technology transfer in this field. Therefore, the study was implemented with certainty by technicians who have as much overseas experience as possible and excellent skills for creating geographic data as well as technicians who are familiar with and have skills and experience in utilization of digital data and maps and effective utilization and popularization of GIS.

Basic management policy 5: Holding of technology transfer seminar

At the beginning of this project, a project kick-off seminar was held to announce the overview of the project and promote the utilization of data to be created.
At the end of this project, a technology transfer seminar was held to announce the outcomes of the technology transfer and promote popularization and utilization of the GIS database to be created. The Study Team assisted IGB to take the initiative in managing these seminars on its own with the purpose of technology transfer regarding the digital data disclosure method, etc. The details of the technology transfer seminar are described in Chapter 3.2 (22), “Technology Transfer Operation.”

Basic management policy 6: Safety management

The study area is where yellow fever is common. Although the overseas travel information says that a vaccination is “recommended,” the Study Team members needed get a vaccination before visiting this country according to the instruction provided by the local embassy. They had to carry specialized medicine all the time and took it immediately when they feel sick to prevent getting seriously ill. When the Study Team members entered the northern project area for the sake of supervising operations, they had to maintain close contact with the JICA Burkina Faso Office and the military police office in the northern area and ask the military police for an escort depending on the circumstances.

1.6 Composition of Study Team

The composition of the Study Team and their main work are as shown in the following Table 1-3.

Table 1-3 Composition of the Study Team and their main work

Name	Responsibility	No.	Work content
Mr. Takashi HARADA	Team leader	(1)	Collection, sorting and analysis of relevant documents and information
		(2)	Preparation of Inception Report
		(3)	Explanation and discussion of Inception Report
		(4)	Discussions on specifications
		(5)	Collection and sorting existing materials
		(6)	Obtaining satellite images
		(7)	Aerial photography
		(8)	Ground control point survey
		(9)	Aerial triangulation
		(10)	Field identification and field verification
		(11)	Digital plotting and compilation
		(12)	Preparation of Interim Report
		(13)	Explanation and discussion of Interim Report
		(14)	Map symbolization of topographic maps
		(15)	Digital data structurization
		(16)	Creation of data files
		(17)	Preparation of output maps
		(18)	Promotion of utilization
		(19)	Holding technical seminar for wide-area collaboration
		(20)	Preparation and discussion of Draft Final Report
		(21)	Preparation of Final Report
		(22)	Operation associated with technology transfer
			Creation of orthophotos
Mr. Takao IKEDA	Discussions on specifications	(1)	Collection, sorting and analysis of relevant documents and information
		(2)	Preparation of Inception Report
		(3)	Explanation and discussion of Inception Report
			Creation of map symbol specifications (draft)
			Creation of marginal information plate (draft)
		(4)	Discussions on specifications
Mr. Masaji KOYAMA	Ground control point survey 1	(2)	Preparation of Inception Report
		(5)	Collection and sorting existing materials
		(8)	Ground control point survey
		(12)	Preparation of Interim Report
		(20)	Preparation of Draft Final Report
		(22)	Technology transfer (1 Ground control point survey, 9 Quality management)
Mr. Masaaki ECHIZEN	Ground control point survey 2	(8)	Ground control point survey
		(12)	Preparation of Interim Report
		(20)	Preparation of Draft Final Report

		(22)	Technology transfer (① Ground control point survey, ⑨ Quality management)
Mr. Takao IKEDA	Aerial triangulation	(2)	Preparation of Inception Report
		(9)	Aerial triangulation
		(11)	Preparation of Interim Report
		(19)	Preparation of Draft Final Report
		(22)	Technology transfer (b. Aerial triangulation)
Mr. Yoshihide OMURA	Field identification, field verification	(2)	Preparation of Inception Report
		(10)	Field identification (plotting / ground photographs to assist compilation, operation of handled GPS receiver) / field verification
		(12)	Preparation of Interim Report
		(20)	Preparation of Draft Final Report
		(22)	Technology transfer (c. Field identification/field verification)
Mr. Takao IKEDA	Digital plotting	(2)	Preparation of Inception Report
		(11)	Digital plotting
		(12)	Preparation of Interim Report
		(20)	Preparation of Draft Final Report
		(22)	Technology transfer (d. Digital plotting, partial correction)
Mr. Jun HOSHINO	Digital compilation	(2)	Preparation of Inception Report
		(11)	Digital compilation
		(12)	Preparation of Interim Report
		(16)	Creation of data files
		(20)	Preparation of Draft Final Report
		(22)	Technology transfer (d. Digital compilation, ⑨ Quality management, ⑩ Partial correction)
Mr. Takeshi MIYATA	Map symbolization	(2)	Preparation of Inception Report
		(14)	Map symbolization
		(16)	Creation of data files
		(20)	Preparation of Draft Final Report
		(22)	Technology transfer (f. Map symbolization)
Ms. Junko YAMASHITA	Data structurization	(2)	Preparation of Inception Report
		(15)	Data structurization
		(16)	Creation of data files
		(20)	Preparation of Draft Final Report
		(22)	Technology transfer (e. Data (GIS) structurization)
Mr. Mitsuo IWASE	Utilization plan	(1)	Collection and analysis of existing documents and information
		(2)	Preparation of Inception Report
		(18)	Utilization plan/promotion
		(19)	Holding technical seminar for wide-area collaboration
		(20)	Preparation, explanation and discussion of Draft Final Report

		(21)	Preparation of Final Report
		(22)	Technology transfer (g. Utilization / construction of system of usage, seminar)
Mr. Naoki GOTO	Construction of website		Construction of website
		(20)	Preparation, explanation and discussion of Draft Final Report
		(22)	Technology transfer (Construction of website, Seminar)
Mr. Yuji OUCHI	Operation coordination / Digital plotting assistance	(1)	Collection, sorting and analysis of relevant documents and information
Ms. Naomi TAMURA		(3)	Explanation and discussion of Inception Report
Mr. Takashi TOMURA		(5)	Collection and sorting existing materials
		(6)	Obtaining satellite images
		(12)	Explanation and discussion of Interim Report
		(19)	Holding technical seminar for wide-area collaboration
		(20)	Explanation and discussion of Draft Final Report
		(22)	Technology transfer (Seminar)

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1.7 Personnel Plan

The final personnel plan for implementation of the study is as shown in the following table.

Table 1-4 Personnel plan

Fiscal year	FY 2011	FY 2011	FY2012	FY2012	FY2012	FY2012	FY2012	FY2012	FY2012	FY2012	FY2012	FY2012	FY2012	FY2012	FY2013	FY2013	FY2013	FY2013	FY2013	FY2013	FY2013	FY2013	FY2013	FY2013	FY2013	FY2013	FY2014	FY2014	FY2014	FY2014	FY2014
Month No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Month	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.

	Responsibility	Name	Affiliation	Grade
Work in Burkina Faso	Operation management group Team Leader	Mr. Takashi HARADA	Aero Asahi Corp.	2
	Sub Team Leader	Mr. Takao IKEDA	Aero Asahi Corp.	3
	Discussions on specifications	Mr. Takao IKEDA	Aero Asahi Corp.	4
	Ground control point survey 1	Mr. Masaji KOYAMA	Aero Asahi Corp.	3
	Ground control point survey 2	Mr. Masaaki ECHIZEN	Hokkaido Aero Asahi Corp.	4
	Field identification/verification	Mr. Yoshihide OMURA	Kokusai Kogyo Co., Ltd.	3
	Aerial triangulation	Mr. Takao IKEDA	Aero Asahi Corp.	4
	Digital plotting	Mr. Takao IKEDA	Aero Asahi Corp.	4
	Digital compilation / Digital compilation after field verification	Mr. Jun HOSHINO	Aero Asahi Corp.	5
	Map symbolization	Mr. Takeshi MIYATA	Kokusai Kogyo Co., Ltd.	5
	Data structurization	Ms. Junko YAMASHITA	Aero Asahi Corp.	4
	Utilization plan/promotion	Mr. Mitsuo IWASE	Infrastructure Development Institute-Japan	3
	Construction of website	Mr. Naoki GOTO	Aero Asahi Corp.	4
	Operation coordination/ Digital plotting	Mr. Yuji OUCHI Ms. Naomi TAMURA Mr. Takashi TOMURA	Aero Asahi Corp.	4
	Interpreter	Mr. Noboru OKADA Ms. Akemi NISHIYAMA	Freelance	4
Work in Japan	Operation management group	Mr. Takashi HARADA	Aero Asahi Corp.	2

Schedule notes: Delivery (Aug., month 30); 29 (Dec., month 10, Digital plotting)

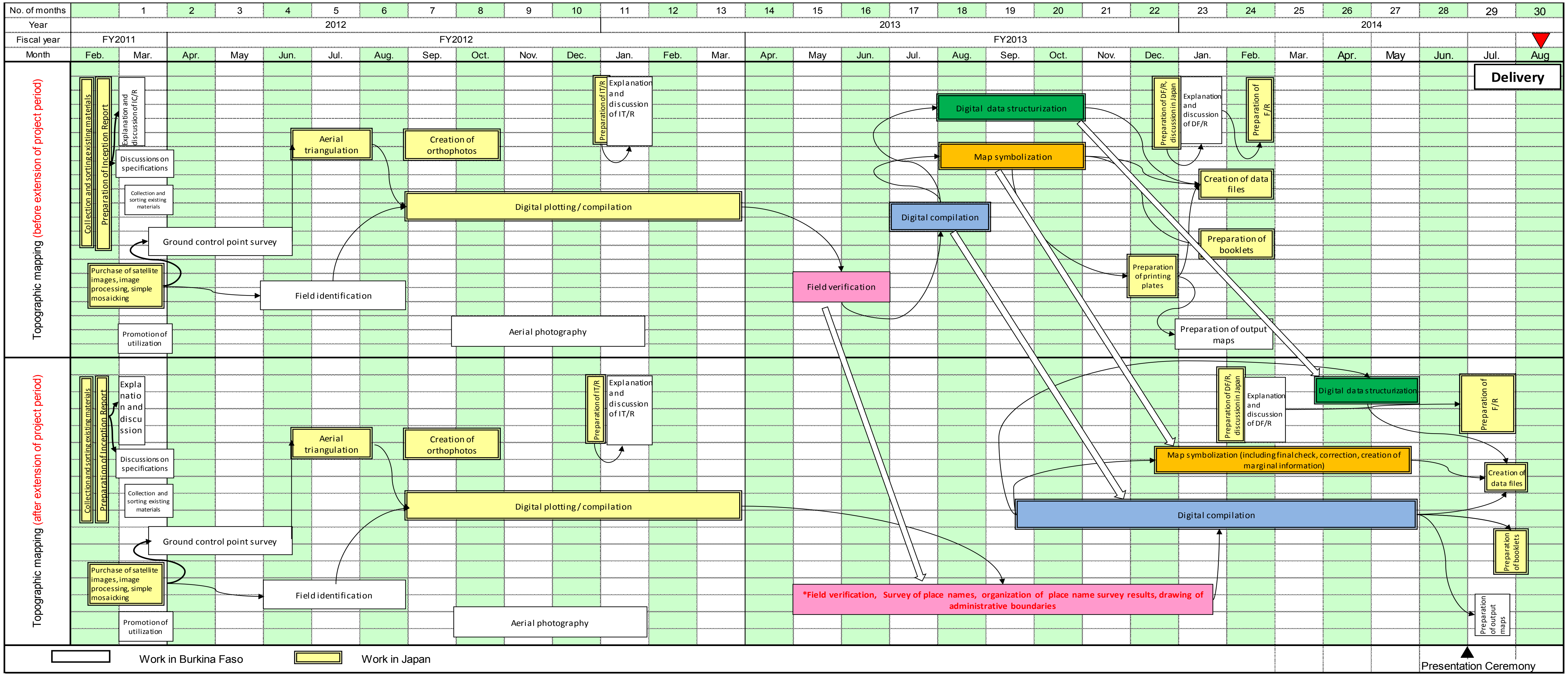
Milestones: ▲ Inception Report; ▲ May 25 Opening Seminar; ▲ Dec. 18-19 Technical Seminar for Wide-Area Collaboration; ▲ Explanation and discussion of Interim Report; ▲ Feb. 13-14 Technical Seminar for Wide-Area Collaboration; ▲ Explanation and discussion of Draft Final Report; ▲ Ceremony of Presentation of Topographic Maps

Legend: ■ Work in Burkina Faso; □ Work in Japan

Chapter 2 Implementation Status of Study Operations

The following table shows the workflow of the operations implemented.

Table 2-1 Operation workflow



2.1 (1) Collection, Sorting and Analysis of Relevant Documents and Information (Work in Japan)

Before the start of field identification, the following operations were implemented in Japan.

- Sorting and analysis of materials collected by the Preliminary Study Team and our company on their own
- Creation of format rules (draft) for discussion on specifications
- Summary of basic policies, work methods, procedures, etc.

Furthermore, additional information that can be acquired in Japan was collected, sorted, and analyzed.

2.2 (4) Discussions on Specifications (Work in Burkina Faso)

At the start of the project, the Inception Report was discussed regarding the specifications of topographic maps to be created, survey criteria, field verification methods, etc. and the result of the discussion was confirmed in the Minutes of Meeting (Annex-1). The basic specifications (such as format rules, map symbols, and annotations) required to create 1/50,000 topographic maps in this study must comply with the specifications conventionally owned by IGB in principle, but the details were determined through discussion with IGB based on the "Overseas Mapping (National Base Map) Standard Specifications". (Annex-2)

The major discussion topics in the discussion on specifications are listed below.

1. Map Symbols
   - Acquisition items were discussed.
   - The Study Team created examples of sizes, forms, colors, etc. of the chosen symbols and the final draft was determined through discussion with IGB.
   - Data such as national borders, administrative boundaries, and control points to be used will be supplied from IGB and will not be edited in principle.

2. Survey Criteria

   The survey criteria were determined as follows:

Datum	: ITRF2008
Reference Ellipsoid	: GRS80
Projection	: BFTM

* BFTM is a map projection that has been extended from UTM projection, which was adopted in a program by MCA.

3. Scope of Mapping
   - Each sheet covered a scope delimited with latitude/longitude lines at 15-minute intervals.
   - When the map area drawn in a sheet is negligible, a neighboring sheet can be extended. Sheets

to be extended were to be determined by IGB.

- The scope of plotting was included an area up to two kilometers beyond the national border. For the area beyond the national border, no field identification but only photo interpretation was conducted.
- On a sheet including an area of a neighboring country, the blank (neighboring country area) was complemented with ortho images.
- The sheet name and sheet numbers were supplied by IGB.

4. Other

- Ortho images have a ground resolution of 2.5 meters.
- The scope of ortho image files was basically identical to the scope of sheets.

2.3 (5) Collection and Sorting Existing Materials (Work in Burkina Faso)

The following existing data that can be utilized in this study, such as the existing topographic maps and survey outcomes, was collected and sorted in Burkina Faso.

- 1/50,000 topographic maps (created by JICA in 2001)
- 1/200,000 topographic maps (created by IGN France)
- African Mapping Standard (owned by IGB)
- “Guidelines for the Creation of Topographic Maps Using ALOS Optical Images to Support GIS Infrastructure Development Activities in the Asia-Pacific Region” (created by Geospatial Information Authority of Japan in 2009), etc.

The collected topographic maps are shown in the table below.

Table 2-2 List of existing topographic maps

Topographic map scale	Mapping rate	Year of mapping	Remarks
1/50,000 topographic maps	36%	1984 –	137 sheets including 32 created by JICA in 2001
1/200,000 topographic maps	100%	1960 –	34 sheets created by France and being partially modified by EU
1/500,000 topographic maps	100%	1966	9 sheets
1/1,000,000 topographic maps	100%	2010	1 sheet

2.4 (6) Purchase of Satellite Images (Work in Japan)

The satellite images acquired for the study area (about 26,000 km^2) were ALOS/PRISM images with a resolution of 2.5 meters, which enable stereoscopic view and were constantly acquired.

In principle, triplet images were acquired in view of the quality of the final outputs, and the images used for the processes are as follows:

- Digital plotting was performed using stereo pairs of forward views and backward views with good height accuracies.
- As orthophotos, nadir views were used because buildings and other structures look less tilted in them.
- Aerial triangulation was performed using all of the triplet images.
- Since the ALOS/PRISM images are panchromatic images, color images for the same range (ALOS/AVNIR-2 images) are also acquired to improve the interpretation accuracy in digital plotting and create color orthophoto data (only in the area for which topographic maps are to be created).

2.5 (7) Aerial Photography (Work in Burkina Faso)

In the urban planning and development area of about 1000 km^2 in the Ouaga 2000 district in Ouagadougou and its surrounding area, aerial photography was conducted using the following specifications:

- Date of photography : September 13, 2012
- Photography aircraft : King Air B200
- Photo scale : About 1/20,000
- Camera : RC30
- Lens : WILD 15/4 UAD-S
- Focal length : 153.51 mm
- Flight altitude : About 3000 m
- Film : AGFA AVIPHOT PAN, Panchromatic film 24 cm x 76 m Gevar Polyester
- Number of courses : 9 courses
- Area photographed : About 1,000 km^2
- Number of photographs :

L-1	26
L-2	26
L-3	26
L-4	29
L-5	26
L-6	26
L-7	25
L-8	27
L-9	27
Total	238 photographs

For the taken photos, films were developed promptly in the IGB darkroom, contact prints were made, and the quality control operation was conducted. The results were as follows:

- Overlap : 55% or more
- Sidelap : 30%±5%

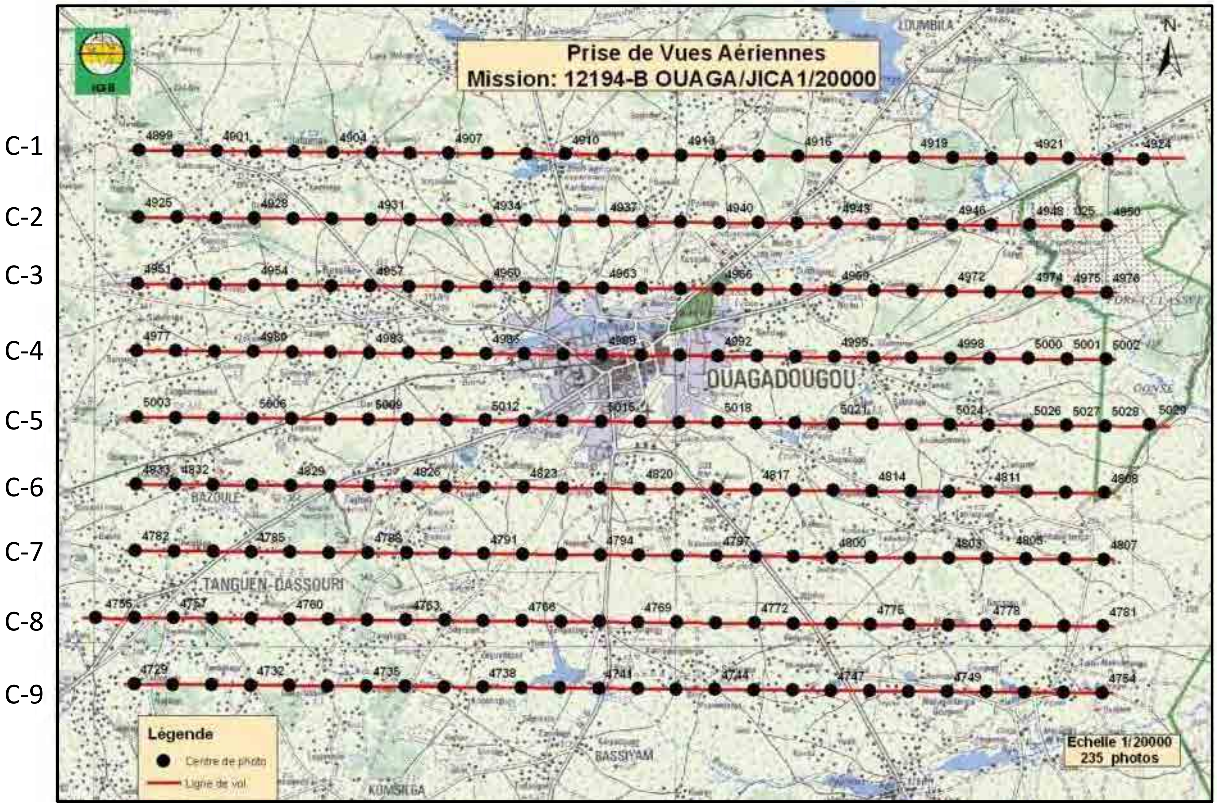


Figure 2-1 Index map for aerial photography

2.6 (8) Ground Control Point Survey (Work in Burkina Faso)

A GNSS-based ground control point survey was conducted as described below.

[Point Selection Plan]

Before planning and implementing the ground control point survey, the Study Team selected the approximate positions of ground control points by making effective use of Google Earth images, 1/50,000 and 1/200,000 topographic maps, and description of existing control points.

After overlaying the obtained satellite images, 1/50,000 topographic maps, and map sheet divisions on the Google Earth images, 59 ground control points were selected (44 in the Dori-Djibo district and 15 in the Ouaga district) with positions that can be identified from the Google Earth and ALOS images. The selected points were located at positions that facilitate pricking on ALOS images (*e.g.*, corners of buildings, crossings of roads, or isolated trees). Furthermore, the approximate location information of the selected ground control points was obtained from Google Earth taking into consideration facilitating the path search at the time of GNSS field observation.

[Observation Plan]

According to the Overseas Mapping Standard Specifications, an observation plan was established using three GNSS-2 frequency receivers, one level, and four vehicles. Known points were selected in view of distances from new points, access conditions, etc.

The plan specifies that the elevation values of ground control points will be checked by direct leveling from the benchmarks.

To establish the GNSS observation plan, safe and efficient observation procedures were examined based on the positions of known points and ground control points, road conditions, weather status, etc., and a session plan was established via the static method. In the observation plan, the adopted observation method is to obtain the position of a new ground control point using two neighboring existing control points as known points. This method is intended to shorten the time required for access, improve the observation efficiency, and simplify the analysis calculation processing.

[Check of Equipment before Use]

A functional check of equipment to be used for observation was conducted before observation.

Table 2-3 Result of functional check of equipment

Name	Compliant?	Remarks
GNSS receiver	Yes	Trimble R6 : 4 units
GNSS antenna extension pole	Yes	Made in Japan : 2 sets
Tripod	Yes	
Electronic level	Yes	Trimble DiNi : 2 sets
Comparison with GNSS existing baseline length	Yes	

[Technical Consultation with IGB (Survey Criteria, Existing Control Points, Structure of Observation Groups)]

The Study Team discussed with IGB and confirmed that the survey should be conducted using the following survey criteria:

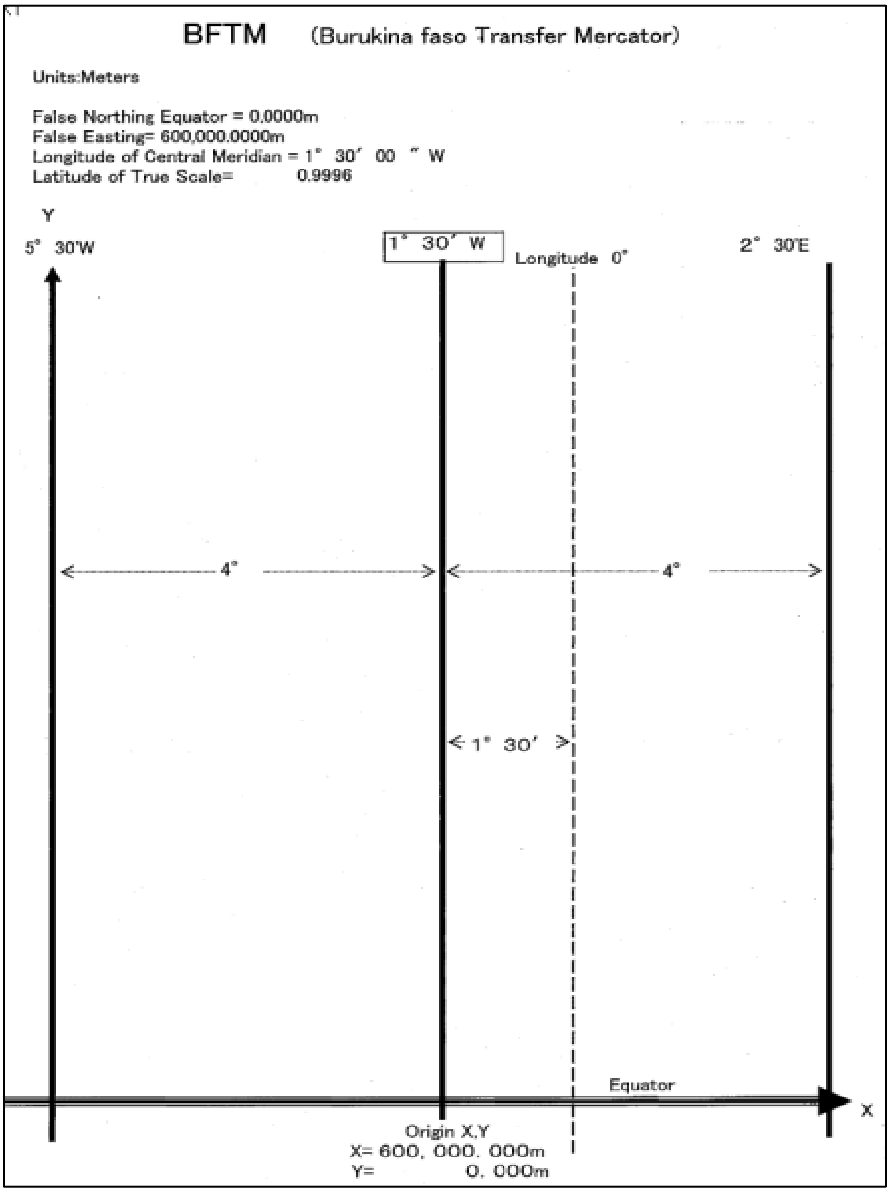


Figure 2-2 BFTM orthogonal coordinate system

Table 2-4 Survey criteria

Geographic coordinate system	ITRF2008
Map projection	BFTM (Extended 30 Zone=BFTM)
Reference ellipsoid	GRS 80
Elevation	Dakar port mean sea level/existing benchmarks

- Existing control points

The existing control points (planimetric and altitude) shown in the “Description of Points” data for First and Second order control points established in 1990 and later received from IGB are the criteria to be used for ground control point surveys.

The existing benchmarks that can be used as the altitude criteria were established in the leveling conducted by IGB recently. As for the elevations, the reference elevations determined by France in the 1950s are used as the basis.

As for the elevations in the Dori-Djibo district, the Grades 1 and 2 benchmarks are used as existing control points. In the Ouaga district, the benchmarks established in 2010 are used as existing control points.

- The observation groups consist of members shown below according to a proposal made by IGB.

Table 2-5 Members of study groups

Group name	IGB	Study Team (Quality and accuracy control)	Remarks
A	Mr. CULIBALY Roland	Mr. KOYAMA and ECHIZEN	・ Mainly Groups A and B conduct ground control point observation. ・ Group D also conducts leveling.
B	Mr. SOMANDE Bassogban		
C	Mr. COMPAORE Soidou		
D	Mr. OUEDRAGO Bousia		

[GNSS Receivers and Analysis Software and Setting of Observation Specifications]

The GNSS receiver to be used was TrimbleR6 already owned by IGB. The analysis software to be used is Leica Geo Office 8.0 (hereafter LGO) supplied in this project.

Before observation using the GNSS receiver, the observation conditions needed to be set on the controller, and the following major observation specifications were used as the initial settings.

- Minimum observation elevation angle : 15 degrees
- Observation data acquisition interval : 15 seconds
- Types of satellite frequencies to be acquired : GPS L1 and L2 and GLONASS

Before GNSS observation, the distance between the existing control points established by IGB (from GPS99 to 2517) were measured and it was checked that the measurement result met the required accuracy.

[GNSS Observation]

Simultaneous GNSS observation was conducted at two existing control points as known points and one new ground control point. The standard observation duration was set as one hour or longer, and the observation timing was coordinated and determined by the four observation groups which contacted each other.

In the Ouagadougou district (15 points), the GNSS observation was conducted at two points per day as planned.

On the other hand, in the northern Dori-Djibo district (44 points) (Figure 2-3), the observation period coincided with the beginning of the rainy season so that the road conditions deteriorated due to sand storms and heavy rain. Furthermore, flat tires were often encountered due to “thorns” of bushes, and off-road tires were installed as replacements. Therefore, observation was conducted at about 1.5 points per day, including resurveys.

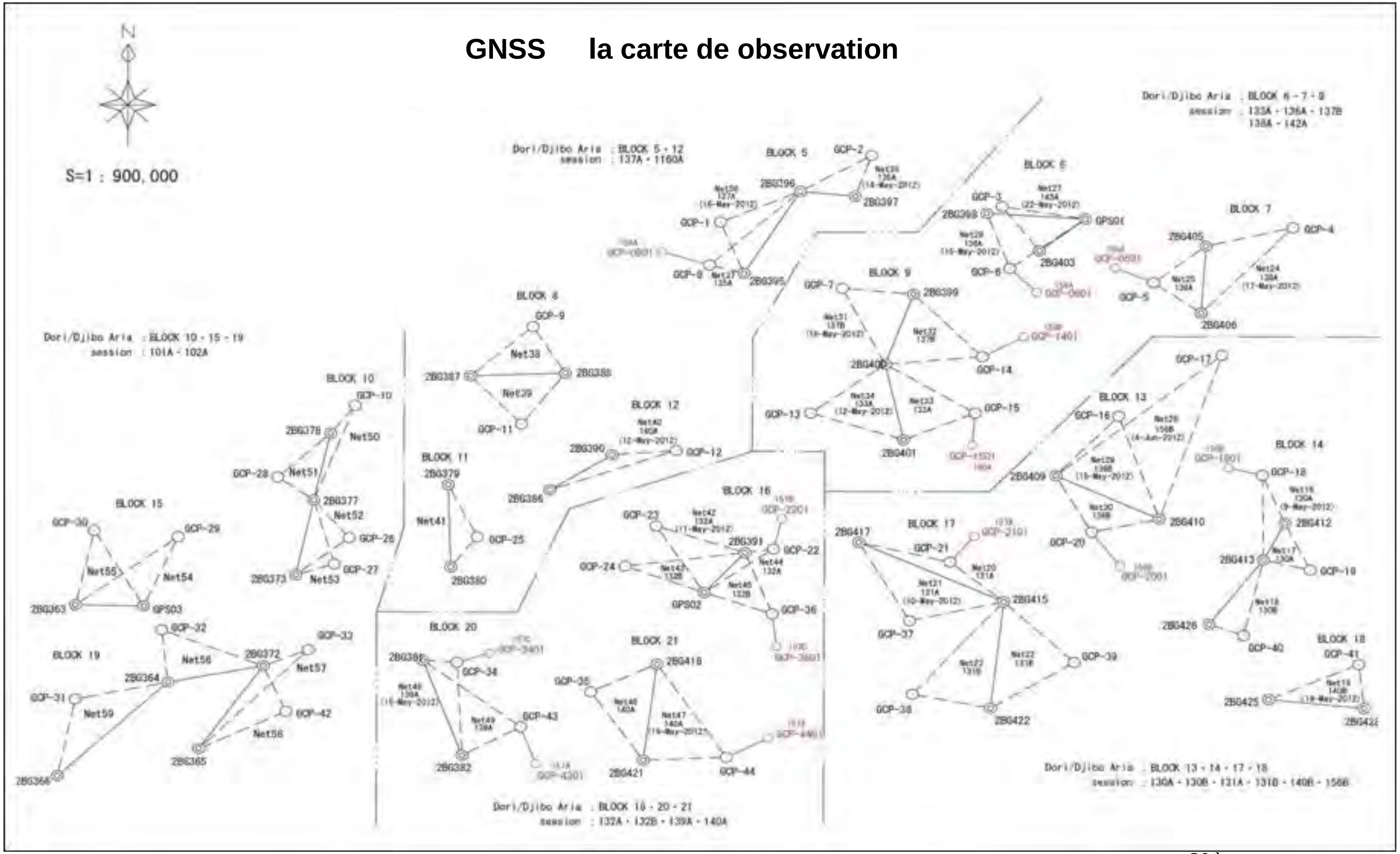
Resurveys due to mismatches of ground control points and selected positions were conducted by using the primary ground control point established in this project to obtain the position of the secondary ground control point via open routes by GNSS observation (30 minutes).

Photo 2-1 Ground control point GCP-49

Photo 2-2 Control point 2517

Photo 2-3 Ground control point GCP-01

Photo 2-4 Existing GPS control point 2399



30 km

・Open route < 1km

Figure 2-3 GNSS observation chart (Dori-Djibo district)

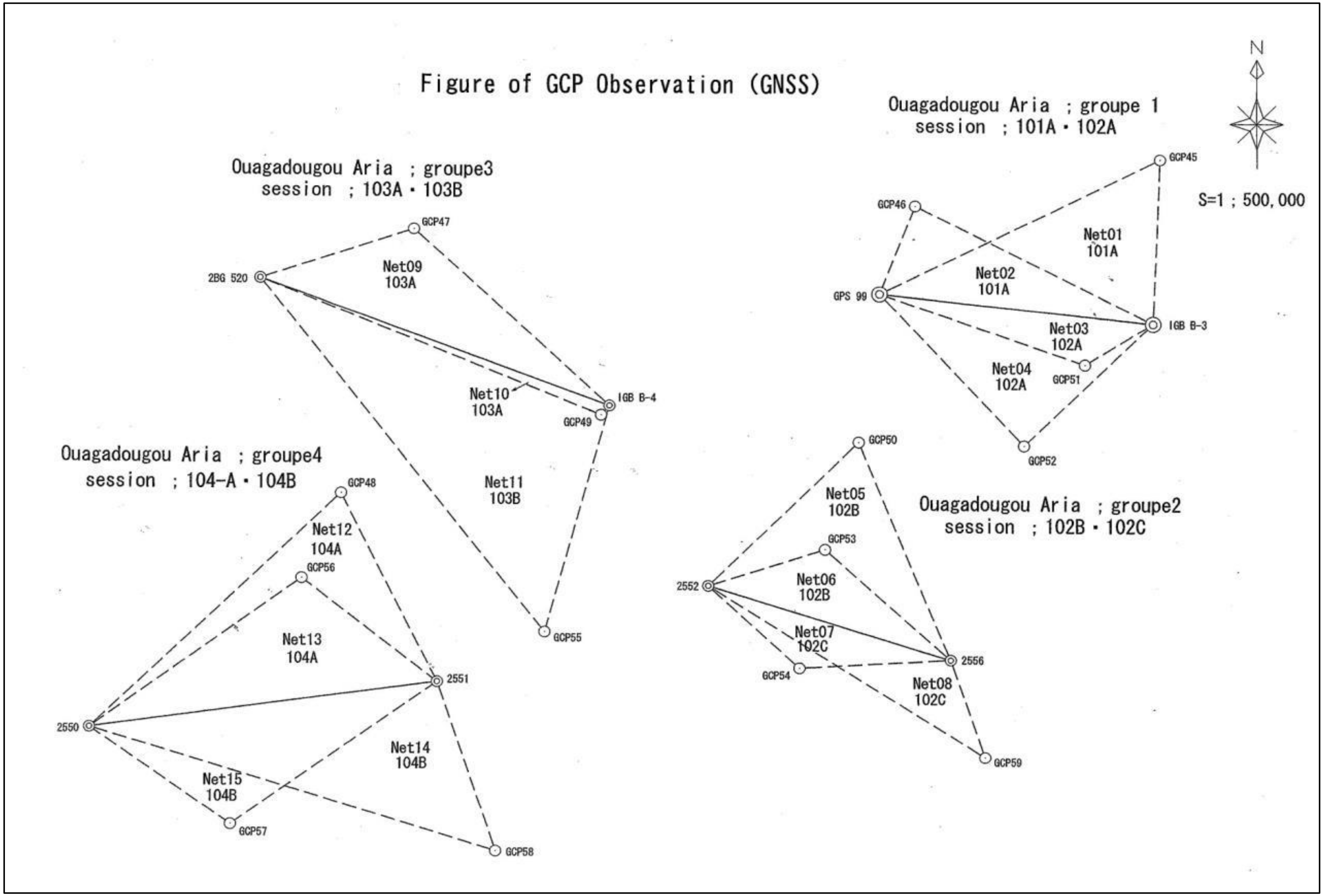


Figure 2-4 GNSS observation chart (Ouagadougou district)

[Baseline Analysis]

After observation was completed, the Study Team downloaded the GNSS observation data on known points and ground control points to the analysis PC and converted to RINEX. Then, the results of the known points (longitude/latitude and ellipsoidal height) were entered, closed traverse errors in baseline vectors were checked according to baseline analysis results, and the 3D location accuracy was checked. The analysis process was conducted using Leica's LGO. Note that each observation session was checked by applying mutatis mutandis the limit values specified in the Article 42-D, “GNSS Observation A(3)” of “Working Rules for Public Survey Work Regulations” of Japan. All the check results were within the limit values, and good results were obtained (Figure 2-5).

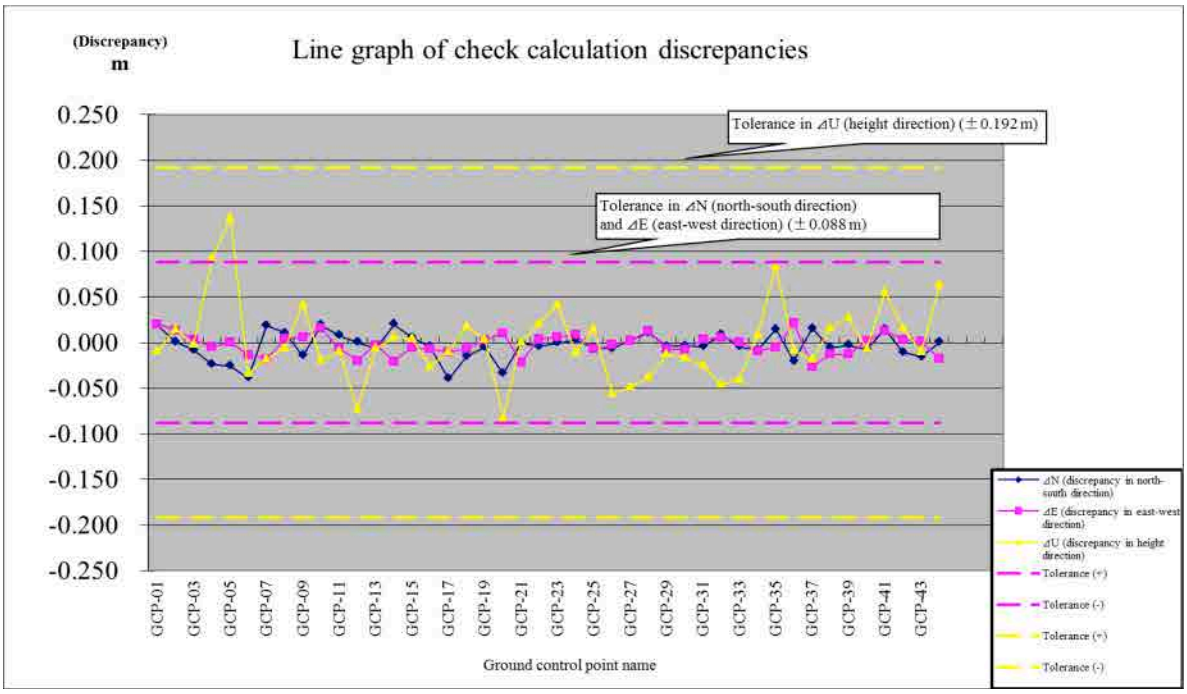


Figure 2-5 Check calculation discrepancy (Dori-Djibo district)

[Network Adjustment]

After the check of location accuracy in baseline analysis, network adjustment was conducted for each session by fixing the longitudes and latitudes and ellipsoid heights in known point results. The 3D network adjustment was conducted using the embedded software in LGO. The geoid model used to obtain elevations from the ellipsoid heights was Earth Gravitation Model 1996 (EGM96). Table 2-8 shows the results of ground control point position coordinates obtained through 3D network adjustment.

[Pricking of Ground Control Points]

The pricking of ground control points was conducted by outputting the ALOS image data in an enlarged form and checking it against the planimetric features in the field. The pricked ground control points turned out to consist of corners of hedges and fences, road intersections, and houses around villages in many cases. In areas without such planimetric features, minimal independent trees and midpoints between two independent trees were interpreted in images for the sake of pricking. The pricked points in images, neighborhood sketches, and ground photographs were summarized in the pricking point details register of ground control points. At the ground control points pricked and observed in the field, an iron bar (50 cm in length and 1.2 cm in diameter) was established at the same height as the ground, with a few white-painted boulders placed on the iron bar to facilitate rediscovery at resurveys, etc.

Photo 2-5 Ground photograph showing distant view (CGP-49)

Photo 2-6 Ground control point under GNSS observation (GCP-49)

Photo 2-7 Pricking position on ALOS image (GCP-49)

[Verification of Ground Control Point Elevations Using Existing Benchmarks]

Elevation values were verified by comparing the elevation values obtained through direct leveling using as given points the existing First and Second order benchmarks that underwent leveling recently and the elevation values obtained from the GNSS ellipsoidal heights and geoid heights (EGM96). The verification results for the elevation values obtained from GNSS/EGM96 were within a difference of 60 cm as shown in the table below. It has been confirmed, therefore, that the elevation values obtained from EGM96 can be used in this study.

Table 2-6 Verification of elevation values of ground control points

District	No.	Elevation		Direct H-GH (m)	Limit (m)	Remarks
		Direct leveling H (m)	GNSS H (m)			
Dori, Djibo	GCP-3401	294.194	294.190	0.004	±1.000	
	GCP-36	299.200	299.259	-0.059	±1.000	
	GCP-39	284.914	285.047	-0.133	±1.000	
Ouaga.	GCP-46	289.753	290.092	-0.339	±1.000	
	GCP-48	329.978	330.571	-0.591	±1.000	

[Verification of Ground Control Point Positions Using GNSS Permanent Station]

Burkina Faso has 9 (nine) GNSS Permanet Station that were established in collaboration with the U.S. and came into service in 2011. At the start of this study, the director general of IGB requested us to use the GNSS Permanet Stations as the existing control points for ground control survey.

Since the ground control point positions used to be obtained using as given points the existing First and Second order control points, it was decided to use as given points the GNSS Permanet Stations, considering that an inspection survey using them is a good opportunity for verifying the accuracy of the electronic control points.

All the results of verification (inspection survey) were within the limits.

Table 2-7 Verification (inspection survey) of control points

Point Name	① Inspection survey value	② Adopted value	①－②	⊿N⊿E⊿U	Limit
GCP-34	X＝ 6186331.985	6186331.911	0.074	⊿N= 0.391	0.635
(Dori-Djibo)	Y＝ -139654.239	-139654.573	0.334	⊿E= 0.332	0.635
	Z＝ 1542243.767	1542243.343	0.424	⊿U= 0.182	0.202
GCP-43	X＝ 6190083.412	6190083.339	0.073	⊿N= 0.391	0.635
(Dori-Djibo)	Y＝ -127568.719	-127569.049	0.330	⊿E= 0.328	0.635
	Z＝ 1528374.435	1528374.012	0.423	⊿U= 0.179	0.202
GCP-49	X＝ 6230372.198	6230372.100	0.098	⊿N= 0.412	0.635
(Ouaga)	Y＝ -182084.019	-182084.340	0.321	⊿E= 0.324	0.635
	Z＝ 1349991.024	1349990.583	0.441	⊿U= 0.180	0.202
GCP-55	X＝ 6235444.515	6235444.302	0.213	⊿N= 0.415	0.635
(Ouaga)	Y＝ -188683.450	-188683.710	0.260	⊿E= 0.266	0.635
	Z＝ 1325411.091	1325410.621	0.470	⊿U= 0.201	0.202

Unit: meter 6% (Inspection survey rate)

[Introduction of Leica's LGO (GNSS Analysis Software)]

Although IGB owns the receiver Trimble R6-2 and analysis software Trimble Business Center, LGO was introduced upon request from IGB. Additionally, an instructor dispatched by Leica gave four-day software operation training. It is considered that several of the IGB technicians mastered the operation. All the GNSS analysis in this project was conducted using LGO. If the GNSS observation equipment is unified to Leica in the future, all of observation, analysis, coordinate system conversion, etc., can be conducted as one flow of operation, which seems to be effective in improving the efficiency.

[Consideration]

The mapping area is divided into two districts, Ouagadougou (capital) and Dori-Djibo districts. The Ouagadougou district is in the metropolitan area, on which ground control point survey was possible in a one-day trip from IGB. Therefore, technology transfer and training on accuracy control, process management, etc. were conducted in this district.

Before the GNSS observation was conducted in the field, training was given regarding observation planning, functional check and organizing of equipment, GNSS installation, selection of ground control point positions, creation of description of pricking point, shooting using digital cameras, etc. To check whether the training contents are conducted properly in the field, the Study Team members visited the GNSS observation sites as required. The four group leaders conducted work seriously, making the most of understanding what they had learned in the training. However, some problems were found in the selection of staff by IGB. Their insufficient awareness for sharing the required knowledge, work methods, etc. and communicating with other groups interfered with the progress of this operation.

For the sake of security, the Study Team members checked the operation results and conducted quality control and process control in the Dori-Djibo district without entering the district. All the GNSS observation was conducted by IGB. Since there were few distinct planimetric features that could serve as the ground control points (pricking points) in this district in the ALOS images, trees often had to be chosen.

During the operation, sandstorms from the Sahara (Harmattan) were encountered several times, but all the operations were safely completed thanks to appropriate decisions made and actions taken by IGB technicians.

Although the technology transfer for ground control point survey (GNSS) and quality and process control was conducted, complete execution of these operations has not been realized yet. It seems that both repetitious execution and long-term technical guidance will be required for this purpose.

The fact that the IGB technicians had honest and humble attitudes toward GNSS observation, and had enthusiasm for their profession was impressive. The Study Team is grateful to all those concerned for the completion of this study within the project period in a friendly atmosphere.

◇ Consistency between GNSS Permanent Station and existing First and Second order control points

Using the GNSS Permanent Stations, two ground control points in the Ouagadougou district and three in the Dori-Djibo district were checked for accuracy. All the five points met the required accuracy for inspection survey. Differences of ⊿N≒40cm and ⊿E≒30cm were discovered between the existing First and Second order control point results and the GNSS Permanent Stations results. Therefore, the GNSS Permanent Stations network and the First and Second order control point network were found not to be directly linked. If the GNSS Permanent Stations are used as given points for control point survey in the future, the First and Second order control point results should be recalculated using the GNSS Permanent Stations as known points in order to unify the results.

◇ Number of Established GNSS Permanent Stations

The distance that can be analyzed through observation in one or two hours was found to be about 100 kilometer. Therefore, it is impossible to conduct GNSS survey on the entire land of Burkina Faso using only GNSS Permanent Stations and it is desirable to establish more GNSS Permanent Stations.

Table 2-8　Ground control point result table

No.	Cartesian Coordinates			Latitude / Longitude(GRS80)		Ellipsoid	Coordinates(BFTM)		Altitude
	X(m)	Y(m)	Z(m)	Latitude	Longitude	(m)	Easting (m)	Northing (m)	(m)
GCP-01	6162711.459	-88069.899	1636879.728	14° 58' 09.09990" N	0° 49' 07.48251" O	279.804	673251.966	1655031.254	256.194
GCP-02	6160609.319	-58022.445	1646010.435	15° 03' 16.73482" N	0° 32' 22.60564" O	270.561	703226.751	1664595.108	247.466
GCP-03	6162482.471	-34134.982	1639689.805	14° 59' 43.83855" N	0° 19' 02.52227" O	268.521	727152.373	1658169.033	245.905
GCP-0401	6164162.044	19322.948	1633628.838	14° 56' 19.76745" N	0° 10' 46.58116" E	263.701	780643.998	1652242.408	241.597
GCP-0501	6166993.956	-5176.486	1623225.994	14° 50' 29.24310" N	0° 02' 53.13566" O	300.167	756219.859	1641297.571	277.930
GCP-0601	6166028.326	-32850.282	1626460.804	14° 52' 18.31056" N	0° 18' 18.89098" O	278.706	728529.194	1644485.352	256.202
GCP-07	6166882.375	-64994.223	1622404.379	14° 50' 01.49810" N	0° 36' 13.79280" O	310.872	696422.299	1640131.147	287.807
GCP-0801	6165163.989	-90289.451	1627635.971	14° 52' 57.69062" N	0° 50' 20.55305" O	299.444	671097.835	1645456.588	275.837
GCP-09	6167983.774	-124312.841	1614684.658	14° 45' 41.95638" N	1° 09' 16.60839" O	284.006	637172.642	1631992.751	259.827
GCP-10	6171618.608	-156761.635	1598092.022	14° 36' 23.68706" N	1° 27' 18.08408" O	307.929	604844.050	1614813.191	283.561
GCP-11	6173483.939	-126710.471	1593537.404	14° 33' 50.65135" N	1° 10' 32.98120" O	298.087	634920.664	1610135.936	273.865
GCP-12	6175537.380	-97069.119	1587751.183	14° 30' 36.04191" N	0° 54' 01.87081" O	313.225	664594.063	1604216.928	289.321
GCP-13	6173928.059	-71265.936	1595605.181	14° 34' 59.40300" N	0° 39' 40.81842" O	387.894	690337.501	1612389.782	364.536
GCP-1401	6171039.498	-38284.984	1607487.670	14° 41' 39.60191" N	0° 21' 19.64559" O	313.042	723227.149	1624830.650	290.435
GCP-1501	6174162.349	-39954.846	1595582.441	14° 34' 59.07801" N	0° 22' 14.78245" O	335.975	721639.294	1612515.156	313.227
GCP-16	6174533.056	-12392.443	1594503.236	14° 34' 23.01765" N	0° 06' 53.97810" O	310.031	749202.595	1611559.271	287.535
GCP-17	6170921.549	9872.604	1608273.269	14° 42' 06.21356" N	0° 05' 29.99432" E	291.046	771370.108	1625940.199	268.799
GCP-1801	6177789.342	14616.426	1581798.784	14° 27' 16.27540" N	0° 08' 08.01416" E	283.200	776293.776	1598623.221	260.568
GCP-19	6182994.260	23675.902	1561384.601	14° 15' 50.61012" N	0° 13' 09.82467" E	289.926	785489.536	1577616.074	266.972
GCP-2001	6180961.378	-17353.896	1569459.758	14° 20' 21.70712" N	0° 09' 39.11517" O	294.518	744411.071	1585676.725	271.522
GCP-2101	6182426.709	-44987.033	1563238.788	14° 16' 52.67884" N	0° 25' 00.87956" O	311.711	716826.103	1579109.430	288.262
GCP-2201	6181321.598	-78509.867	1566362.287	14° 18' 37.34510" N	0° 43' 39.65850" O	336.621	683292.199	1582191.294	312.743
GCP-23	6179684.405	-101088.598	1571492.214	14° 21' 29.59801" N	0° 56' 13.82287" O	338.438	660685.656	1587418.350	314.342
GCP-24	6181748.895	-107044.807	1562939.670	14° 16' 42.56337" N	0° 59' 31.37926" O	320.547	654787.871	1578586.153	296.315
GCP-25	6179532.844	-135464.182	1569391.797	14° 20' 19.30932" N	1° 15' 20.89493" O	308.409	626331.890	1585198.940	284.081
GCP-26	6178990.693	-160004.758	1569228.841	14° 20' 13.81359" N	1° 29' 00.02690" O	311.221	601796.385	1585016.270	286.839
GCP-27	6180360.260	-162912.757	1563581.451	14° 17' 04.15191" N	1° 30' 35.83013" O	315.498	598926.523	1579189.511	291.079
GCP-28	6175249.487	-173628.565	1582409.400	14° 27' 36.46069" N	1° 36' 37.98910" O	322.657	588085.477	1598618.020	298.268
GCP-29	6177974.417	-192967.724	1569547.722	14° 20' 24.46704" N	1° 47' 20.54363" O	317.850	568832.695	1585362.968	293.341
GCP-30	6177046.003	-209405.279	1571146.989	14° 21' 18.04471" N	1° 56' 29.81427" O	333.534	552383.349	1587034.993	308.917
GCP-31	6186221.696	-212999.017	1534476.911	14° 00' 47.23307" N	1° 58' 19.13966" O	357.720	549032.544	1549228.181	332.521
GCP-32	6182898.899	-196824.807	1549708.159	14° 09' 18.43773" N	1° 49' 23.96391" O	323.543	565107.448	1564906.171	298.804
GCP-33	6184921.708	-168155.929	1545032.772	14° 06' 41.57827" N	1° 33' 26.55565" O	322.565	593806.859	1560063.943	297.951
GCP-3401	6186336.813	-138793.544	1542284.250	14° 05' 09.40553" N	1° 17' 06.87733" O	318.734	623183.103	1557242.113	294.187
GCP-35	6188501.508	-113882.933	1535775.340	14° 01' 30.88679" N	1° 03' 15.32752" O	344.096	648131.236	1550563.802	319.501
GCP-3601	6184880.585	-79100.733	1552260.605	14° 10' 44.09121" N	0° 43' 57.85334" O	323.303	682795.012	1567649.276	299.186
GCP-37	6185585.276	-52852.653	1550543.074	14° 09' 46.52726" N	0° 29' 22.38406" O	314.584	709046.855	1565980.332	290.747
GCP-38	6189565.799	-52450.794	1534698.512	14° 00' 55.01242" N	0° 29' 07.85992" O	314.860	709552.691	1549651.238	290.631
GCP-39	6188092.942	-21380.774	1541301.370	14° 04' 36.51650" N	0° 11' 52.67250" O	308.809	740571.731	1556609.686	285.047
GCP-40	6186663.463	7595.490	1547020.884	14° 07' 48.58854" N	0° 04' 13.23529" E	284.815	769505.512	1562688.996	261.481
GCP-41	6188053.665	32133.213	1541214.450	14° 04' 33.71624" N	0° 17' 51.07852" E	294.669	794080.051	1556875.732	271.453
GCP-42	6188146.879	-172685.178	1531686.835	13° 59' 13.88976" N	1° 35' 54.49063" O	331.233	589365.596	1546311.971	306.408
GCP-4301	6189986.796	-126822.370	1528810.153	13° 57' 37.32714" N	1° 10' 25.42616" O	344.954	635240.406	1543367.490	320.244
GCP-4401	6192528.907	-87210.299	1521224.420	13° 53' 23.22491" N	0° 48' 24.66571" O	321.973	674890.801	1535645.846	297.229
GCP-45	6225361.773	-119325.430	1379251.793	12° 34' 17.70150" N	1° 05' 53.12337" O	305.085	643657.559	1389792.883	279.389
GCP-46	6226014.275	-146763.114	1373735.962	12° 31' 13.74579" N	1° 21' 01.28987" O	315.906	616257.956	1384113.526	290.091
GCP-47	6225035.189	-202801.726	1371227.525	12° 29' 49.87198" N	1° 51' 57.40283" O	352.469	560237.785	1381560.028	326.407
GCP-48	6231356.819	-211143.431	1341145.194	12° 13' 07.72733" N	1° 56' 26.40827" O	356.650	552067.783	1350788.767	330.570
GCP-49	6230372.107	-182084.339	1349990.585	12° 18' 02.13189" N	1° 40' 26.43036" O	377.537	581078.821	1359799.012	351.519
GCP-50	6231783.246	-153346.055	1346860.570	12° 16' 18.19826" N	1° 24' 34.55270" O	334.279	609831.120	1356602.035	308.486
GCP-51	6230418.830	-127962.537	1355562.172	12° 21' 08.28300" N	1° 10' 35.74376" O	297.415	635159.312	1365532.093	271.839
GCP-52	6232295.106	-134869.842	1346357.086	12° 16' 01.60365" N	1° 14' 22.97228" O	309.951	628306.326	1356104.316	284.363
GCP-53	6234309.715	-157185.946	1334721.066	12° 09' 34.06249" N	1° 26' 39.46276" O	327.630	606060.386	1344187.331	301.819
GCP-54	6237174.000	-160188.312	1321159.000	12° 02' 02.48904" N	1° 28' 16.30072" O	359.987	603135.331	1330316.193	334.150
GCP-55	6235444.311	-188683.714	1325410.624	12° 04' 24.12716" N	1° 43' 59.64156" O	336.121	574617.207	1334677.425	310.039
GCP-56	6233245.437	-215682.426	1331536.612	12° 07' 48.06726" N	1° 58' 54.31743" O	327.217	547581.307	1340977.222	301.143
GCP-57	6239019.039	-223957.242	1303190.890	11° 52' 04.80319" N	2° 03' 20.95053" O	363.371	539463.830	1312017.889	337.351
GCP-58	6240623.306	-194416.406	1300100.880	11° 50' 22.29176" N	1° 47' 03.76486" O	329.133	569024.439	1308824.552	303.100
GCP-59	6239872.260	-139482.969	1310754.410	11° 56' 16.42113" N	1° 16' 49.97209" O	351.596	623894.875	1319695.641	326.112

2.7 (9) Aerial Triangulation (Work in Japan)

The ALOS/PRISM images are provided from a data provider as a so-called exterior orientation model called an RPC model. The RPC models are files that describe rational polynomial coefficients by which satellite images and ground space are connected, being similar to exterior orientation parameters in aerial photographs. The plotter can convert the RPC models associated with satellite images (ALOS/PRISM) into stereo models, allowing measurement of the 3D coordinates of planimetric features in the images. However, RPC models provided from a data provider generally include systematic errors so that the accuracy must be improved in order to create topographic maps. Therefore, the RPC models were readjusted through adjustment calculation using the image coordinates of tie-points and ground control points, RPC models, and ground control point results (3D coordinates). The result is described below.

[Implementation Period]

- From June to August 2012

[Scope of Implementation]

The scope of implementation is shown below. In the plotting range of about 26,000 km^2, 183 ALOS/PRISM images (61 scenes x triplet) were used. Since the study area is divided into two districts, the work was conducted separately on the two blocks.

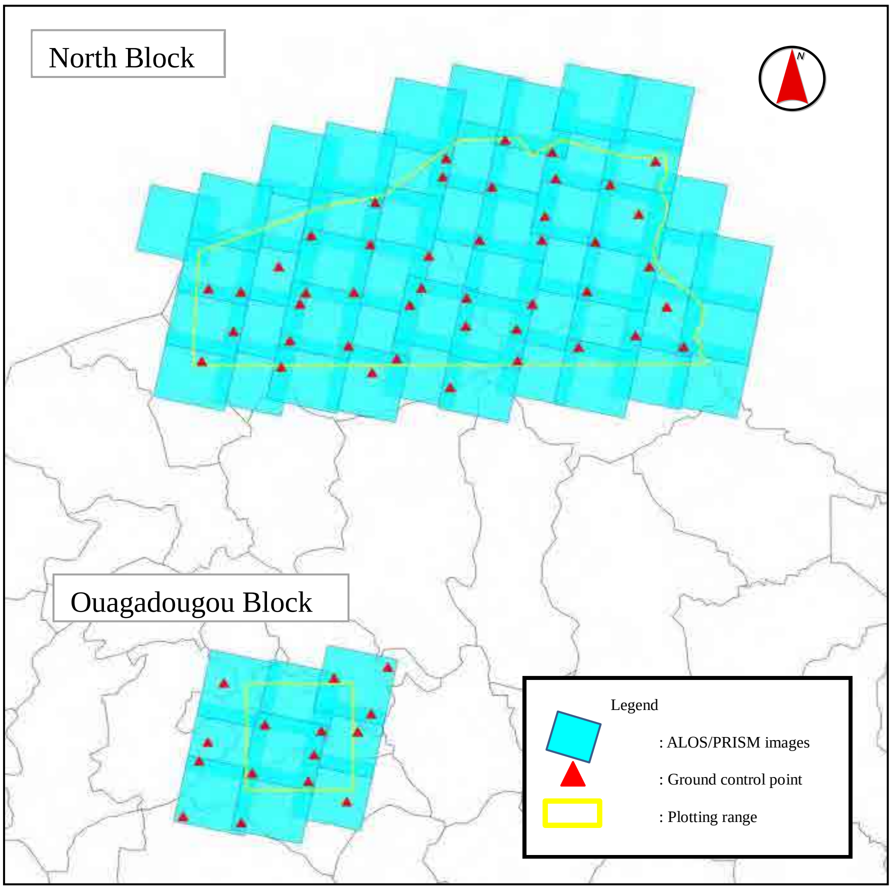


Figure 2-6 Blocks for aerial triangulation

[Data used]

The used data is as follows:

- Satellite images : ALOS/PRISM, Level 1B1, CEOS format
- Orientation model : RPC model2
- Ground control points : 59 points in total
- Reference coordinate system
  - Map projection : BFTM (Burkina Faso Transverse Mercator)
  - Reference ellipsoid : GRS80
  - Geodetic coordinate system : ITRF2008

[Software used]

The following software was used:

- ➢ LPS2011, Intergraph product

[Implementation Flow]

Aerial triangulation was implemented using the following workflow:

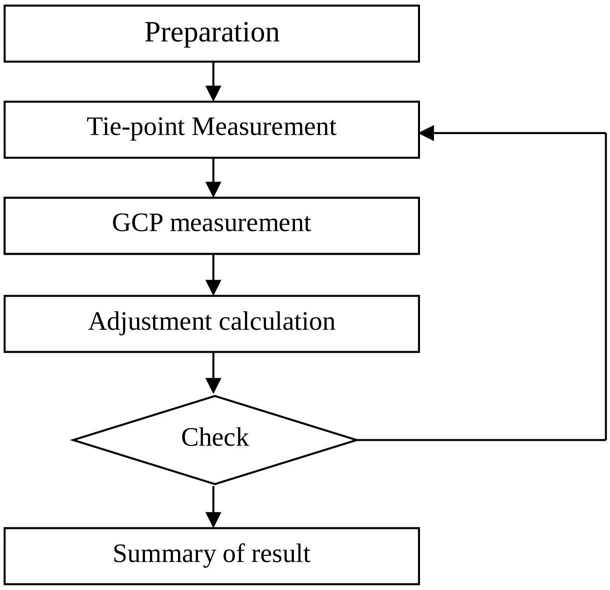


Figure 2-7 Aerial triangulation workflow

[Description of Implementation]

a) Preparation (Change of Scene IDs)

The ALOS/PRISM images include scenes to each of which a unique ID is assigned. In the area indicated with a broken line in the figure below, for example, “alpsmn254603275” is the scene ID and the part “254603275” consists of the number of satellite orbits and the frame number, with the upper five digits and the lower four digits recognized as Path and Row, respectively.

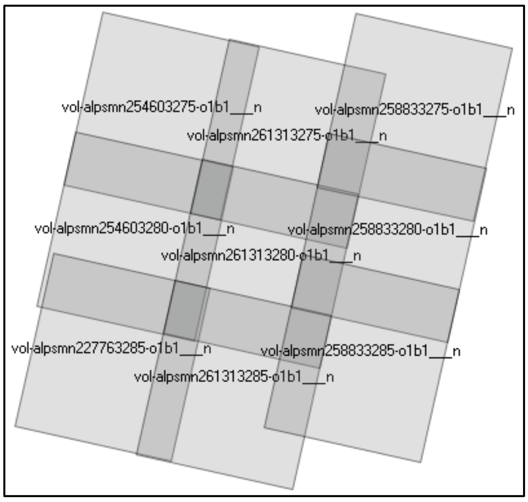


Figure 2-8　ALOS/PRISM original scene IDs

When the work is done using the original scene IDs, it is not easy to manage images because the location of a path cannot be easily identified from the number and there are also different frame numbers in the triplet. Before the implementation of aerial triangulation, therefore, the scene IDs were changed to numbers that can be easily managed in this project. The naming rules were as follows:

- A scene ID shall be “Path number (2 digits) - Frame number (4 digits) - Line of sight (N, F, or B).” An image file name is suffixed with “_original-scene-ID” in the end to enable checking to be done later.
- A path number shall be “01” on the western end. Subsequent paths are assigned with numbers in ascending order.
- A frame number shall be an original number. The same number as for the nadir view shall be used for the forward view and backward view. It is appended with a symbol N, F, or B that identifies the line of sight.

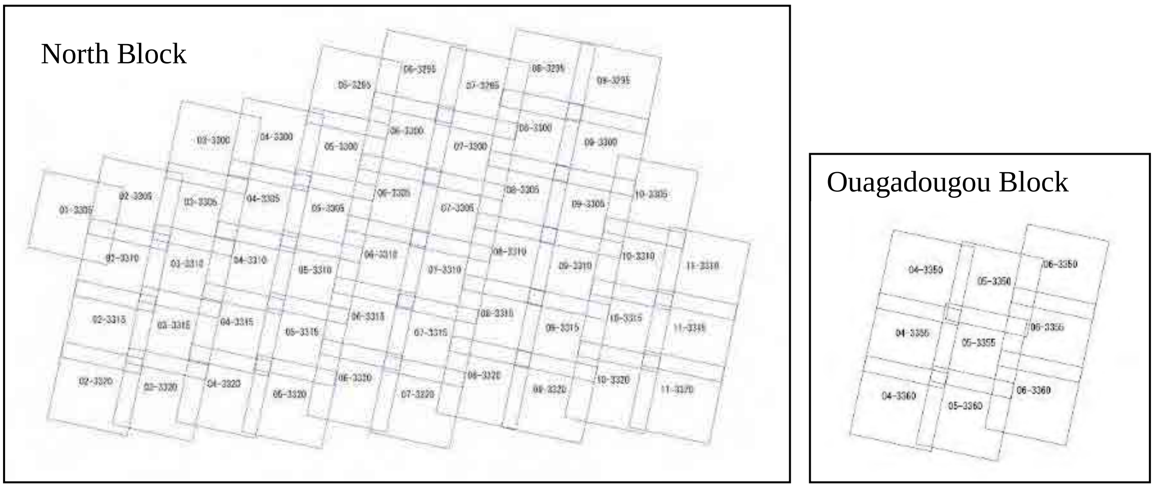


Figure 2-9　Scene IDs after change

a) Tie-point Measurement

LPS has a function of automatically acquiring tie-points (points that connect photos). In this process, the Study Team executed automatic processing in the beginning and later checked the points with large residual errors and needed points, made corrections or conducted additional measurement as required, and acquired the image coordinates of tie-points. With the tie-point allocated as “3 x 3,” automatic acquisition was conducted. The accuracy of automatically acquired tie-points depends on the accuracy of RPC models and geometric accuracy and radiometric accuracy of images. The success ratio of this process was around 40%, demonstrating a comparatively inferior result. There are the following two possible causes for this:

The first cause is that a large part of the target area is savanna with few distinctive planimetric features so that there was a low probability for identifying the same point on the software.

The second cause is that the RPC model accuracy was not good enough in some scenes. When the check calculation regarding the second cause was conducted on each scene also for the purpose of factor analysis, a large residual error was confirmed in the forward view images with a pointing angle of “+1.2” (odd-number path). In the scenes including this image, the standard deviation of intersection residual errors exceeded 2.0 pixels. There is a clear difference when compared with the said standard deviation over 0.5 pixels of images with a pointing angle of “-1.2” (even-number path). This tendency was confirmed in all the images in the target area. However, a stereo model could be created without causing a problem in digital plotting using the nadir and backward view images even after the forward view image was removed. Therefore, it was decided to conduct adjustment calculation after removing the forward view images in odd-number paths with large residual errors.

b) Ground Control Point Measurement

Using the details register acquired in ground control point measurement, the image coordinates of the ground control points were measured. Since the ground control points were selected taking into consideration overlap of images, 12 images were measured per point at the maximum. One ground control point (No.6) was found not to be identified on an image but considered not to influence the overall accuracy so that only this point was removed.

c) Adjustment Calculation and Results

Adjustment calculation was conducted using the image coordinates of tie-points and ground control points, ground control point results (3D coordinates), and RPC models. The additional parameters used in adjustment calculation were the shift item and the drift item. The limit values used to determine the conformance of results were the following values specified in the “Guideline for Creating 1/50,000 Topographic Maps Using ALOS Optical Images” created by the Geospatial Information Authority.

- (Limit values)

Control point residual error : Horizontal position : 5.0 m standard deviation, 10.0 m maximum value

Height : 3.3 m standard deviation, 10.0 m maximum value

- Intersection residual error : 1.0 pixel standard deviation, 2.0 pixels maximum value

As described in the tie-point measurement, calculation was conducted after removing the forward view images in odd-number paths, and the calculation results regarding both the intersection residual errors and control point residual errors satisfied the limit values. The calculated intersection residual errors and control point residual errors are shown in the table below.

Table 2-9 Aerial triangulation results

Block	Intersection residual error (Unit: pixel)		Control point residual error (Unit: m)				Remarks
			Horizontal location		Height		
	Standard deviation	Maximum value	Standard deviation	Maximum value	Standard deviation	Maximum value	
North	0.18	1.73	2.476	5.909	1.882	4.414	Removed forward view images in odd-number paths
Ouagadougou	0.21	1.31	2.402	5.518	0.383	0.682	Same as above

d) Summary of Results

The RPC models after adjustment were stored in the format of LPS, the supplied software, so that they can be used by IGB in the future. At the same time, they were also stored in text format scene by scene in consideration of versatility.

2.8 (10) Field Identification and Field Verification (Work in Burkina Faso)

(Field identification : 90 days from May 27 to August 21, 2012)

(Field verification : 74 days from May 8 to July 20, 2013)

The work overview for field identification (photo interpretation) and field verification is shown below.

- Work Area and Volumne
  - Area surrounding Ouagadougou : 3,000 km^2 (4 sheets)
  - Northern area of Burkina Faso : 23,000 km^2 (40 sheets)
- Work Period

  Field Identification
  - Area surrounding Ouagadougou : June 11 to August 9, 2012
  - Northern area of Burkina Faso : June 26 to August 12, 2012

  Field Verification
  - Area surrounding Ouagadougou : June 6 to July 11, 2013
  - Northern area of Burkina Faso : June 10 to December 15, 2013
- Work Team Members

  The following five members participated from IGB.

  (Mr. NAGABILA participated only in photo interpretation.)

Mr. Nagabila
Photo interpretation

Mr. Koudougou

Mr. Nikiema

Mr. Konate

Ms. Coulibaly

Ms. Sougue Field verification

Photo 2-8 IGB technicians participated in the technology transfer on field identification and field verification

[Photo interpretation]

1. Outline

Since Burkina Faso has a wide variety of unique vegetation types not found in Japan, plotting work in Japan would make it difficult to distinguish them. If IGB conducts plotting, on the other hand, it is important to unify the vegetation interpretation results. For the scope of interpretation, therefore, the counterpart technicians discussed vegetation interpretation to unify the interpretation criteria before starting the work. All the technicians had experience in photo interpretation (plotting and compilation) although the level of experience varies among them.

2. Preparation

a. Put a polyester base sheet over a field identification photo and fix it with scotch tape temporarily at the three positions in the upper part.
b. According to the neat lines marked on the field identification photo, put a Reso + mark on the four corners of the polyester base sheet.
c. Write a drawing number on the upper left corner of the polyester base sheet.
d. On the polyester base sheet on the field identification photo, draw vegetation boundaries to be generated as polygons for each map symbol code and write a relevant code number on it.

3. Precautions

a. Care was taken so that a vegetation boundary for each code formed a polygon.
b. Edge matching between map sheets (up, down, right, and left) was always checked. Checking was carried out sufficiently to prevent form and code mismatches and interpretation was carefully conducted.
c. After the work was completed, the same sheet was checked by a different technician to ensure that the unified interpretation method had been used.

Photo 2-9 Discussion about interpretation method

Photo 2-10 Image interpretation in progress

Photo 2-11 Preliminary interpretation work

Photo 2-12 Study Team member giving instructions in the meeting

Photo 2-13 Overlay resulting from preliminary interpretation

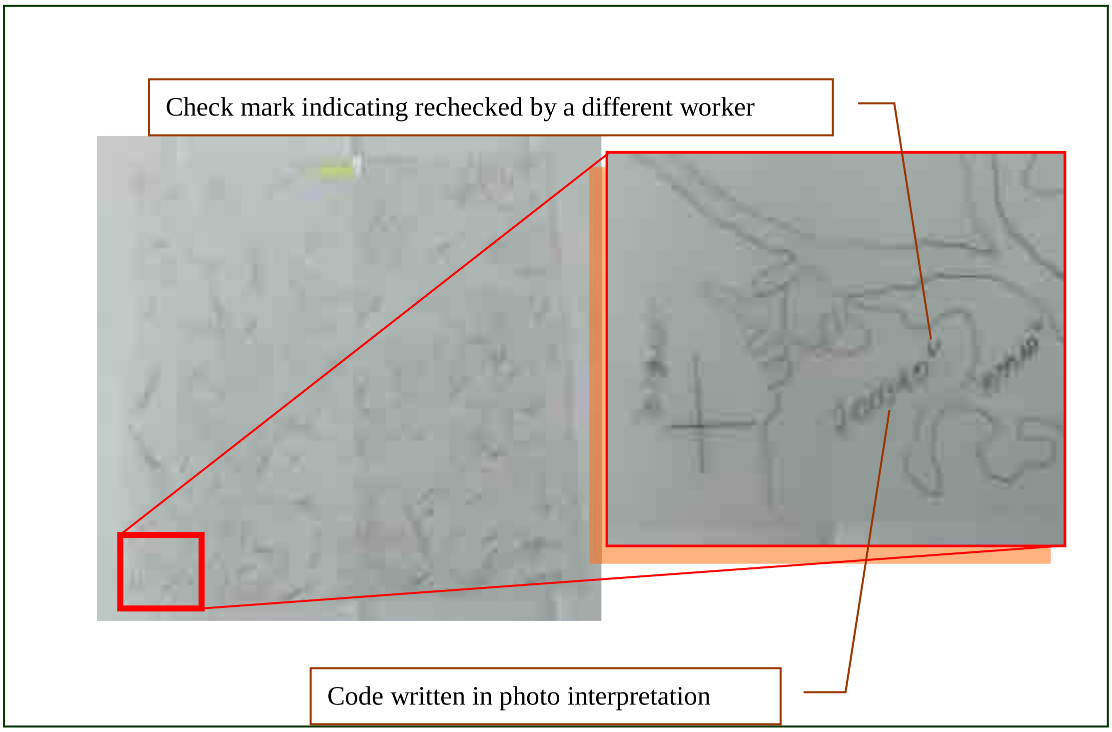


Figure 2-10 Example of photo interpretation

[Field Identification]

1. Outline

The field identification photos have as small a scale as 1/50,000, making it difficult to identify houses in a concentrated area. Therefore, the adopted method was to shoot landmark objects with GPS-enabled digital cameras to obtain the planimetric feature types and location information simultaneously. This method can improve the efficiency and accuracy of plotting and compilation by identifying in more concrete images what cannot be directly interpreted in field identification photos.

2. Preparation

- Photos for field identification
- GPS-enabled digital cameras
  (Spare batteries and rechargers for car use)
- Code table (Tags)
- Straight edges and triangles
- Four-color ballpoint pen

3. Method

a Shooting of Landmark Objects

Pictures were taken in a way to ensure a well-balanced layout of the full view of a landmark object and a map symbol code tag on the lower left corner.

For the urban area in the Ouagadougou district (built-up zone), the existing maps were not very useful as reference because it is expanding significantly. Therefore, all the roads were driven by a car to check the landmark objects thoroughly. For the area surrounding Ouagadougou and the northern area, all the villages were surveyed referencing the symbols marked on the existing topographic maps. Also interview surveys in the field were conducted to check the landmark objects without omission.

b Sorting

Sorting of information was done by identifying a building in a field identification photo, drawing a leader line to out of the photo, and writing a code number in red. For the urban area in the Ouagadougou district (built-up zone), however, sorting was done on 1/25,000 images, which were enlarged from 1/50,000 images.

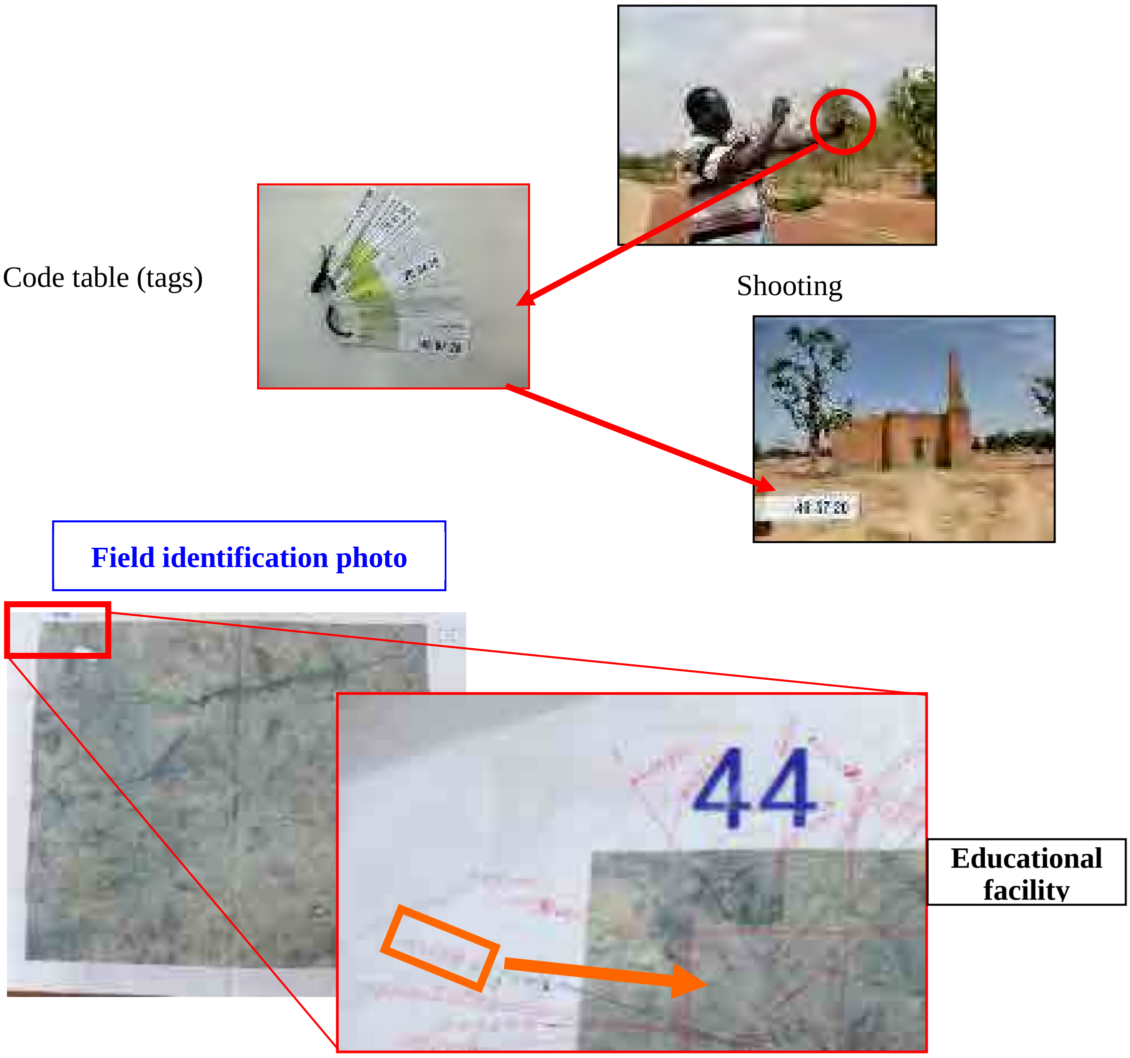


Figure 2-11 Sorting of information in field identification

4. Implementation

After the start of this work, a few days were spent for training, giving direct guidance on the field identification method to two of the four counterpart members. Then, these two members explained the field identification method to the other two. In this process, the understanding of the method by each person was checked. While the counterpart members gave explanations, one or more Study Team members always accompanied counterparts to check the content of explanations and give additional instructions if required, thus ensuring that both those who explained and those who were explained to could further deepen their understanding. The technicians who had received explanation of the method from other technicians in their independent survey were accompanied by a Study Team member to check their understanding and gave additional instructions. At the end of the field identification instruction work, a brief test was given to check the participants' understanding about the field identification (shooting) method.

The field identification was conducted in four groups, each consisting of one person. One vehicle was assigned to each of the groups so that the field identification could be conducted by each of them independently.

Photo 2-14　Training among C/P members

Photo 2-15　Field identification by interview

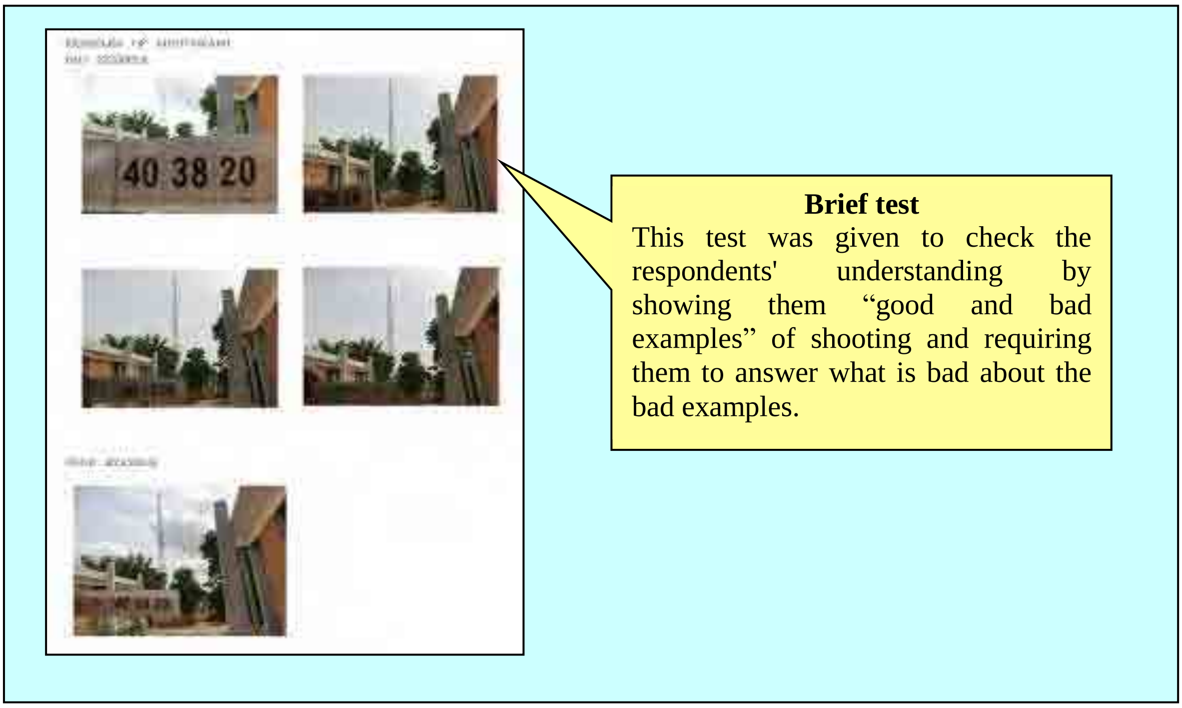


Figure 2-12　Brief test

[Field Verification]

1. Outline

Questionable points identified in the results of the field identification and in the digital compilation and annotations of place names were verified in the field verification. 'Symbols,' 'vegetation,' 'areas,' 'forms,' 'positions, 'annotations' and 'features' were the survey items in the field verification. However, as the counterparts were expected to review vegetation and annotations, these two items were removed from the list of verification items on the verification sheets.

Tablets were used in the field verification to improve the efficiency of the work. The tablets contributed significantly to the improvement of the efficiency of the field verification, as the navigation function installed on the tablets had made it easy to reach destinations (designated verification sites) in the field verification areas after the counterparts had become familiar with the use of the tablet.

Table 2-10 Verification items

Symbol	Legend	Japanese	Remarks
A	Symbol unclear	記号	
C	Area unclear	範囲	
D	Form unclear	形状	
E	Position unclear	位置	
G	Feature unclear	地物	

2. Preparation
   - Field verification sheets
   - GPS-enabled digital camera
     (Spare batteries and rechargers for car use)
   - Code table (Tags)
   - Straightedges and triangles
   - Four-color ballpoint pens
   - Tablets

3. Method
   a Preparatory work

   Positions of the survey items described on the verification sheets were used for the selection of an efficient field verification route in advance. For the verification of annotations (names of places), main local authorities and their areas of jurisdiction identified in the preparatory work were included in the reference materials for the field verification.

   As the communication environment in the study area was poor, the tablets were configured to enable positioning and navigation to destinations independently. For the positioning and navigation, instruction data of the field verification converted into the KMZ file format and maps (photo maps) of the verification areas were installed on the tablets before the field verification.

   There were several reference materials on annotations. The data derived from those materials were combined. The created data were considered best at the moment and expanded on the verification sheets.

b　Tablets

Although tablets did not meet the criteria for the survey equipment to be procured in the study, they were used in the study in order to improve the efficiency of work.　Implementation of field identification and verification by different survey personnel enables flexible personnel assignment, reduces misinterpretation of survey results caused by preconceived ideas and, consequently, leads to improvement of accuracy of survey.

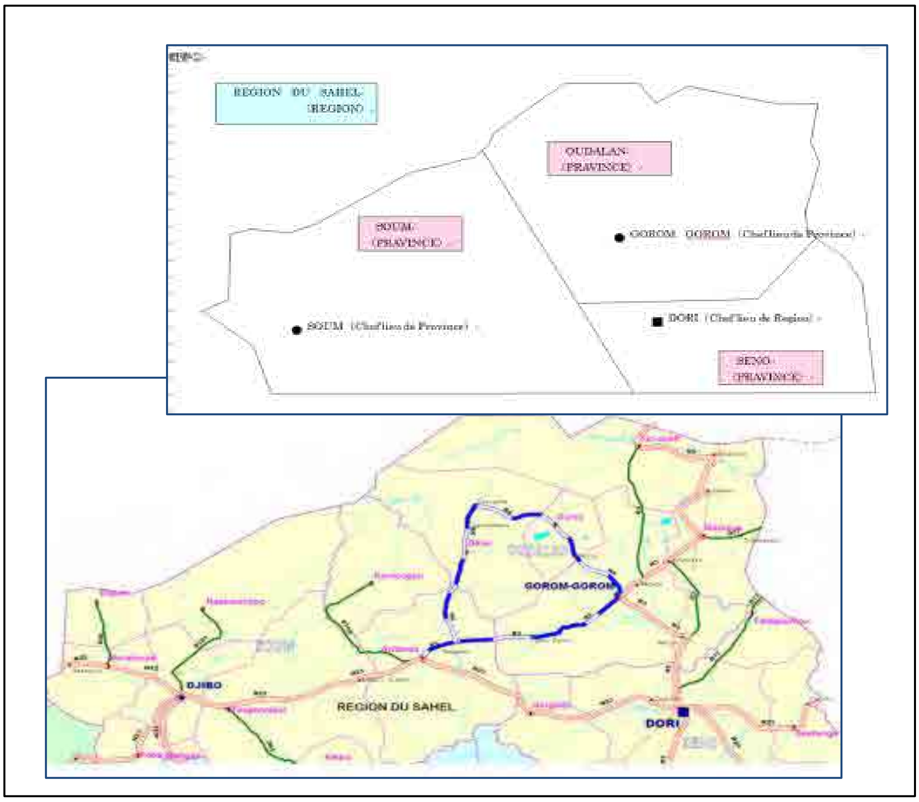


Figure 2-13　Reference materials for the verification of annotations

The use of the tablets improved the efficiency of the survey because it made it easy for anyone to reach destinations.

Photo 2-16　Training on operation of the tablet (in an office)

Photo 2-17 Training on operation of the tablet (at IGB premises)

Photo 2-18 Training on operation of the tablet (in the field)

c Survey

The survey was conducted in accordance with the description on the verification sheets. The subjects of the verification were photographed as in the field identification. A significant amount of time had to be spent on the survey of annotations of place names because the existing maps were created many years ago and there were many villages which had been formed after their creation.

d Survey of place names

A decree issued in December 2012 makes it mandatory to study not only new place names but also histories of old place names in toponymic surveys conducted under the instruction of the National Commission of Toponymy established for toponymic surveys. Because of this stipulation of the decree, an extravagant amount of time had to be spent on the survey of place names. In the end, it took about 2.5 (two and half) times as long as it was scheduled in the original plan to complete the field verification. Figure 2-14 in next page shows the outline, description of its duties and organizational structure of the National Commission of Toponymy.

Figure 2-14 Brochure for the establishment of National Commission of Toponymy 1

Benefits

Standardized use of accurate geographic names is a main element of smooth communication in the world. It contributes to economic and social development and helps protect scenic spots and infrastructure in each country.

A geographic name explains and represents a certain component of a certain culture or heritage or certain sceneries.

Correct use of accurate geographic names brings various benefits to local authorities and domestic and international organizations in the activities mentioned below, in particular.

- Communication and domestic and international trade
- Census and national statistics
- Land ownership and cadasters
- Urban planning and national land development
- Management of the environment, relief efforts after natural disasters and responses and dispatch of assistance at the time of emergency
- Creation of maps and atlases
- Automation of navigation
- Security for tourists and peace-keeping

Contacts

Secretariat of the National Commission of Toponymy of Burkina Faso
Geographic Institute of Burkina Faso (IGB)
03 BP 7054 Ouagadougou 03
+226 50 32 48 23/24
institut.geog@fasonet.bf

Address

United Nations Group of Experts on Geographical Names (UNGEGN - GENUNG in French)
*http://unstats.un.org/UNSD/GEOINFO/UNGEGN/default.html*****
******
French-speaking Division, UNGEGN
http://www.toponymiefrancophone.org/

"Le nom de lieu, signature du temps et de l'espace (The place name, signature of the time and space)"[1]

Note[1]: Commission of Toponymy of Québec

Ministry of Territorial Administration and Security	Ministry of Infrastructure, Road Development and Transport

National Commission of Toponymy

Established in accordance with the Decree 2012-1015/PRES/PM/MATDS/MID/MEF dated December 28, 2012

Figure 2-15 Brochure for the establishment of National Commission of Toponymy 2

Outline

Toponymy is the study of names of places, or geographic names. Meanings, origins, histories and social influence of geographic names are studied in toponymy. In addition to (commonly-known) names of inhabited and uninhabited places, geographic names of mountains, rivers and traffic routes (roads), those used in limited fields are also studied in toponymy. In response to the changing international relationship since the latter half of the 20th Century and an increase in the importance of toponymy at the global level, the United Nations established the **United Nations Group of Experts on Geographic Names (UNGEGN - GENUNG in French)** in 1959. The group stated the need to establish an organization responsible for geographic names in each member country at the very beginning of its operation.

Burkina Faso is a member of the French-speaking Division and the Africa West Division of UNGEGN.

Authorities

The National Commission of Toponymy of Burkina Faso is responsible for the following:

- To study geographic names in detail and preserve them
- To establish official orthography of geographic names in the official language
- To establish a principle, method and rules on spellings of all geographic names
- To establish criteria for selection of names to be given to places in the entire territory of the country
- To create awareness of geographic names in Burkina Faso at the national and international levels
- To participate in international efforts to preserve geographic names which are considered as heritage because they are living witnesses of the history of the culture and languages and re-adapt their identities
- To represent Burkina Faso in international meetings and conferences on toponymy

The commission expresses its views to the Government on all issues related to toponymy presented to it by the Government.

Organizational structure

Chairperson
Minister of Territorial Administration

Organization for technical supervision
Ministry in charge of mapping

Supervising administrative organization
Ministry of Territorial Administration

Secretariat
Geographic Institute of Burkina Faso

Directorate of Toponymy

Members

Geographic Institute of Burkina Faso **IGB**	General Directorate of Territorial Administration **DGAT**
Department of History and Archaeology, Training and Research Unit - Human Science, University of Ouagadougou **UFR-SH/UO**	National Institute of Statistics and Demography **INSD**
Department of Geography **UFR-SH/UO**	Institute of Social Science/National Center of Scientific and Technological Research **INSS/CNRST**
Department of Linguistics **UFR-SH/UO**	Directorate of Research, Innovation in Non-formal Education and Literacy **DRINA**
Association of Municipalities of Burkina Faso **AMBF**	General Directorate of Civil Protection **DGPC**
National Brigade of Fire-fighters **BNSP**	Institute of Science and Information and Communication Technologies **ISTIC**

e　Topographic Survey

In the topographic survey, the Study Team visited local administration offices, interviewed officials in charge of geographic information and obtained latest reference materials on villages. Then, the team visited villages and acquired information on the conditions in and around the villages from their leaders.

As the counterparts had not been able to identify high-tension power lines in the area around Ouagadougou, they went to the field with a technician in charge of high-tension power lines of the National Electricity Company of Burkina Faso (SONABEL) to verify routes of the power lines. However, as they were unable to obtain definite answer from the technician, they conducted re-verification and collected additional reference materials available. Because of the lack of accurate route maps of national highways and discrepancies between the actual conditions in the field and data in the reference materials, routes of roads were verified on the ground.

Various incidents that occurred during the field verification mentioned above had a significant influence on the progress of the subsequent work conducted in Japan. The Study Team members did everything they could to make the work progress as planned.

Photo 2-19　Interview with an official of a local administration

Photo 2-20　Interview with a village leader

Photo 2-21　Field survey with an engineer of SONABEL

f　Compilation

Results of the survey (codes) were described on the verification sheets and the photographs taken during the survey sorted by verification subject. Data of annotations were compiled in designated sheets. The table below shows the workflow of the compilation.

Figure 2-16　Workflow of the compilation of verification results

2.9 (11) Digital Plotting/Compilation (Work in Japan)

The outputs mentioned below were created in the digital plotting/compilation conducted in Japan:

- Digital plotting/compilation sheets :40 sheets
- Edit sheets for field verification :40 sheets
- Road maps for verification of roads :40 sheets

2.9.1 Digital Plotting

The digital plotting was carried out in accordance with the standard specifications mentioned below. The data of the orientation of satellite images acquired in the aerial triangulation were used in the digital plotting. In order to facilitate interpretation, all the images used in the plotting were pan-sharpened and stereoscopy of those images was carried out in the plotting.

[Specifications for the plotting]

- Satellite images : ALOS (forward, backward and nadir views)
- Ground resolution: : 2.5 m
- Plotting scale : 1/50,000
- Plotted area : approx. 26,000 km^2
- Number of plotted sheets : 44 (excluding the extended areas)
- Contour intervals : 10 m between the intermediate contours
  50 m between the index contours
- Map projection : BFTM
- Map sheet neatline : 15’ intervals both in the longitudinal and latitudinal directions

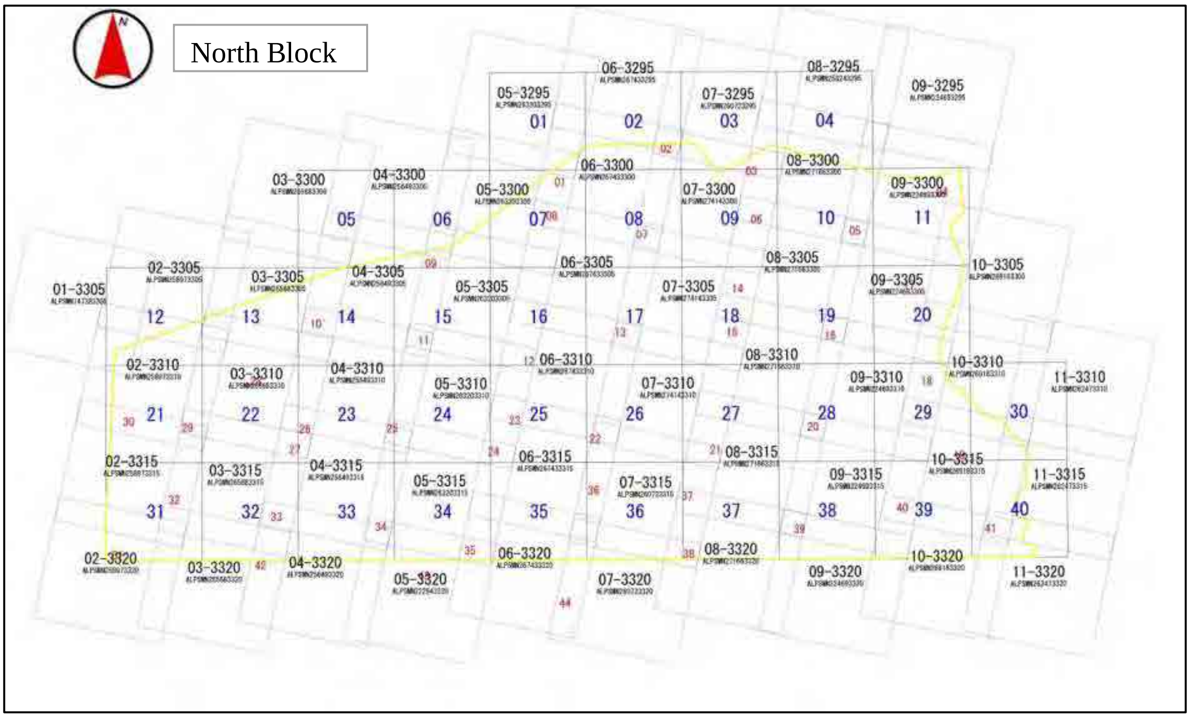


Figure 2-17 Map of digital plotting/compilation sheet divisions (North Blocks)

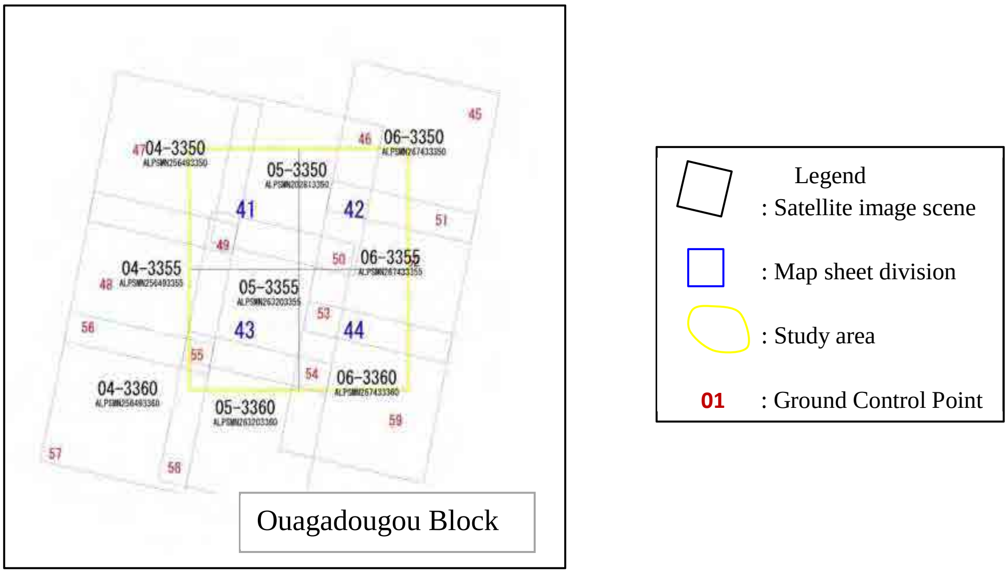


Figure 2-18 Map of digital plotting/compilation sheet divisions (Ouagadougou Blocks)

[Equipment used]

Digital plotter : LPS (Leica)
: Summit (DAT/EM)

[Data used]

The following were the main data and reference materials used in the plotting:

- Preliminary interpretation maps of vegetation, topography, etc. in which the results of the preliminary interpretation of vegetation, topography, etc. conducted by the counterparts were compiled.
- 1/50,000 pan-sharpened color orthophotos
- Collected existing 1/50,000 topographic maps and 1/200,000 map data, etc. Since satellite images were archived data, data on vegetation at the time when the satellite images had been taken were obtained as supplementary data for the interpretation.
- Field identification photos (kmz photographic data file of planimetric features taken on the ground)
- Map symbol specifications (standards for acquisition of data of planimetric features) which is the compilation of the results of the Discussion on Specifications and discussions between the Study Team and IGB held to date
- Resource files specifying line types, etc.
- Photographs depicting conditions on the ground

2.9.2 Digital Compilation

The following specifications were used in the digital compilation:

- Specification
  - Compilation scale : 1/50,000
  - Compilation area : approx. 26,000 km^2
  - Compilation sheet number : 40
  - Map sheet neatline : 15' intervals both in the east-west direction (approx. 26.8 km) and in the north-south direction (approx. 27.7 km)

- Equipment used
  - CAD for compilation : MicroStation V8 (Bentley)

- Digital compilation

  Data on annotations and administrative boundaries derived from the following reference materials were added to the output of the digital plotting.

  1) Field identification photographs (kmz file data of photographs of planimetric features taken on the ground)

     Photographs taken in the field identification of locations interpreted for the plotting were used to verify presence/absence of omission or error in the interpretation and to verify whether data of the planimetric features included in the kmz data file had been acquired or not.

  2) Existing topographic maps (1/50,000)

     These maps were used mainly to enter annotation data and align acquired features.

  3) Existing data (SHP files)

     The existing maps and data were used as reference materials in the compilation of map symbols, annotations and administrative boundaries.

  4) Data on classes of roads

     The data concerned were used to confirm classification of main roads.

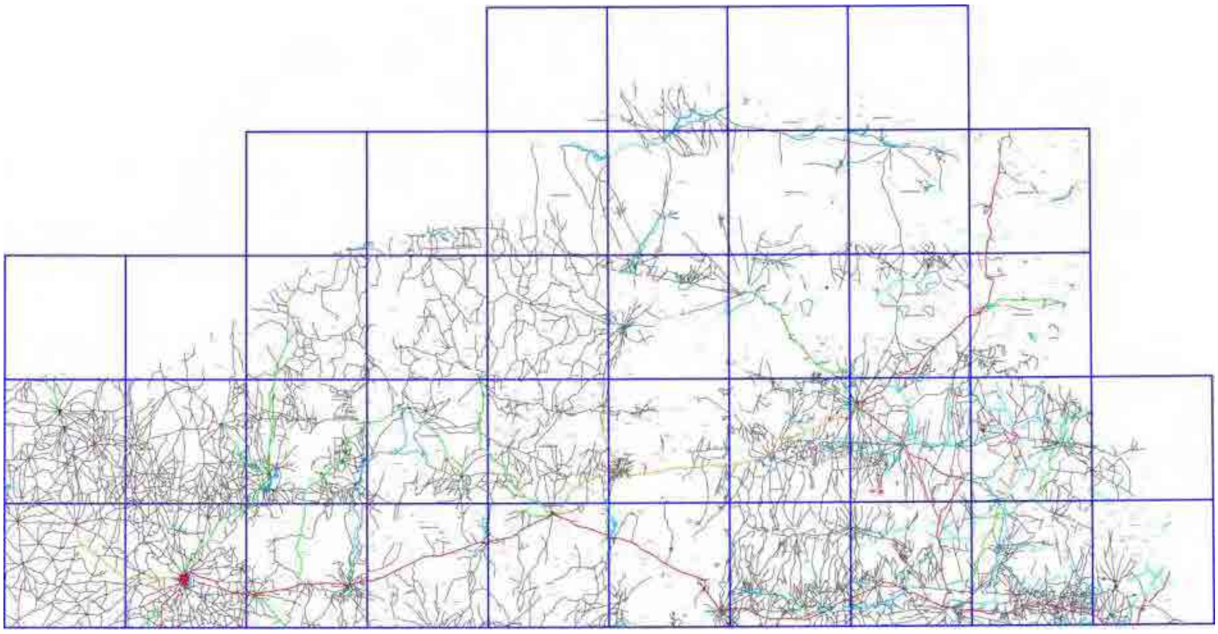


Figure 2-19 An example of road classification data (North Block)

5) Positions and names of villages

Data of areas of villages obtained from the existing maps and their names were added to the outputs of the digital plotting.

6) Field verification subjects

Locations where discrepancies had been identified between the outputs of the digital plotting and data derived from various reference materials were marked with symbols indicating types of verification to be conducted in the field verification. Notes were added where it was difficult to describe the purpose of the verification only with those symbols.

- Output of the Digital Compilation

The digital compilation data were created with MicroStation V8 of Bentley (in the DGN file format).

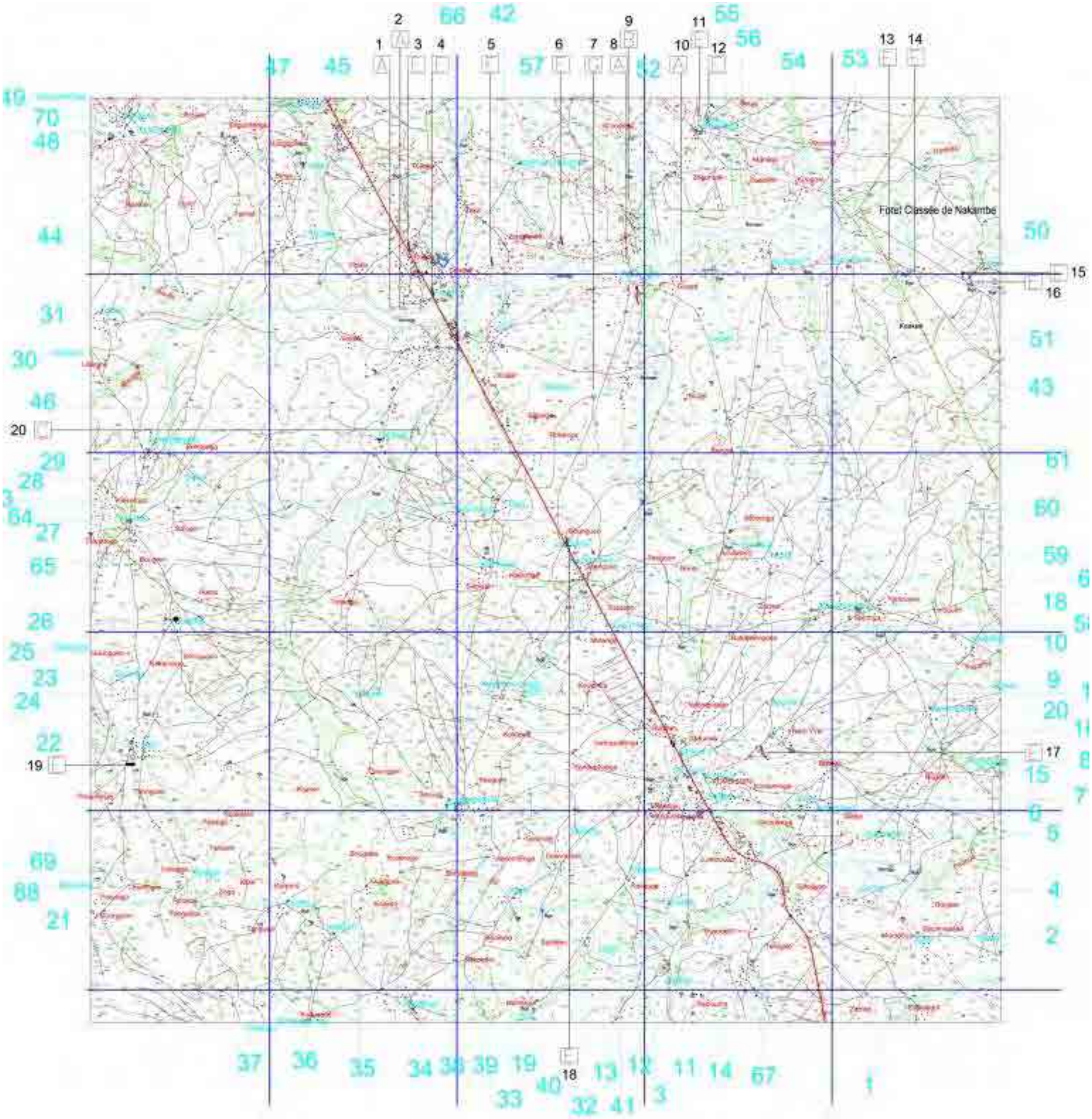


Figure 2-20   An example of Compilation Sheet for Field verification

[Digital Compilation after Field Verification]

The specifications described below were used in the digital compilation after field verification.

- Specification
  - Compilation scale : 1/50,000
  - Compilation area : approx. 26,000 km^2
  - Compilation sheet number : 40
  - Map sheet neatline : 15’ intervals both in the east-west direction (approx. 26.8 km) and in the north-south direction (approx. 27.7 km)

➢ Equipment used

CAD for compilation : MicroStation V8 (Bentley)

➢ Digital compilation after field verification

The outputs of the field verification mentioned below were used as the basic data of the digital compilation after field verification.

- Road tracking data (for identification of village names)
- Results of the field verification

➢ Details

1) Utilization of the road tracking data (for identification of village names)

The track of the vehicle used in the field verification was recorded *wi*th a GPS device. Names of villages along the track studied in the verification were also recorded. Then, the data of village names were used to identify villages whose names had remained unidentified before the field verification.

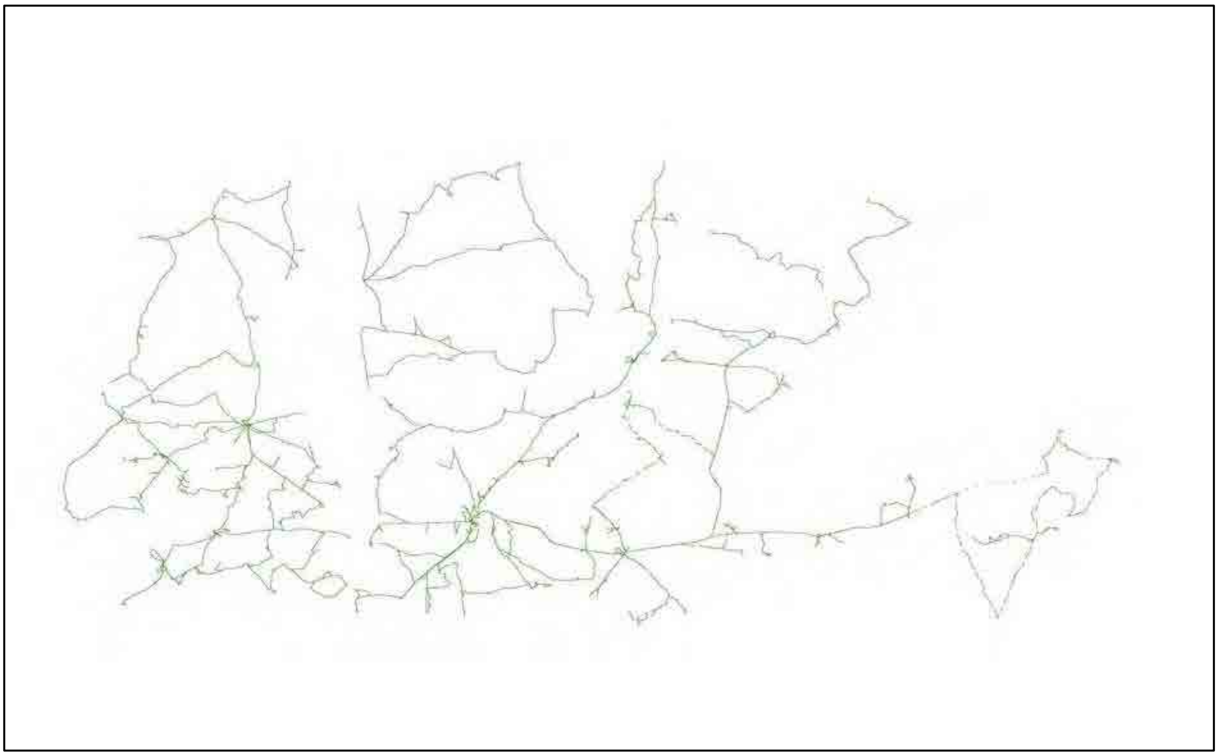


Figure 2-21 Road tracking data

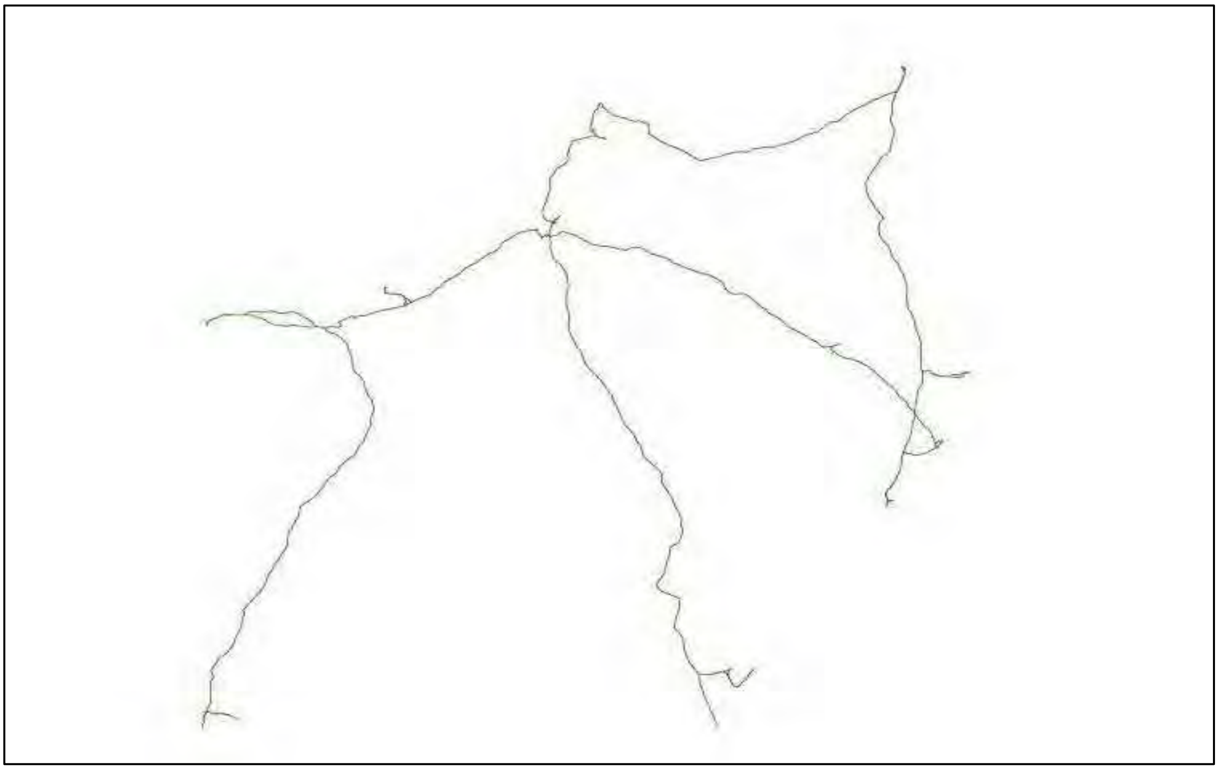


Figure 2-22 Road tracking data (enlarged)

2) Entry of Other Field Verification Results

Data of planimetric features identified as requiring verification in the digital compilation were corrected in accordance with the results of the verification.

Figure 2-23 Photographs of planimetric features taken with a GPS camera and the result of the verification of their locations

➢ Outputs of the digital compilation after field verification

The output data of the digital compilation after field verification were created with MicroStation V8 of Bentley (in the DGN file format).

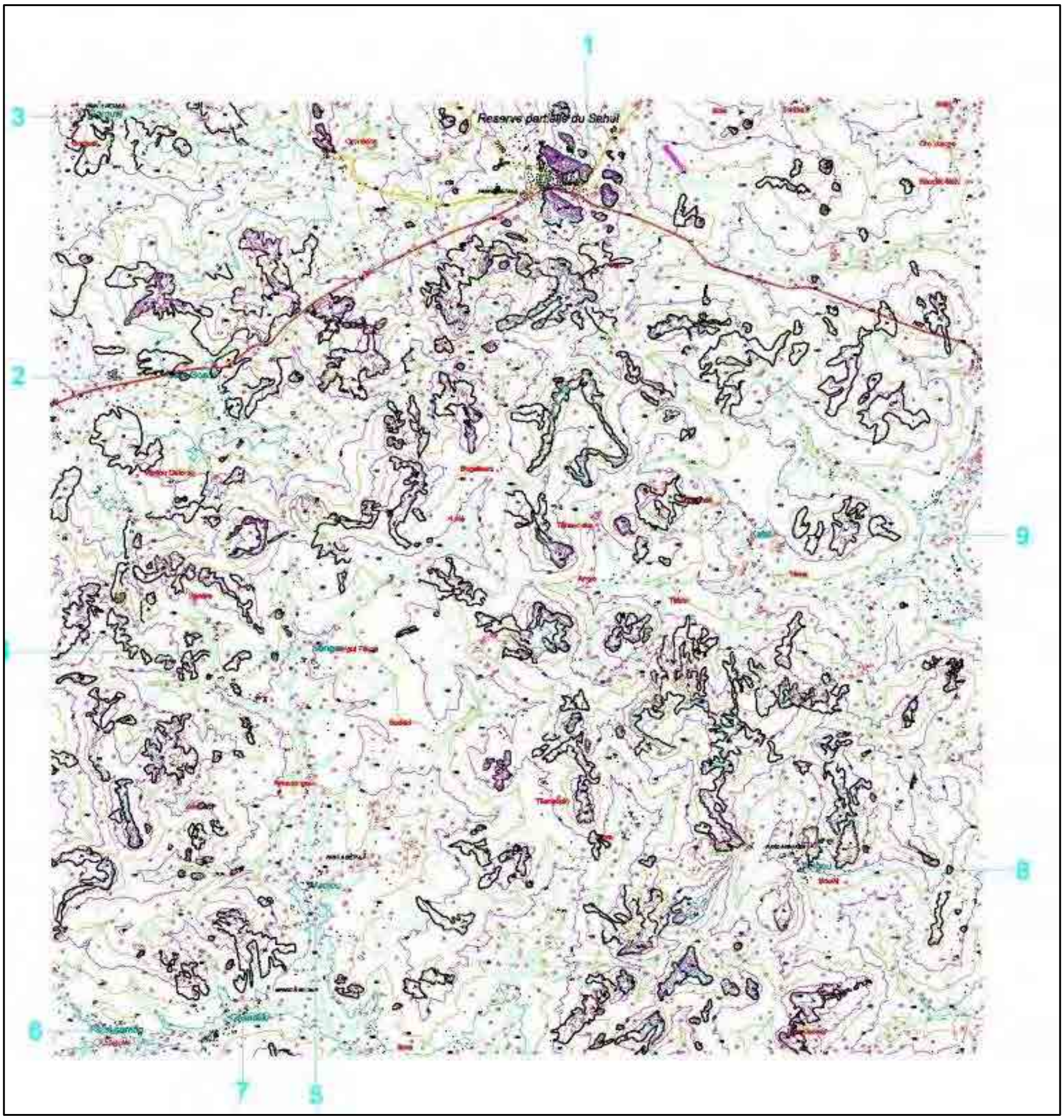


Figure 2-24 Output of the digital compilation after field verification

2.10 (15) GIS Data Structurization (Work in Japan)

The format of the output data of the digital compilation after field verification was converted into a data format supported by GIS and data compilation required for the conversion (structured compilation) was carried out.

[Data structurisation]

In the data structurisation, the output data of the digital compilation after field verification were checked and corrected for logical inconsistency for data structurization with no geometric or topological inconsistency. Bentley Map was used in the structured compilation. The output data of the structurisation were also used as the source data of the map symbolization.

a) Logical check

The data were checked and corrected for the problems mentioned below with the logical check function of the software and processed for creation of polygons.

- Line connection:
  Detection and correction of an error caused by two lines which do not extend far enough to form a continuous line as they are supposed to.
- Undershoot:
  Detection and correction of an error caused by a line which does not extend far enough to touch the line that it is supposed to touch.
- Overshoot:
  Detection and correction of an error caused by a line which extends too far beyond the line that it is supposed to touch.
- Node generation:
  Data processing to generate a node at a point where two lines intersect.

b) Topological Structurization

Topological structurization, or classification of all planimetric features in the output data of the structured compilation into point, line and polygon data, was carried out in accordance with the format rules. As a polygon is composed of other feature elements, a point element which specifies a feature such as savanna or farmland has to be acquired within an area where a polygon is to be created. After creating polygons, the output data were inspected visually for consistency of with the feature classification rule and the following:

- Overlapping of polygons : Are there any overlaps between polygons?
- Gap between polygons : Are there any gaps between adjacent polygons?
- Consistency of classification : Are there any polygons with no feature assigned?

[Creation of GIS data]

The output data of the structurisation were converted into SHAPE file format in accordance with the specifications mentioned below. In principle, name and classification code were the only attributes added to each set of data. Elevation values were added to data of such features as contours which have elevation data. Details of the added attributes are described in the map symbol specifications. A breakdown of the specifications is shown below.

➢ Specifications

- File format : SHAPE format
- Attributes : Name, classification code, etc. (see the map symbol specifications)
- Data division unit : District (a total of 15 district)
- File unit : One SHAPE file per each map symbol item
- Geographic coordinate system : ITRF2008
- Map projection : BFTM
- Reference ellipsoid : GRS80
- Coordinate unit : Meter

2.11 (14) Symbolization/compilation (Work in Japan)

- Specification
  - Map symbolization scale : 1/50,000
  - Map-symbolized area : approx. 26,000 km^2
  - Number of map-symbolized sheets : 40 sheets
  - Map sheet neatline : 15' intervals both in the east-west direction (approx. 26.8 km) and in the north-south direction (approx. 27.7 km)
- Equipment used
  - CAD for map symbolization : MicroStation V8 (Bentley)
    : Bentley MAP (Bentley)
  - Creation of symbolized map data : Adobe Illustrator (Adobe)

- Symbolization of topographic maps

The output data of the digital compilation after field verification were used for the map symbolization, which consisted of the following:

1) Data structurization for map symbolization;
2) Preparation of a marginal information plate; and
3) Map symbolization.

- Details

1) Data structurization for map symbolization

   In order to perform map symbolization and create data for GIS applications, the data were processed in such a way that a geometric structure compliant with the standard specifications could be created from the processed data.

   - Line connection and node generation

     The data were inspected to ascertain whether features which were supposed to be connected to each other had been connected or not. If not, necessary correction was made on the data. Nodes required for creation of polygons were generated at points of intersection between features.

   - Creation of polygons

     Lines required for creation of polygons of features which were to be represented as polygons were extracted from the data.

2) Preparation of a marginal information plate

   The conclusion of the discussion between IGB and the Study Team was incorporated in the description of the marginal information and the marginal information on the existing maps was used as reference in the preparation of the marginal information plate.

3) Map symbolization

A map symbol was created for each feature in accordance with the map symbol specifications.

➢ Outputs of the map symbolization

The output data of the map symbolization were created in Adobe Illustrator (AI) data format.

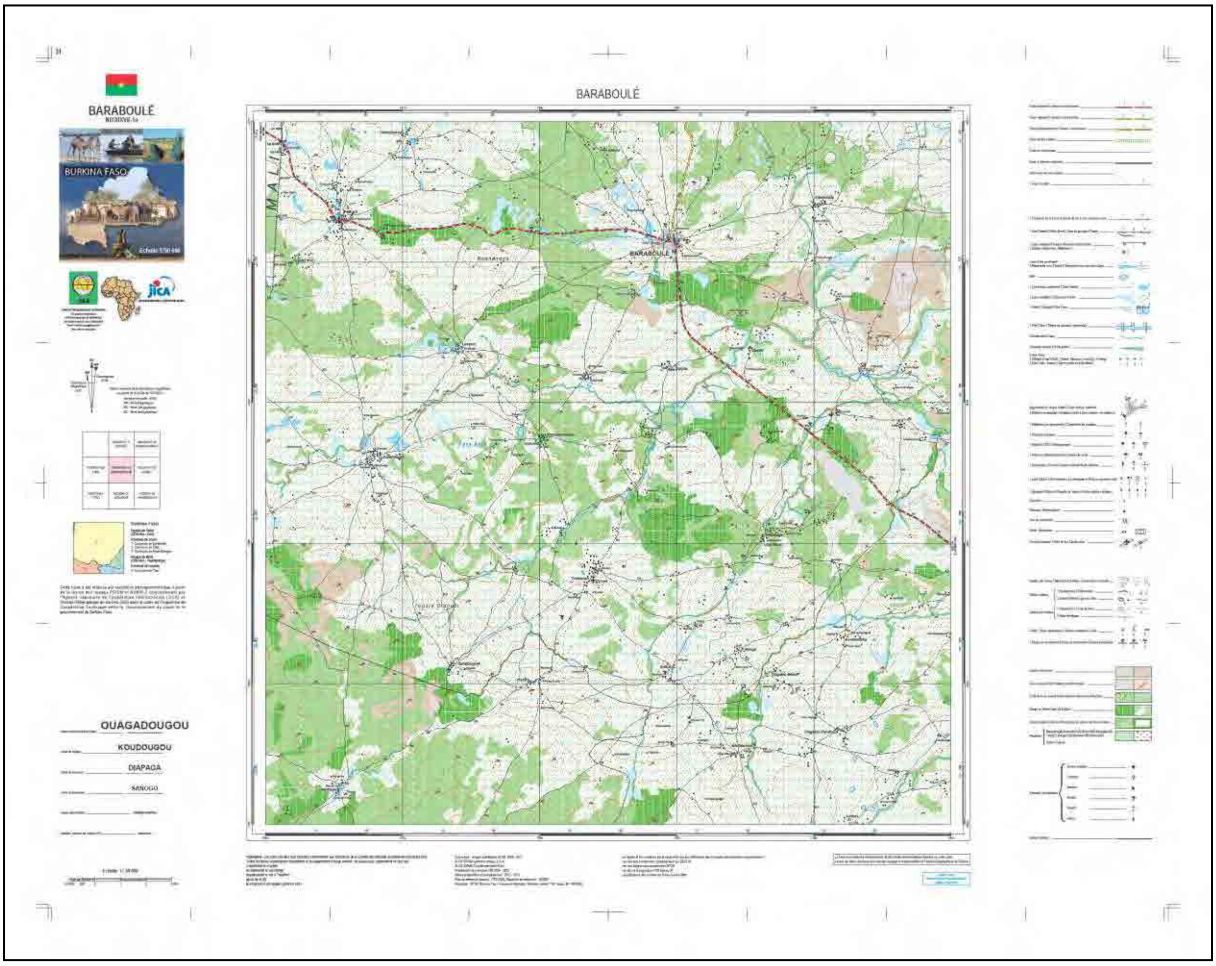


Figure 2-25 A topographic map after the map symbolization (ND30XVII-1a)

[Quality control]

Each map sheet was inspected at each of the stages mentioned below and the results of the inspection were compiled in accuracy control tables.

- Digital plotting
- Digital compilation

- Map symbolization

Samples of accuracy control tables are shown below.

Table 2-11 Accuracy control table-1 Digital plotting

Sample quality control sheet **Digital plotting,Data compilation/Symbolization** **Quality control sheets** **Checked Date : 20/Jul/2011**

Project Name	Sheet Name/No.	Mapping Scale	Volume	Executive Organization	Chief Engineer	Checked by
	0114		0.1K㎡	AERO ASAHI CO.,LTD.		

Item	Missing	Error	Item	Missing	Error	Item	Missing	Error	Item	Missing	Error
Geodetic points			**Railway institutions**			**Water features**			Water name		
Classification	0	0	Over bridge	0	0	Classification of symbol items	0	0	Place ground name		
Value	0	0	Platform	0	0	Position of symbol items	0	0	**Marginal information**		
Contour Lines			**Administrative Boundaries**			Form of line items	0	0	Sheet Name/No.		
Form	0	0	Classification	0	0	**Traffic**			District name		
Value	0	0	Form	0	0	Classification	0	0	Neat & Grid Line		
Roads			**Public facilities**			Position	0	0	Coordinates Value,etc.		
Classification	0	0	Classification	0	0	**Vegetation**			Scale Bar/Map symbol		
Form	0	0	Position	0	0	Form of boundary	0	0	Sheet index		
Road institutions			**Buildings**			Classification of symbol	0	0	Sheet History		
Embankment	0	0	Classification	0	0	**Natural features**			Planning / Executing Org.		
Underpass	0	0	Form	0	0	Classification	0	0	Others		
Over bridge	0	0	**Fences**			Form	0	0	Connection between adjacent sheets	0	0
Distance marker	0	0	Form	0	0	Flow direction	0	0			
Bridge	0	0	**Building symbols**			**Annotation**					
Foot bridge	0	0	Classification	0	0	Administration name					
Road divider	0	0	Position	0	0	Road name					
Railways			**Accessory objects**			Road institution name					
Classification	0	0	Classification of symbols	0	0	Railway name					
Form	0	0	Position of symbols	0	0	Railway station name					
			Form of lines	0	0	Building name					

Table 2-12 Accuracy control table-2 Digital compilation

Sample quality control sheet | Digital plotting,Data compilation/Symbolization | Quality control sheets | Checked Date : 25/Nov/2011

Project Name	Sheet Name/No.		Mapping Scale	Volume		Executive Organization			Chief Engineer	Checked by	
	0224			20.7K㎡		AERO ASAHI CO.,LTD.					
Item	**Missing**	**Error**	**Item**	**Missing**	**Error**	**Item**	**Missing**	**Error**	**Item**	**Missing**	**Error**
Geodetic points			**Railway institutions**			**Water features**			Water name	0	0
Classification	0	0	Over bridge	0	0	Classification of symbol items	0	0	Place ground name	0	0
Value	1	0	Platform	0	0	Position of symbol items	0	0	**Marginal information**		
Contour Lines			**Administrative Boundaries**			Form of line items	0	0	Sheet Name/No.	0	0
Form	0	0	Classification	0	0	**Traffic**			District name	0	0
Value	0	1	Form	0	0	Classification	0	0	Neat & Grid Line	0	0
Roads			**Public facilities**			Position	0	0	Coordinates Value,etc.	0	0
Classification	0	0	Classification	0	0	**Vegetation**			Scale Bar/Map symbol	0	0
Form	0	0	Position	0	0	Form of boundary	0	0	Sheet index	0	0
Road institutions			**Buildings**			Classification of symbol	0	0	Sheet History	0	0
Embankment	0	0	Classification	0	0	**Natural features**			Planning / Executing Org.	0	0
Underpass	0	0	Form	0	0	Classification	0	0	Others	0	0
Over bridge	0	0	**Fences**			Form	0	0	Connection between adjacent sheets	0	0
Distance marker	0	0	Form	0	0	Flow direction	0	0			
Bridge	0	0	**Building symbols**			**Annotation**					
Foot bridge	0	0	Classification	0	0	Administration name	0	0			
Road divider	0	0	Position	0	0	Road name	0	0			
Railways			**Accessory objects**			Road institution name	0	0			
Classification	0	0	Classification of symbols	0	0	Railway name	0	0			
Form	0	0	Position of symbols	0	0	Railway station name	0	0			
			Form of lines	0	0	Building name	0	0			

Table 2-13 Accuracy control table-3 Map symbolization

Sample quality control sheet | Digital plotting,Data compilation/Symbolization | Quality control sheets | Checked Date : 25/Dec/2011

Project Name	Sheet Name/No.		Mapping Scale	Volume		Executive Organization			Chief Engineer	Checked by	
	0119			22.2K㎡		AERO ASAHI CO.,LTD.					
Item	**Missing**	**Error**	**Item**	**Missing**	**Error**	**Item**	**Missing**	**Error**	**Item**	**Missing**	**Error**
Geodetic points			**Railway institutions**			**Water features**			Water name	0	0
Classification	0	0	Over bridge	0	0	Classification of symbol items	0	0	Place ground name	0	0
Value	0	0	Platform	0	0	Position of symbol items	0	0	**Marginal information**		
Contour Lines			**Administrative Boundaries**			Form of line items	0	0	Sheet Name/No.	0	0
Form	0	0	Classification	0	0	**Traffic**			District name	0	0
Value	0	0	Form	0	0	Classification	0	0	Neat & Grid Line	0	0
Roads			**Public facilities**			Position	0	0	Coordinates Value,etc.	0	0
Classification	0	0	Classification	0	0	**Vegetation**			Scale Bar/Map symbol	0	0
Form	0	0	Position	0	0	Form of boundary	0	0	Sheet index	0	1
Road institutions			**Buildings**			Classification of symbol	0	1	Sheet History	0	0
Embankment	0	0	Classification	0	0	**Natural features**			Planning / Executing Org.	0	0
Underpass	0	0	Form	0	0	Classification	0	0	Others	0	0
Over bridge	0	0	**Fences**			Form	0	0	Connection between adjacent sheets	0	1
Distance marker	0	0	Form	0	0	Flow direction	0	0			
Bridge	0	0	**Building symbols**			**Annotation**					
Foot bridge	0	0	Classification	0	0	Administration name	0	1			
Road divider	0	0	Position	0	0	Road name	0	0			
Railways			**Accessory objects**			Road institution name	0	0			
Classification	0	0	Classification of symbols	0	0	Railway name	0	0			
Form	0	0	Position of symbols	0	0	Railway station name	0	0			
			Form of lines	0	0	Building name	0	0			

Quantities of omissions and erroneous entries were recorded by type of feature. The correction was made on the omissions and errors detected in the inspection at each stage before the data were used in subsequent stages.

2.12 (16) Creation of Data Files (Work in Japan)

The output data of the data structurization and map symbolization were created as topographic map data and GIS basic data, respectively, in the data formats mentioned below. Map sheet and the district were used as the units of file division of the topographic map data and GIS basic data, respectively, as mentioned in the previous section. For the expected use for data correction for changes of features expected in future, a DGN data file and a DWG data file were created for each map sheet as outputs of the structured compiling. The topographic map data and the output data of the structured compilation were created in AI and DGN file formats, respectively. In addition, PDF files of the topographic map data and DWG files of the structured compilation data were created for wider application. Those data files mentioned above were saved in such storage media as HDDs or DVDs.

- Topographic map data : PDF and AI file formats, by map sheet
- GIS basic data : SHAPE file format, by district
- Output data of structured compilation : DGN and DWG file formats, by map sheet

2.13 (17) Printing of Topographic Maps (Work in Burkina Faso)

Since IGB has had no printing equipment, it has had to contract out the printing of maps. However, as there was no printing company in Burkina Faso, the map printing work in this project was contracted out to the company in Niger mentioned below.

Name of Company	:NOUVELLE IMPRIMERIE du NIGER
Director	:Mr. Maman ABOU
ADDRESS	:Place du Petit Marche, face Pharmacie de L'Espoir
Additional	: Quartier Terminus, BP 12015, City Niamey, NIGER
TEL	:+227-20 73 47 98
	+227-20 73 52 78
	+227 20 73 46 36
e-mail	:nin@intnet.ne

In the printing process in this project, 8,000 map sheets (200 copies each of the 40 sheets) were to be printed in two weeks. All those map sheets to be output were printed and delivered to IGB within this time period.

2.14 Creation of Orthophoto

DEMs were obtained with the stereo matching function of the plotting system using control point elements obtained from aerial triangulation. The obtained DEMs and nadir view images from ALOS/PRISM were used for the creation of the orthophoto data. Color orthophotos were obtained by the pan sharpening method using ALOS/AVNIR-2 color images. DEMs were for creation of orthophoto data; DEMs were not used for automatic generation of contour lines. The figure below shows the area covered by the created orthophotos.

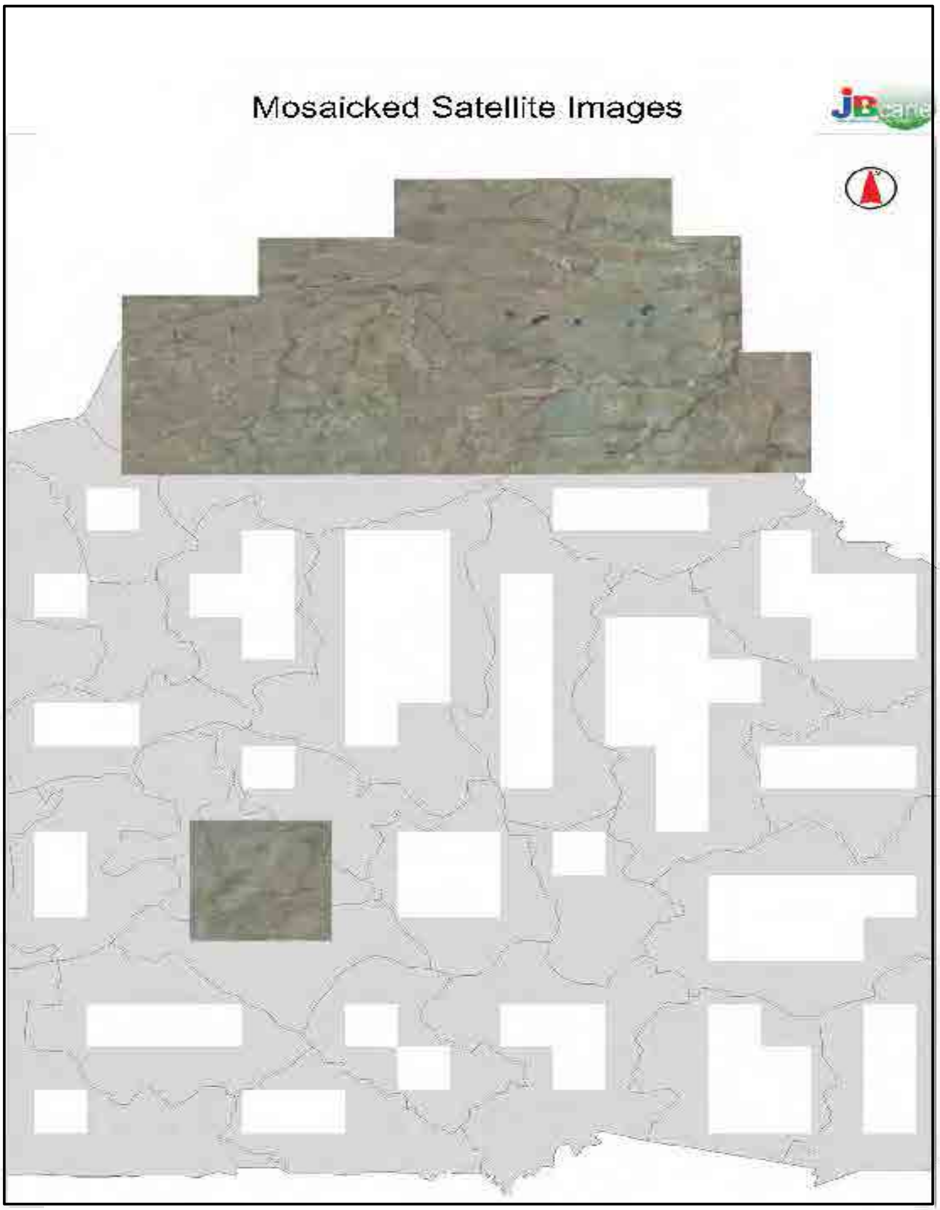


Figure 2-26 Area covered by created orthophotos

2.15 Presentation Ceremony of the Topographic Maps

The topographic maps created in the Project were presented to the Government of Burkina Faso at the conclusion of the Project. The presentation ceremony was well attended by more than 70 people, including the Parliamentary Vice-Minister for Foreign Affairs of the Government of Japan, Mr. Ishihara, the Minister of Infrastructure, Development and Transport of the Government of Burkina Faso and many other senior government officials of Burkina Faso. The following is the summary of the ceremony.

1. Date and time: July 1, 2014 from 16:00 to 17:00
2. Venue: The Chamber of Commerce and Industry of the City of Ouagadougou
3. Sponsors: IGB and JICA
4. Attendees: See the list of attendees
5. Purposes: To notify the general public of the existence of topographic map data of Northern Burkina Faso and Ouagadougou and its environs created in this project and to facilitate the use of the data for development and survey activities in future in Burkina Faso through this publicity activity

Photo 2-22 Presentation Ceremony of the Topographic Maps (from left to right: Mr. Morishita, Chief Representative of JICA Burkina Faso Office, Mr. Ishihara, Parliamentary Vice-Minister, Mr. Ouedraogo, Minister of Infrastructure, Development and Transport, Mr. Futaishi, Ambassador of Japan to Burkina Faso and Mr. Tapsoba, Director General of IGB)

Photo 2-23 The Parliamentary Vice-Minister, Mr. Ishihara, Presents a Topographic Map to the Minister of Infrastructure, Development and Transport, Mr. Ouedraogo

【Program of the Presentation Ceremony】

16:00 Reception
16:15 Address of the Parliamentary Vice-Minister for Foreign Affairs of the Government of Japan, Mr. Ishihara — 5 min.
16:20 Address of the Minister of Infrastructure, Development and Transport of the Government of Burkina Faso, Mr. Ouedraogo — 10 min.
16:30 Press conference
16:50 *Pause-café* (Coffee break)

Photo 2-24 The Minister of Infrastructure, Development and Transport, Mr. Ouedraogo, and the Parliamentary Vice-Minister, Mr. Ishihara, Inspect the Training Room of the IGB Project

Photo 2-25 The Assistant Team Leader of the Project, Mr. Ikeda, Explains the Topographic Maps to the Parliamentary Vice-Minister, Mr. Ishihara, during the Coffee Break

Table 2-14 List of Participated Organization to the Presentation ceremony

No.	Organizations
1	Mr. Hirotaka ISHIHARA, Parliamentary Vice-Ministar for foreign Affairs Member, The House of Representative
2	Minister of Infrastructure, Development and Transport
3	Minister of Housing and Urban development
4	Technical Advisor to the Minister of Infrastructure, Development and Transport
5	Minister of Territorial Administration and Decentralization
6	Minister of Youth and Employment
7	Deputy Minister of Transport
8	The Chef of the Defense Staff
9	Mr. KITAGAWA, Excutive Assistant to Mr. Hirotaka ISHIHARA
10	Mr.ISHIMARU, Principal Deputy Director First Africa Division African Affairs Department
11	Embassies : Mr. FUTAISHI Plenipotentiary, Ms. KAMEDA 3rd Secretary,
12	Embassy, France – European Union
13	UEMOA
14	Members of National Commission on Toponymy (DGPC, BNSP, ISTIC, INSD, ISS, Geography, history, linguistics, DRINA) (09)
15	General Direction of Urban development and Topography (DGUT)
16	General Direction of Taxes (DGI)
17	IFN (National Forest Inventory) Project Coordinator
18	General Direction of Land Development and Decentralization Support (DGAT/AD)
19	General Direction of Local and Regional Land Development (DGAT/DL)
20	Permanent Secretariat of National Council for the Environment and Sustainable Development
21	General Direction of Mines and Geology of Burkina
22	General Direction of National Soil Office
23	Advanced Research Institute of Demography, Ouagadougou University
24	General Direction of National Institute for Environment and Agricultural Research
25	General Direction of Water Resources
26	General Director of National Tourism Office
27	General Direction of Cooperation
28	General Direction of Land Administration (DGAT/MATS)
29	Members of the Board of Directors of IGB
30	Directions of Ministry of Infrastructures of Remote areas and Transportations
31	Former General Directors of IGB (Tarnanguida, Bassolé, lohouara)

[Speech by Mr. Hirotaka ISHIHARA, Vice Ministar of Ministry of Freighn Affaires]

Digital Topographic Mapping Project in Burkina Faso
Presentation of the completed map

I consider it a great honor to have the opportunity to participate in this ceremony during my visit to Burkina Faso. It is with great pleasure that I share the stage today with H.E. Mr. Jean Bertin Ouedraogo, Minister of Infrastructure, Development and Transport at this presentation of the topographic map which marks the culmination of the project.

As you all know, Japan and Burkina Faso have a history of friendly relations that spans many years, and Japan has made an active contribution to the development of Burkina Faso through our country's Official Development Assistance.

Making good use of the advanced topographic mapping technologies Japan has developed to the present time, starting in 1971 we have implemented cooperation projects related to mapping in countries all over the world; in Africa, so far we have implemented projects in 23 countries.

The digital topographic maps created in this project will provide a foundation for development programs of all kinds, including urban planning, road maintenance and improvement projects, and projects to improve agricultural land. In addition, in order to enable the continued use and application of topographic maps, in this project the relevant technology was passed on to the technical experts of the Geographic Institute of Burkina Faso. I have great expectations that this cooperation between our two countries will contribute to the sustained development of Burkina Faso.

Furthermore, in this project initiatives were taken in collaboration with UEMOA to help spread topographic map-making techniques throughout West Africa. It is my dearest wish that cooperation within the area will help promote the economic integration of UEMOA.

In this way, Japan has put its expertise to use in implementing cooperation projects based on the needs of Burkina Faso; and it is my hope that I will be able to work to strengthen and enhance still further the relationship between our two countries.

[Speech of the Minister of Infrastructure, Development and Transport]

AT THE PRESENTATION CEREMONY
OF
DIGITAL TOPOGRAPHIC MAPS AT A SCALE OF 1/50,000

- *Ladies, Gentlemen, Members of the Government;*
- *His Excellency, the Ambassador of Japan;*
- *Ladies, Gentlemen, Representatives of Diplomatic Missions and International Organizations;*
- *Dear Collaborators;*
- *Distinguished guests with your respective ranks and titles;*
- *Ladies and Gentlemen;*

Last January, after the delivery of topographic maps at a scale of 1/200,000, updated for the Western half of our country, we are holding another event of similar importance this afternoon, which is the delivery of the digital topographic maps at a scale of 1/50,000.
We wish to thank all the persons who are honoring us with their presence, and I wish to inform you again that the signing of the convention for the production of digital topographic maps for northern part of Burkina Faso, between the Government of our country and the counterpart in Japan, was held in October 2011.
Since then, the staff assigned to implement the project have been working incessantly. These are employees of the Geographic Institute of Burkina Faso (IGB) and the Study Team of Japan International Cooperation Agency (JICA).
In order to assure the installation of production equipment, the training of IGB personnel and the gathering of data required to obtain details taken from satellite images under the kind supervision of the Japanese experts, these teams have worked tirelessly for two years, braving heavy rains, difficult access roads, and at the risk of their own personal safety… in order to comply with the given deadlines.

- *Distinguished Guests;*
- *Ladies and Gentlemen;*

These workers who went over the field, from village to village, hamlet to hamlet, to gather said information from local authorities and the residents, well deserve our heartfelt congratulations. I also wish to thank the Japanese experts who, simply from the sampling stage, were able to very quickly familiarize themselves with the type of land occupation in Burkina Faso, as well as the experts contributed to the success of the project remotely from Japan, without setting foot in Burkina Faso.

Furthermore, in spite of the language barrier, the Japanese experts were able to successfully execute the transfer of skills to the IGB personnel for use of the equipment which is now the property of Burkina Faso. Leadership from Burkina Faso has therefore been reinforced through the Technical Cooperation Project of the Japanese Government.

The concentration of all these efforts has now allowed the use of forty (40) new maps covering Ouagadougou and the northernmost part of our country. For the North area, these maps covered the Djibo, Diguel, Tin-Akof, Markoye, Falangountou, Dori, Arbinda, and Baraboulé communes and for Ouagadougou area, the city and communes of Kombissiri and Saponé.

- *Distinguished Guests;*
- *Ladies and Gentlemen;*

This project has benefited not only our country, but has offered cooperation frameworks for countries in the West African Economic and Monetary Union (UEMOA) for shared concerns, through the two seminars held in Ouagadougou.

The first seminar was held on December 18 and 19, 2012, bringing together the directors general of the cartography departments of UEMOA member countries and Guinea. For the participating countries, this seminar provided the occasion to share experiences with their Japanese colleagues. The West African Economic and Monetary Union has also benefited from this seminar in order to inform the participants of its projects and to express its expectations on national cartography agencies.

The second seminar was organized in February 2014 and, aside from the directors general of mapping agencies, it brought together the managers of geographical data user departments. In this seminar, the participants exchanged the concerns of users in order to better direct map production to their needs.

- *Ladies and Gentlemen;*
- *Distinguished Guests;*

From an estimated amount of more than two billion six hundred million FCFA, the project has provided maps at finer scales, allowing more accurate targets for projects and investment priorities. The production of these maps required the provision of satellite images ALOS PRISM with a geometric resolution of 2.5 meters, together with color images (ALOS/AVNIR2), in order to provide better demarcation of land occupation.

The outputs of this project will be developed through multiple uses such as early alerts and response to disasters, project planning in fields as varied as water, agriculture, health and infrastructures.

I also wish to take this occasion to renew our gratitude and heartfelt thanks to the people and Government of Japan for their multi-form support to Africa in general and to Burkina Faso in particular.

- *To His Excellency, the Ambassador of Japan;*

Along with many African countries, Burkina Faso falls way behind in the field of geo-information. Since our needs remain high in this field, I would like to request that you be our spokesperson to your Government, in order to once again express our gratitude to the generous Japanese people for their efforts to assist Burkina Faso in the mapping of the territory and the training of the staff in Japan. Kindly inform your Government of our needs and concerns, which may eventually be embodied in projects to be submitted to your country.

Before my closing remarks, please allow me to reiterate my encouragement to all IGB personnel who I hope will benefit from this rich experience in order to continue their excellent work on a daily basis.

- *We look forward to more reliable and efficient spatial data acquisition,*
- *As well as a fruitful and lasting cooperation between Burkina Faso and Japan!*

Thank you very much!

Chapter 3 Promotion of Data Utilization Plan

3.1 (18) Promotion of Data Utilization Plan (Work in Burkina Faso)

To promote utilization of map data and GIS data, it is necessary to enhance public relations and develop an environment in which the data is provided. Therefore, the following operation was conducted in accordance with a basic recognition of the status quo and in the issues that are the background of the project. In addition, the Study Team constructed a website for data utilization as mentioned below, in response to a strong request from IGB, after having held consultation with JICA on the matter.

3.1.1 Holding of Seminars

[Period of Operation]

April 24 to May 28, 2012

[Description of Operation]

Seminars were held as a part of activities in the Study on Data Utilization Plan (Phase 1).

[Purposes of Operation]

The purposes of operation by the utilization plan are as follows:

1) Promoting utilization of topographic map results and carrying out public relation activities
2) Promoting wide-area collaboration for topographic mapping technology, etc.
3) Constructing a system for promoting utilization

[Overview of Operation]

In this Phase 1 study, information was exchanged with and collected from the government agencies of Burkina Faso, output user organizations and national surveying/mapping organizations from UEMOA member countries and Guinea, and the relevant Japanese personnel.

(1) Bureau of Mines and Geology of Burkina (Bureau des Mines et de la Géologie du Burkina)

- Interviewee: Mr. Jean Alphonse SOME
Chief of Geologic and Mineral Survey Section
Mr. Samuel G. DJIGUEMDE
Geologic technician
- Subject of discussion
  - At present, the organization is creating geological maps such as topographic maps based on 1/200,000 maps. However, it is **urgently required to create thematic maps based on detailed maps (1/50,000)**.

- The map data currently used as the basis has been supplied from IGB. Since the organization has a close relationship with IGB, they have great expectations for the results of the project.
- Training on GIS-based creation of thematic maps is required (Human resources development is the issue).

[Consideration]

Not only the Bureau of Mines and Geology of Burkina, but the major organizations within Burkina Faso, such as forestry, natural environment, conservation of wildlife, water resources, etc., are working on developing thematic maps using GIS, based on the geospatial information (hereinafter referred to as "map") data being prepared by IGB. The thematic maps will be heavily used for analysis of planar areas, and structured map data is suitable for use, so it is considered that the method of transmission and supply of the maps from the producer IGB will be important. In addition, it is considered that human resource development measures to provide both the technology for topographic mapping and the technology for development of thematic maps (GIS) are necessary. For example, it is considered necessary to investigate the promotion of participation of technicians from both IGB and the Bureau of Mines and Geology of Burkina in training in Japan (participation in GIS courses and remote sensing technology courses), or the dispatch of JICA technical cooperation experts.

It is considered necessary to encourage other organizations as well as the Bureau of Mines and Geology to actively utilize the data, taking into consideration use of the outputs during the project.

(2) UEMOA: Union Economique et Monétaire Ouest Africaine (West African Economic and Monetary Union)

- Interviewee: Mr. Prosper S. KEDAGNI
  Officer in charge of regional development
- Subject of discussion

i) They are aware of the necessity of the development of maps from the point of view of regional development, but because of the lack of technicians there has been no specific progress in that discussion. However, the officer in charge understood the effectiveness of technology transfer through the map production project and the importance of linking up with IGB.

ii) Around October 2013 a technician was scheduled to be appointed, who would then make contacts and discussion regarding detailed matters in connection with map development.

iii) It is necessary that the technical capabilities be levelized in the participating regions, and technical workshop meetings are necessary, through the technical seminar for wide-area collaboration. Technical workshop meetings are necessary. Also, participation will not necessarily be limited to UEMOA member countries, but it was declared that there was agreement that non-member countries such as Guiniea and Ghana could participate.

[Consideration]

Rather than being a map user organization, UEMOA is an organization that takes measures to stabilize the West African region (CFA franc currency countries). Hence they hold various seminars and workshops aimed at stable development of the region, and hold management training, and have constructed a strong shared network in these fields.

Using the UEMOA network which is already constructed is a good approach to raising awareness for the utilization of the mapping field, and it is necessary to propose cooperation regarding holding a technical seminar for wide-area collaboration in December. In addition efforts should be made to share various kinds of information through JICA experts dispatched to UEMOA, which is considered to be the necessary impetus for the promotion of map development and awareness of their use in the West Africa region.

(3) Holding of Meeting about Maps

The staff of the Japanese Embassy in Burkina Faso and people related to JICA were invited to an explanatory meeting about maps as a map promotional activity.

[Objectives]

The objective of this explanatory meeting was to provide relevant Japanese personnel in Burkina Faso with an overview of this project, and to provide explanations and impart understanding regarding the basics of viewing and reading maps, etc., and the future trends in geospatial information.

[Expected Effect]

By making Japanese personnel with local connections, such as experts, volunteers, etc., aware of the map information, it was expected that it would promote awareness of the existence of the maps among relevant local persons, and promote their use.

[Issues and Measures]

As the number of volunteers and experts that participated was small, in the future an explanatory meeting will be held again at the completion of the project, after making sufficient contacts.

[Outline of the Meeting]

- Date and time : Friday, May 18, 2012 16:00 – 17:30
- Place of venue : Conference Room, JICA Burkina Faso Office
- Contents explained :
  - Discussion about maps: Viewing and reading maps, explanation of map symbols, etc.
  - Summary of the JBcarte map project: Summary of the project that is now ongoing
  - Geospatial information in the future: The status of the latest map development in progress in Japan was introduced through the work of the Geospatial Information Authority of Japan. (Preparation of electronic basic maps of the national land from the basic map information.)

Table 3-1 Participants, names, honorifics omitted, in no particular order

Surname, given name	Title	Affiliation
HARADA Norie	Second Secretary	Embassy of Japan in Burkina Faso
MORIYA Yuji	Head of office	JICA Burkina Faso Office
OGAWA Jo	Employee (responsible for project)	JICA Burkina Faso Office
MARUKAWA Yoko	Coordinator	JICA Burkina Faso Office
YISHIKAWA Jun	Expert	Projet Améli-EAUR
OHNO Yukiko	Coordinator	Projet Améli-EAUR
SUGIURA Satomi	Medical coordinator	JICA Burkina Faso Office
TAKEKOSHI Kumiko	Study Team member	JICA Burkina Faso Office
SAITO Yukiko	Expert	Projet d'Appui aux Comités de Gestion d'Ecole

[Consideration]

By explaining the outline of the map project to relevant Japanese persons in Burkina Faso before informing the people of Burkina Faso, it was expected that there would be a propagation effect regarding the features, interesting points, and uses of maps at the workplaces of the Japanese persons that have participated.

In general, much interest was shown in discussions about the earth, comparison of satellite images and aerial photographs, various symbols, etc. In the future, when the maps are completed, the participants can take the initiative in using the maps in their work, and promote the use of the data at each government organization, in school education, medical treatment, water supply, agriculture, etc.

Photo 3-1 Explanatory meeting about maps on Friday, May 18, 2012 at JICA Office conference room

(4) Opening Seminar (Project Kickoff)

At the start of the project, an opening seminar was held as follows:

- Date and time : Friday, May 25, 2012 08:00 - 11:30
- Location : IGB
- Attendance : About 100 persons
- Speeches (in order of speeches) : Director General of IGB
  Chief Representative of JICA Burkina Faso Office
  Japanese ambassador to Burkina Faso
  Administrative Vice-Minister of Ministry of Infrastructure, Burkina Faso

[Overview]

In order to publicize the start (kick off) of the project, about 100 persons were invited to the counterpart organization, Institut Géographique du Burkina (IGB) for the kick off seminar. After the greeting from the Director General of IGB, which is the major party to the project, the Chief Representative of JICA Burkina Faso Office and the Japanese ambassador to Burkina Faso provided a greeting regarding the significance of Japanese project assistance and their expectations for the development of Burkina Faso. After the greeting by the Administrative Vice-Minister of the Ministry of Infrastructure of Burkina Faso, IGB personnel provided explanations of panels summarizing the process of making topographic maps, which were displayed within the Bureau.

Photo 3-2　Mr. Tapsoba, Director General of IGB

Photo 3-3　Mr. Sugiura, Ambassador Plenipotentiary

Photo 3-4　Administrative Vice Minister of the Government of Burkina Faso

Photo 3-5　EU ambassador and Ms. Harada, Second Secretary

Photo 3-6　Mr. Moriya, Chief Representative of JICA Burkina Faso Office

Photo 3-7　Panel explanation by Mr. Belem, IGB Technical Director

(5) Map User Meeting

[Objectives]

This meeting was held with the objectives of giving the various organizations within Burkina Faso that are anticipating using the map data from IGB an understanding of the project specification, etc., and to hear the opinions on the methods of providing the data to suit the convenience of the users.

[List of participating organizations]

Participating organizations are as follows.

- Bureau of Mines and Geology of Burkina
- National Council for Combating Desertification
- Bureau of Environment and Development (Project for Support of Seedling Production)
- National Institute of Soil
- Institute of Demography
- International Institute of Water Environmental Engineering
- Private Consultant
- Institute of Agricultural Environment

Photo 3-8 Data user meeting after the project kick-off seminar

[Outline]

This meeting was mainly attended by working level participants from organizations invited in advance by IGB as candidate users. First, IGB explained the project in outline, so that the participants could understand the objectives, specification, etc.

Then there was an exchange of opinions regarding expectations and hopes for the project. Of these the most common opinion was that they want a website to be constructed, from which the data can be easily accessed. After hearing this, the Director General of IGB immediately conveyed the wish for construction of a website to the Study Team. The Study Team replied that they would discuss this with JICA.

The minutes of the Map User Meeting are shown below.

TECHINICAL COMMUNICATION

1. Introduction

On Friday, 25th of May 2012, a technical communication has been made after official launching preside by the general secretary of the government on the Digital Topographic Map project in Burkina Faso financed by Japan International Cooperation Agency. (hereafter "JICA")

The communication was realized by JICA Mission and presented by M.BELEM Abdoulaye, IGB technical director to the users was focused on the:

- Outline of the Project;
- Project Implementation
- Technology transfer and work flow;
- Japanese experiences in digital data management (case in disaster)

2. Opinion Exchanges

- After communication, lot of participants have appreciated and thank Japan government for realizing this project which can be helpful for many project implementation in Burkina Faso.
- Participants have also requested to JICA to think about data access by creating a web-site where users can access and download data.
- Data accuracy of the maps, usage of software and methods have been discussed and also the mapping of the remaining areas of the territory as request.
- The need of assistance of Japan expert in mapping and GIS is also been express by the participants.
- Some questions such as, distribution of GCP points; sheets names; data updating; loading data into GPS Production method; period of GCP point observation (rainy season); LPS and MicroStation et.

3. Participants list:

- Somé Jean Alphonse	Direction Générale des Mines et de la Géologie du Burkina
- Ouédraogo Félicité	Direction Générale des Mines et de la Géologie du Burkina
- Zougouri Rémi	SR/CONEDD
- Ouédraogo François	DGFF/MEDD
- Ouédraogo Hamadé	Bureau National des Sols
- Kibora P. Marc	Private organization of cartography
- Sangli Gabriel	Institut des sciences de la Population
- Simal Amadou	ZiE

- Koné Nicolas INERA — Direction General de l'Institut National pour l'Environnement et la Recherche Agricole

[Consideration]

The implementation plan for this project does not include a work item for the construction of a website, but the Study Team also considers that it is necessary to introduce a website as a tool for efficient promotion of the use of the project. The reasons for the necessity are explained in the following.

3.1.2 Information Collection from Topographic Map User Organizations (Work in Burkina Faso)

[Period of Operation]

September 25 to November 2, 2013

[Description of Operation]

The Study Team investigated the current state of the utilization of topographic map data by conducting a questionnaire inquiry and, later, an interview survey of the major map user organizations in Burkina Faso. The Study Team visited the major user organizations mentioned below for the interview survey.

- Department of Environmental Economics and Statistics/Ministry of Environment and Sustainable Development : (DEES/MEDD)
- National Institute for Environment and Agricultural Research : (INERA)
- General Directorate of Mining, Geology and Quarries : (BUMIGEB)
- Division of Capacity Development, Information and Environmental Monitoring/National Council for Environment and Sustainable Development : (DCIME/CONNED)
- General Directorate of Soil : (SOL)
- International Institute for Water and Environmental Engineering : (2IE)
- Private map consultants

[Consideration]

The Study Team visited the major topographic map user organizations in Burkina Faso and learned in the interview survey the current state that those organizations endeavored to create thematic maps using the 1/50,000 (analog) topographic maps while maintaining close working relationship with IGB. However, all those organizations were using the time-consuming and low-accuracy method of tracing maps manually on pieces of tracing paper placed on analog (printed) maps. As the digital map creation method will be readily available after the completion of this project, it will become possible for them to create accurate thematic maps in a short period of time.

In order to promote the digital map creation method, awareness creation activities to promote utilization of topographic map data in digital formats will have to be carried out actively in government ministries, agencies and institutions and in the field of education, *e.g.* schools. The Study Team considers activities to draw attention and create awareness of the people to the national institution for topographic map creation, such as holding regular "mini seminars for promotion of data utilization" for potential data users including those organizations mentioned above and having one or two "IGB Open Days" a year to provide the general public with opportunities to see the facilities in IGB, as effective and practical ways.

3.1.3 Construction of Website (Work in Japan and Burkina Faso)

The Study Team assumes that there is no need to mention advantages of having a website. A website to promote data utilization has been constructed and is in use in Senegal. Since the establishment of this site, a large number of inquiries on the data have been made by not only map data user organizations but also JICA experts (in Ministry of Health, etc.). Such a situation is very promising for the promotion of the data utilization in the future.

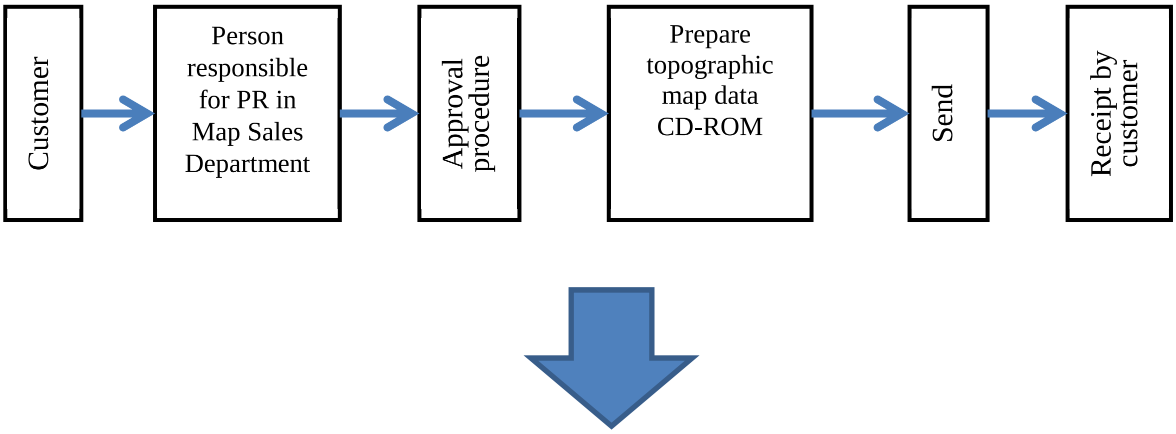
At present, map users in Burkina Faso purchase maps that they require after having confirmed availability of such maps by making inquiries to IGB by telephone or visiting IGB and browsing around their stocks. Such a sales/purchase system requires fulltime sales personnel. For data provision, users have to select data that they would like to acquire using printed maps and apply in writing for provision of the data. IGB begins the process of data delivery after users' applications have been approved. Users receive the data a few days after the preparations for data delivery have been completed. This data delivery system is no longer practical because of the personnel cost required for the data delivery process in IGB. Introducing a website can be expected to have a big effect on solving these problems. The requirements for providing data at present are as follows.

- Publicizing the status of development of geospatial information
  Widely publicizing the information to the general public can contribute to further expanding the user base, in addition providing the information to the current users of map data.
- Providing the latest data
  Using the latest data which is constantly updated can contribute to the accurate business plans and designs of the data users.
- Rapid provision of data
  Providing the data on demand can contribute to the smooth business plans and

designs of data users.

By achieving data transmission through a website, it is considered that the current distribution process can be simplified as shown below.

(Current map and data distribution method)



(Method of distributing maps and data using a website)

Figure 3-1 Comparison of data distribution methods

[Outline of the website construction]

The Study Team carried out the work required for the construction of a website for downloading and browsing digital topographic maps with the WebGIS technology in order to promote utilization of the project outputs. The details of the work conducted in Japan and Burkina Faso for the website construction are described below.

[Implementation policies for the website construction]

Since the website being operated by IGB (http://www.igb.bf) is not implemented with functions required for dynamic display of maps or a data delivery function enabling provision of geospatial information data, the website is to be reconstructed with implementation of such functions.

The main purpose of the functions to be implemented with the WebGIS technology should be data browsing (enlargement/reduction of data, movement in data, display/non-display of specific

layers, etc.). Functions to analyze geospatial information data should not be implemented. A password-based data acquisition system should be considered for data downloading. If a function to receive orders for products owned by IGB is to be incorporated in the data delivery system, an online settlement function with credit cards or other means should not be implemented in the system, as the social environment in the country is not conducive to the use of such a system.
The said system is to be created by combining multiple open-source systems which can be used as free packages.

[Work in Burkina Faso Phase 1: July – August 2013]
In the first phase of Work in Burkina Faso, the Study Team studied the status of infrastructure development in Burkina Faso and conditions of various facilities in IGB and collected information to be used for the discussion on the details of the work for the website construction. The existing website owned and operated by IGB does not have appropriate functions to promote utilization of geospatial information data. In this phase, the Study Team studied the conditions in the field and held discussion on strategies for the renewal of the existing IGB website with IGB with the aim of implementing the above-mentioned functions on the website.
In the first stage, the Study Team confirmed the following with regard to the currently accessible website.

- IT engineers of IGB designed (the current version of) the website.
- The same IT engineers manage and administer the website.
- Three staff members of IGB have experience in designing websites.
- The following technologies and software are used in the designing and operation/management of the website.
  - Dreamweaver (a web development tool)
  - PHP (a programming language for web development)
  - JavaScript (a programming language for web development)
  - SWiSH Max (a flash creation tool)
  - Fireworks (a graphic editor)

As the Study Team had learned that the website was currently hosted on a government server, the team studied the details of the server. The study revealed that the software on the server was old and that updating of existing software and installation of new software would be required for the operation of the renewed website. The study also revealed that the server concerned was used as a host server of multiple websites and that, therefore, suspension of operation of all the websites on the server concerned and verification of normal operation of those sites would be required before and after the updating/installation, respectively. Because of such requirement, the Study Team concluded that the current server could not be used as a host server of the renewed website. The Study Team learned that the organization operating the current host server could provide hosting service to a server procured by a client.

In the next stage, the Study Team presented a draft plan for the implementation of a function for dynamic display of maps and a data delivery function for the provision of geospatial information data on the existing website to the IGB and held discussion with IGB on the plan. In the discussion, the Study Team received the following requests and new information from IGB.

- To use a data downloading procedure different from the one proposed in the draft plan.
- To install a function to accumulate browsing history of users (access analysis function) on the website.
- To make the information to be disclosed on the website, such as display of metadata, displayed and explained in an easy-to-understand way for visitors.
- To implement an ordering system for map purchase.
- To upload all the map data that it possesses on the website.
- To display of map data to respond smoothly to users' commands.
- Various rules have to be established on passwords for access to data (setting of a period of validity of passwords and different levels of restriction on accessibility).
- To manage map data in the storage in IGB not on the server on which the website is to be hosted.
- To replace the currently accessible website with a new website being created by IGB.
- IGB is studying designs for the site to make it attract attention of visitors.
- IGB is conducting a trial of implementation of web mapping as part of the renewal of its website. (IGB already has technical capacity to display maps dynamically.)

When the Study Team asked IGB to choose priority requests from the above-mentioned requests, IGB chose the following three:

- Map display with web mapping;
- A data download system (for data to be provided free of charge); and
- A simple ordering system (for products for sale, without a charging function).

As IGB already had technical capacity to construct a web-mapping site and the time remaining in the project was limited, the two parties agreed to share the work of the website construction: IGB was to complete the development of a system to display maps with web mapping from the trial system, while the Study Team was to develop a data download system and a simple ordering system.

Although the Study Team was able to confirm the requests of IGB and outline screen transitions in this phase of Work in Burkina Faso, the team did not have time to discuss matters required for designing the systems with IGB. Therefore, the Study Team requested IGB to select data that

could be provided on the website and provide information on those data.
As IGB requested procurement of a new server instead of the current system of using a shared host server because of the restriction on the use of the shared server, the team requested IGB to estimate the cost of procurement of a new server.
In addition, the Study Team planned to collect information from map user organizations for the promotion of utilization of map data in Burkina Faso. The information that the team intended to collect was for what purposes map users in Burkina Faso planned to use map data if the data were made available from the website and what they expected from the data provision to achieve those purposes. The team planned to collect information mainly from the organizations whose staff members participated in the map user meeting held after the opening seminar by requesting them to fill in questionnaires delivered via e-mail or hand-delivered at the meeting. Since the team was unable to collect completed questionnaires while in Burkina Faso, they asked IGB to collect the questionnaires for them.

[Work in Burkina Faso Phase 2: January – February 2014]
The Study Team made the data download system and the simple ordering system, created in accordance with the required specifications, operational on the website of IGB, made final adjustments to the data entry system and transferred technologies used for the system maintenance to the engineers in charge of the maintenance of the counterpart organization, IGB, in Phase 2 of the Work in Burkina Faso.
Prior to the final adjustments and the technology transfer, the team also installed applications including a web server application and a content management system (CMS) on the server equipment procured in this project and set up the system configurations of the equipment.
The combined use of Apache, PHP and MySQL with Windows Server 2012 as an OS was originally assumed for the configuration of the web server. However, it was revealed that the engineers in charge of IGB did not seem to be familiar with configuring these applications independently. Therefore, it was decided that the Study Team should take the lead in the configuration. Since the configuration of PHP libraries, in addition to the configuration of this standard combination of the applications, was required in this project for the operation of the data download system created in this project, the team prepared a document explaining how to configure PHP libraries, which had not been included in the original plan, in a very short period of time with possibilities of the need for such configuration, including the need to re-configure the server, taken into consideration.

[Work in Japan]
The Study Team developed the systems in Japan in accordance with pre-determined specifications using the following procedures:

1. Development of a draft layout of each web page

2. Study on data to be on each page
3. Study on functions to be installed on the website
4. Creation of frames in each web page
5. Implementation of the website

The table below shows technologies used in the software composing the website and details of the site contents.

Table 3-2 Technologies used in the software composing the website

Item	Description
Data download system	• Use of password authentication for data download • Use of a user registration system for issuance of passwords by the website administrator
Simple ordering system	• Use of password authentication for simple ordering • Use of a user registration system for issuance of passwords by the website administrator
Software composition	• Windows Server 2012 R2 Standard Edition (Server OS) • Apache (Web server application) • Joomla! Ver2.5.x (Content management system)

The two systems were prepared as extensions which would function as add-in tools of Joomla! which was used as a content management system.

The page compositions of each system are as follows:

■ Data download system

This page allows users to display all the data which can be downloaded from the website free of charge and select data to be downloaded

■ Data download system

This page allows users to confirm their selection and download selected data.

■ Simple ordering system

This page allows user to display all the data for sale on the website and select data to be purchased.

■ Simple ordering system

This page allows users to confirm their selection and place an order for the selected data.

Figure 3-2 Page compositions of each system

3.2 (19) First Technical Seminar for Wide-Area Collaboration

Burkina Faso is the leading country in the West Africa region in map making technology, so a technical seminar for wide-area collaboration was held inviting nearby countries, in particular UEMOA (West African Economic and Monetary Union) member countries, with the objectives of the various issues in the organization and sharing solutions.

[Day 1, 1st Technical Seminar for Wide-Area Collaboration about Geospatial Information in Burkina Faso]

On two days, December 18 and 19, 2012, the first Technical Seminar for Wide-Area Collaboration was held by JICA and IGB as the hosts and UEMOA as the sponsor.

The representatives that participated were the heads and the persons responsible for technical departments of national surveying and mapping organizations from 9 countries (Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Guinea, Mali, Niger, Senegal, Togo), and relevant persons from the Japanese side, including the Geospatial Information Authority of Japan, JICA, and private surveying companies. The topics covered were as follows.

Details of Technical Seminar for Wide-Area Collaboration about Geospatial Information in Burkina Faso

1.	Date and time:	Day 1: Tuesday, December 18, 2012 08:30 - 17:00: Lectures and technical sessions Day 2: Wednesday , December 19, 2012 08:30 - 12:30: Special program
2.	Location:	JOLY HOTEL, 02 BP 6149 Ouagadougou (Ouagadougou 2000) TEL: +226-5037-6257 FAX: +226-5037-6259 WEB: www.jolyhotel.bf
3.	Host: Sponsor:	IGB/JICA UEMOA
4.	Participants:	About 50
5.	Participating Countries:	Nine (in alphabetical order) ① Benin ② Burkina Faso ③ Côte d'Ivoire ④ Guinea-Bissau ⑤ Guinea ⑥ Mali ⑦ Niger ⑧ Senegal ⑨ Togo
6.	Requirements for Participants:	Two each country ① Head of a national mapping organization or assistant to the head ② Member of a national mapping organization who is well versed in geographic information development
7.	Objectives:	This seminar is aimed at allowing the national geographic survey institutes of countries in the West African area to share with each other the status quo and current problems encountered by them and find solutions to them, thus contributing to the construction of sustainable mutual cooperation relationships in the West African area.
8.	The second seminar is currently scheduled to be held in February 2014 when the Burkina Faso map project is completed.	

Program of Technical Seminar for Wide-Area Collaboration about Geospatial Information in Burkina Faso

[Day 1, Tuesday, December 18] Lectures and Technical Sessions

M.C.: Directory of press and communiucation in the Ministry of Infrastructure

08:30	Registration (Reception)		
09:00	Opening and Welcome Speech from Host Country	Director General of IGB	10 min.
09:10	Greetings	Mr. Tsutomu Sugiura Japanese Ambassador Extraordinary and Plenipotentiary to Burkina Faso	10 min.
09:20	Greetings	Minister of Infrastructure, Burkina Faso	10 min.
09:30	Press Interview		30 min
10:00	Special Lecture by Mr. Yuji Okazaki	Former Senior Special Advisor of JICA (consecutive interpretation in French) [Topic: Past Support Provided by JICA for Topographic Map Development and Future Course of Cooperation]	45 min.
10:45	Questions and Answers		10 min
10:55	Special Lecture by Ms. Mame Marie B. Camara Monteiro	UEMOA Officer in Charge of Geographic Information [Topic: Status Quo of UEMOA Activities for Area Development]	30 min.
11:25	Questions and Answers		10 min
11:35	Coffee Break		15 min.
11:50	Special Lecture by Mr. Hiroshi Masaharu	(consecutive interpretation in French) Technical Analyst for Updating Base Map Information, Geospatial Information Authority, Ministry of Land, Infrastructure, Transport and Tourism of Japan [Topic: Status quo and Future of Geospatial Information Development in Japan]	45 min.
12:35	Questions and Answers		10 min
12:45	Buffet Lunch		1 h 15 min.
14:00	Technical Session	M.C.: Director General of IGB [Mapping Process and Status Quo of This Project] IGB	30 min.
14:30	Presentations by Various Countries	[Status Quo and Problems of Geographic Information Development in My Country]	10 min, each
15:30	Break		
15:45	Technical Session	M.C.: IGB Speakers: Representatives of Each Country, 5min. each	
16:30	Questions and Answers, Discussion		30 min.
17:00	Closing		

Photo 3-9 JICA Burkina Faso Office and UEMOA

Photo 3-10 Major participants in the Seminar

[Seminar Participant List]

Table 3-3 Seminar participant list (UEMOA Member Countries and Guinea)

18 to 19 December 2012

NOMS ET PRENOMS	PAYS D'ORIGINE	CONTACT
COULIBALY Aliou Adama	Mali	aliouigm@yahoo.fr
KOUNGOULBA Abdoudourahman	Mali	aboudrakoungoulba@yahoo.fr
ENONZAN Nounagnon	Benin	adoenonzan@yahoo.fr +229 95953114
ABATAN Hubert	Benin	hubatan2005@yahoo.fr +229 95063887 / 97645605
M'BRA KOUADIO Sévérin	Côte d'Ivoire	mbrasev@yahoo.fr +225 01054951
KOUAME Jacob	Côte d'Ivoire	jacobcharlesk@yahoo.fr +225 01626467
BIAI Braima	Guinée Bissau	biaib@yahoo.fr +245 6609152
DA SILVA NHGA Nhaga Herculano	Guinée Bissau	Herdasy10@yahoo.es +245 6752130
FOFANA Mohamed Hassimiou	Guinée	mhasfofana@yahoo.fr +224 65518206
CONDE Mamady	Guinée	Mamadyconde562004@yahoo.fr +224 64200582
MATO Harouna	Niger	Mato_harouna@yahoo.fr +227 90452425
HASSANE Tahirou Amadou	Niger	Tahirou_h2008@yahoo.fr +227 99883171
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KOUEDAKOR Anoumou A.	Togo	riomario318@hotmail.com +228 99175034

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NANA Safiata	Burkina	Nana_safiata@yahoo.fr +226 76071129
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BOLLY Ahmadou	Union Européenne	Ahmadou.bolly@ec.europe.eu +226 78 64 03 07
FATY Mélany	UEMOA	mfaty@uemoa.int +226 76819261
CAMARA Mame Marie Monteiro	UEMOA	mmbcamara@uemoa.int +226 72133089
TOMOMI Tokuori	UEMOA	ttkuori@uemoa.int +226 96690205

Table 3-4 Seminar participant list (GSI, Private consultants of Japan)

Nom et prénom	Appartenance et Poste occupée	Adresse email
MASAHARU Hiroshi	IGN Japon/ Ministère du Territoire, des Infrastructures, des Transports et du Tourisme Analyseur des Nouvelles Technologies pour la mise à jour des informations des cartes de base	masaharu@gsi.go.jp
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Table 3-5 Attendants for the Seminar, Embassy, JICA, UEMOA

EMBASSY OF JAPAN

Mr. SUGIURA Tsutomu	Ambassador
Ms. HARADA Norie	Second Secretary

JICA OFFICE

Mr. MORISHITA Hiromichi	Représent Résident de la JICA
Ms. NDIAYE HAYASHI Emiko	Adjointe au Représent Résident
Mr. GANSORE Cheik	Chargé de programme

UEMOA

Ms. TOKUORI Tomomi	Conseillére à la Coodination des Projets TICAD pour le Développement des Infrastructures et de l'Energie L'Expert de la JICA

[Minutes of the Seminar on December 18, 2012]

The questions and answers for the actual reports of the NMO by the representatives of the UEMOA member countries were as follows.

▲Benin → UEMOA:

Q) What kind of support is UEMOA considering to provide to UEMOA member countries for the problems faced by all the countries participating in this seminar, such as insufficient funds, technology transfer, human resources, etc.?

A) UEMOA is well aware of the problems, so we are formulating national land development policies, analyzing the problems of each country, and are studying various projects (convention regionale de cartographie, schema regional de cartographie, carte geographique de developpement). We are holding discussions with donors regarding implementing these projects, and JICA is also participating in these discussions, and are making continuous efforts to obtain funding assistance.

▲Burkina → Benin:

Q) What is the status of the Institut Géographique National (IGN) of Benin (is it some kind of public organization having a social character)?

A) The status of public organization having a social character siginifized that Benin IGN cn not obtain a profit on its services.

Q) You said that you receive support from France IGN, what kind of support is that?
Do you receive funding cooperation from France IGN, or did IGN win a tenders held in Benin, and when they are implement of project together with institute Benin?

A) The assistance from France is the dispatch of experts from France IGN, and cooperation is received from France for the problems identified by the experts. At that time Benin had insufficient geodetic control points, so through the requests of those experts financial support was obtained from France.

▲Burkina → Guinea:

Q) You spoke about the details of map production being pushed by experts, but what does this refer to? I think the experts in this project are JICA experts, but is this the case?

A) Editing the details of maps is carried out based on the legends of the maps of Burundi. In other words, the use of these details is compulsory. This kind of thing can also occur with us, so when some problem arises we solve the problem as appropriate.

▲Niger → Burkina:

Q) What were the reasons for selecting the areas to be covered in the cooperation being carried out in Burkina Faso?

A) The site in the northern area was selected because of the urgent development needs in the north from management of surface water, livestock, and development of mining. Since the existing maps were developed in Ouagadougou they have not been updated, and during that time the size of the city has increased, so it is necessary to update them.

Q) What are the details of the cooperation being received by Burkina Faso from Japan in the project to develop 1/50,000 maps?

A) The cooperation from Japan was technology transfer, equipment, training. In particular the Burkina side has requested transfer of the mapping capability.

▲Niger → Senegal:

Q) You spoke about decentralization. Can you enlarge on this please?

A) This is because the project has not yet started. This project tried to define the boundary lines of administrative areas, but the problem arose that the local governments were unable to accurately determine the boundary lines.

▲ Côte d'Ivoire → Burkina / Mali

Q) We would like to update our maps, so I would like to hear about the experience of Burkina and Mali who are receiving assistance from JICA.

A) Advice regarding obtaining assistance from Japan: When you have an opportunity to meet with a donor, explain your country's needs on that occasion.

▲Guinea → Japan

Q) What was the effect of the large earthquake in Japan?

A) There was 5 m of movement in the earthquake, and 1 m or more of settlement. Even Tokyo moved about 20 cm to the east. As a result it was necessary to completely revise the values of all the control points. Also, when remeasuring the position of the points, VLBI was used. This is because it was necessary to measure how much Japan had moved by international observations. Also, the position of each point was measured using GPS. The Government decided that the disturbed control points would not be used in the restoration work, but the restoration work was urgent so this method was taken.

▲ Senegal → Burkina

Q) In the Burkina Faso presentation it was stated that on the 1/200,000 maps (34 sheets), 27 1/200,000 sheets were developed, why was that?

A) This was as a result of deleting the land of the neighboring countries from the national land maps.

▲Burkina → Guinea

Q) Can you explain about the project for standardization of place names?

A) First stage of standardization of the place names was to pick up all of the place names from the 1/200,000 maps that cover the whole country, and a second stage is to prepare a list of place names for each administrative area. Then we obtained a document containing the know-how for standardization of place names from Canada, and we requested assistance from Canada. However that request was refused, so we are looking for another donor. At present, we have a request with GIZ. We have not completed the standardization.

After the presentation of Mr. Masaharu (Geospatial Information Authority of Japan, Ministry of Land, Infrastructure, Transport and Tourism):

Q) How does Japan use satellites for mapping? How many QZSS satellites do you have?

A) At present the number of satellites is 1, but in the future it is to be increased to 3 or 4.

Q) What is the distance between GPS control points?

A) 25 km

Q) In Japan another system is used instead of WGS84, but can Japan teach the know-how for changing to this new system to countries using WGS84?

A) For selection of map projection, UTM Mercator is used in countries in the Tropics. With the progress of technology, Japan uses a different coordinate system. Without a program to correct the difference in benchmark (referred to as difference in level), it is not possible to change to a new coordinate system.

On the following day, the 19th, individual question-and-answer sessions were conducted. The program is shown below.

[Day 2, Wednesday, December 19: Special Program] M.C.: JICA

Interview survey: Coordinator: JICA

NMOs, JICA, Geospatial Information Authority, private air survey company

* An interview survey is conducted on each of the problems that are remaining in the past map projects and need to be solved in the future.

Interview survey (in alphabetical order) (consecutive interpretation in French)

08:30 -	Benin	30 min.
09:00 -	Côte d'Ivoire	
09:30 -	Guinea-Bissau	
10:00 -	Guinea	
10:30 -	Mali	
11:00 -	Niger	
11:30 -	Senegal	
12:00 -	Togo	
12:30 -	End	

The interview with Burkina Faso was conducted in the afternoon of the same day.

[Minutes of Survey Interviews on December 19]

<Morning of second day: Survey interviews of participating countries>

1. Benin

Problem of personnel

- At present there are only 7 engineers at the Institut Géographique National (IGN) of Benin, of whom 2 are close to retirement. Also the number of high grade technicians is insufficient, so there are insufficient human resources to guide the staff. About 20 years ago we requested a program from Japan for developing management staff, but it never materialized.

- There are 14 high grade technicians, but they are all photogrammetry technicians. They are veterans, and have learned measurement and plotting through experience, but they have not learned advanced technology.
- The number of engineers is insufficient compared with the operative staff, so there is a problem with guiding the staff.
- There are insufficient employees compared with the amount of work, so each person has to be responsible for a lot of work.
- An example of a technical problem is the difficulty of transferring from analog to digital.
- Also, we do not have a large printer, so even though we already produce digital data, we cannot print it because we have no large printer.
- As a result of assistance from the U.S. we obtained satellite photographs covering 40 communes. We commissioned a German company to produce orthophotos from these satellite images, but the completed images were naturally single images, and cannot be used as 3D images. However, it is possible to use these images and obtain the GCPs from the old maps as a method of map making, but we did not want to do that.

Masaharu (Geospatial Information Authority of Japan)

- Regarding document control, the Geospatial Information Authority of Japan not only supplies the latest maps, but also we store the old maps and supply them also. The hardcopy maps are stored, and these are also digitized and stored. This data can be viewed at branch offices of the Geospatial Information Authority of Japan at 10 locations throughout the country. Also, copies can be purchased. Japan already has more than 100 years of modern surveying, and this data is stored.
- The Geospatial Information Authority of Japan provides infrastructure map data free of charge over the internet. This is not considered to be sold. Distribution of maps and other data is sold but the price corresponds to only the cost of reproduction and a sales fee, which does not cover all the costs of surveying and map making.
- Regarding the question asked by Benin about digitization, the idea is that the positions on the newly produced maps and the existing old maps are matched, and the standards are integrated. In other words, there is a requirement that the old maps are not simply digitized, but at the same time are integrated with the new standard.
- In connection with this, the old maps are also stored in the old format. There are needs for the old maps. If it is necessary to match locations, etc., the user must do that.

2. Côte d'Ivoire

- Conflict has continued for 10 years, but in 2010 the conflict erupted by armed forces, and at that time many government offices suffered from theft. CCT also suffered such damage, losing 1 billion FCFA in equipment, including 14 vehicles, 50 PCs, and 4 servers. At present we have 8 vehicles, 20 PCs, and 1 server. In addition 70% of data was lost. Since the restart of services in 2011, we have recovered data using little equipment, but only about 40% of the lost data has been recovered, and the remaining 30 % has not been recovered.

- What equipment is necessary, and what numbers of equipment are necessary?
- Twelve GPS receivers are necessary.
- We need 6 4-wheel drive vehicles.
- We need electronic control points at 10 locations, but at present have only 1.
- Training is necessary, but what training processes are necessary?
- We want to carry out Geoide calculations but do not have the capability, so technology transfer is necessary, and the software is also necessary.
- Technology transfer for aerial triangulation data processing
- Technology transfer for plotting photogrammetry
- Technology transfer for processing satellite photographs
- Equipment for taking aerial photographs
- Editing software
- High performance PCs
- Equipment stolen includes 14 or more vehicles, 50 PCs, and 4 servers

3. Guinea-Bissau

- The Government does not allocate a budget for map making.
- Funds allocated from the Government are normally either budget allocated for a project or a grant for the organization. It is necessary to continuously train human resources. The current training is in the form of seminars, but there is no specialized training. Therefore, specialized training is necessary.
- We would like to undertake projects include development of GIS, and updating the basic existing 1/50,000 maps. The basic maps were produced during the colonial era, and are 72 sheets. Also, we would like to produce city maps (1/10,000, 1/2,000).
- At present there is cooperation ongoing between JICA and the Ministry of Energy & Natural Resources (water) and the Ministry of National Education, Culture, Science, Youth, & Sports (school construction). There is no cooperation regarding map making. Overseas assistance for map making was received for map making between 1979 and 1980, but there has been none since. Portugal is considering projects in Guinea-Bissau, but unfortunately there are no funds.
- They would like JICA to do the first map making project in Guinea-Bissau since independence, and are seeking support for the establishment of a GIS department.
- They were very grateful to the Director General of IGB for creating this opportunity to meet with the JICA representative.

- There was a discussion on manufacturing in Japan in the presentation the previous day, and we would like that know how to be transferred to our organization.
- Were control points damaged in the civil war?
- No control points were damaged in the war, but there are examples of damage for other reasons (age, vandalism by people, etc.)
- The number of staff at present is very small, but is there any plan to increase the number in the future?
- There are some human resources to be employed who are undergoing training at present. Also there are human resources belonging to other organizations that have the knowledge of this department. For implementing projects we can borrow those human resources.
- Also, do you have technicians for map making, what do you have to say in this connection?
- We have map making technicians.
- For JICA to provide cooperation it is necessary that there be a sustainable perspective. In other words, it is important that budget also be allocated after the project. It is seen to be an important point that if budget is not allocated when the project is completed, JICA cannot provide cooperation from the national budget. We want to know how we should appeal for allocation of national budget. We would like JICA to appeal for the necessity of map making and geospatial information to our superiors, using the materials of this seminar.
- In Guinea-Bissau, when a project is carried out, an ad hoc charge is made for the project. Regarding allocation of budget, no budget is allocated to our section after the project is completed. Instead budget is allocated to the ministry responsible for us. Therefore, the budget is allocated to our section from the ministry. If applicable, the budget is allocated to the section. Also, we can sell our services to obtain funds.
- It was considered that to appeal to the superiors in the ministry on the necessity of allocating budget, use of the materials of the seminar would be effective.
- Unfortunately the Government has little interest in map making at present, but finally are beginning to show some recognition of the necessity of map making, so we intend to make efforts to have budget allocated to our section.
- What GIS, GPS, and plotting equipment do you have?
- We have GIS software, but not in our section. Likewise we do not have GPS in our section. Also we do not have a large plotter.
- Which project has higher priority, updating the 1/50,000 maps, or producing the 1/2,000 or the 1/10,000 city maps?
- Updating the 1/50,000 maps has higher priority. It is necessary for development of mineral resources (bauxite, phosphorous).

4. Guinea

- There is no awareness of transfer from analog to digital, and also no technology.
- Organizationally, at the time of establishment we were a production type public organization. Thereafter we became a technical type of public organization, and from 1994 became subject to the ministry, and lost the power to determine investment or what to do. We wish to return to their previous position.
- For development of human resources, human resources are trained by the staff within our organization (staff with doctorate degree, engineers), but there are no external organizations that teach specialities, and staff with qualifications cannot be employed.
- Equipment is also insufficient. Our equipment was provided in the 1980s from Japan, and since then no new equipment has been provided to the organization.
- There is a problem of appealing to policymakers and users regarding the necessity of making topographic map.

Masaharu (Geospatial Information Authority of Japan)

- It is necessary that good work be proposed, and that it is highly evaluated by the Government and that they recognize the importance of the work, and that efforts are made to increase the work and increase the budget.
- Currently there are 45 employees, and recently training has been carried out for 100 persons, of which 25 are scheduled to be employed.
- The interest of politicians is only focused on that which is directly related to the economic development of the country, so they have no interest in the development of the infrastructure that is necessary for development of the country, and therefore they have no interest in map making that is necessary for infrastructure development. Therefore when JICA carries out a project, they need to request that the government bears about 10% of the project budget.
- Various map making projects have been formulated in the past, but they were not implemented because there were no funds.
- Projects have been proposed to the government to develop 1/10,000 or 1/1,000 scale city maps, 1/25,000 maps of agricultural areas, 1/5,000 maps in urban areas (1/10,000 maps are provisional maps), and 1/50,000 maps for important national land, but these projects were not accepted.
- We have insufficient power to appeal to the government, and none of the map making plans or the laws regarding map policies have been adopted. We have requested that the Government allocate a budget of at least 1% of the gross national product to the IGN.

Takano (JICA):

- I have also heard from the JICA project team that opportunities for training at the IGN of Guinea are few, and that you are participating in this seminar outside the framework of UEMOA.

- As part of the present JICA project, tourism maps are scheduled to be developed, and by distributing them to the city residents, the hope is that the necessity of maps can be widely shared among the people. Also, I would like the materials of the present international seminar to be used to make the case within governments and within ministries for the necessity of topographic map making and geospatial information.

5. Mali

- Our problems are concerned with training of human resources and equipment.
- Investment is needed for maps, but the investment effect does not manifest immediately. Many countries have invested in maps for development.
- We purchased an offset printing machine from the Japanese manufacturer, Komori, but after purchasing 2 components were required, so we were unable to use it. We contacted Komori, and the Komori maintenance staff came and they gave us an estimate for the components. However there were no funds, so we were unable to purchase the components, and still the printing machine has not been used.
- At present the status of civil order is calm. On Friday last week a new cabinet was formed, so the status is stable.
- IGN France participated in and won the tender for a project to update 1/200,000 maps. The French team leader stayed in Mali for about 1 month, preparing the tender documents.

Takano (JICA)

- I visited Mali last year during the preliminary survey for the project, and just as the project started the problem arose, and unfortunately the project was suspended. The project was for the production of 1/5,000 city maps of Bamako, but because of the problem at present cooperation projects with Mali are suspended. A wide area seminar will be held again next year, so I wish that participation will continue to create a mutual cooperation network in West Africa. At present there is no immediate prospect that the suspended project will restart.
- How should the request to restart the project be made to Japan?

Takano (JICA)

- The time for restarting assistance is determined between the 2 countries.

Matsumoto (Asia Air Survey)

- Have you re-started cooperation with France?
- Cooperation with France has restarted. However that is for a project with EU funding cooperation.
- Training carried out by JICA in the past went very well, and after completion of the training, maps were produced in the IGM. This training was carried out by Japan and Mali. The period of implementation was from 1998 to 2000.

Tsuda (Pasco)

- I think you had cooperation regarding plotting, is that so?
- Certainly we did, but we want even more training.
- To cover the whole land of Mali with 1/50,000 scale maps would require 1848 sheets.

Harada (Aero Asahi)

- 1/50,000 maps and 1/5,000 maps are different. Even if you can make 1/50,000 maps, it does not mean you can make 1/5,000 maps. It is important to remember this.

Masaharu (Geospatial Information Authority of Japan)

- We are grateful for the cooperation from Mali for the world maps.

6. Niger

- The IGNN of Niger was established in 1991, and cooperation was received from Japan. Japan supplied equipment to the IGNN. Also, in 1994 Japan provided project for the mapping (36 sheets) of the Dejerma Ganda and Dallols regions, and supplied single frequency GPS and 4-wheeled vehicles.
- Problem points are updating the existing maps and insufficient equipment. Also, there has been significant technical progress, and there will be problems if the IGNN does not keep pace with that progress. Also, there is the problem of insufficient funding. Also the Government does not want to implement map making projects, and the number of donors is small. Those are the main problems.

Harada (Aero Asahi)

- Regarding equipment: What types and numbers of GPS and GNSS equipment do you have? What about leveling equipment?
- The national geographic survey institute has 2 Trimble single frequency GPS devices, and a first order level N3, an automatic level NA2, and 1 electronic level.

Ishijima (Kokusai Kogyo)

- Are you updating the old maps?
- We tried to update them using the small amount of equipment we have, but it was difficult. In particular, because of flood damage, there is a great need for 1/50000 maps of Niamey and its suburbs. The Central Government invested a little money in map making, since funds have not been invested much to date. With that money we purchased 4 scenes of SPOT images. We tried digitization using these images.

Harada (Aero Asahi)

- Regarding equipment, do you have aerial triangulation software? Or digital plotting software?
- We have no aerial triangulation software. Regarding Geomatics software, we have ArcGIS, ERDAS, MapInfo, etc. ERDAS includes LPS. We have 1 license for each software.

Harada (Aero Asahi)

- Which will you produce in the future, hard copy maps or digital maps?
- We have requested JICA's cooperation. We will do both (paper and digital). Some users require hard copy, and some donors require digital data.

Tsuda (Pasco)

- Can you talk about the conflict with the geographical data organization which was explained in the presentation?
- One problem is a conflict with the National Land Development Bureau and the Map Making Bureau. Both the National Land Development Bureau and the Map Making Bureau answer to the same ministry, but when the ministry purchases equipment they give it to the National Land Development Bureau, so there is the problem that the Map Making Bureau cannot use it. Also, regarding GIS, GIS is used in many ministries, but a unified standard has not been prepared for them, so they are all different. These problems are referred to as conflicts between organizations.
- We want to integrate the GIS, but in order to do this it is necessary to have basic maps. We do not have these, so the integration has not occurred.

Takano (JICA)

- How are the maps developed through the cooperation with Japan in 1995 being used?
- These maps were developed for regions with high potential for agriculture or water (Dejerma Ganda and Dallols), where the need was high. They are used for surveys in those regions (water use, erosion and groundwater). The maps were produced with a proper geographic coordinate system and level data, so there are no problems in those regions.

Takano (JICA)

- How are these maps shared with other ministries?
- Other ministries purchase the maps.

Tsuda (Pasco)

- Can you provide a more detailed explanation of the EU project currently being implemented, and what is the 3N initiative?
- The EU is providing cooperation for 1/200,000 maps for all the countries in this region. The national land of Niger is extensive, so it is not possible to cover the whole country at 1/50,000, therefore we requested cooperation from EU for 1/200,000 maps. As a result the geographical coordinate system and benchmark level system is also being prepared. Also, updated 1/200,000 maps covering the whole national land are being developed, which will become a reference document for our country. At present the consultant to carry out the work is being selected, and thereafter a survey of the present status will be carried out.
- The 3N initiative is a replacement for the poverty reduction policy of the previous

national policy. 3N is an abbreviation for "Nigerians nourissent Nigerians" (Ensuring stable food supply for Nigerians by Nigerians). Maps have an important place in this policy. Responsibility for 3N is the 3N Committee which is under the direct control of the President.

Ishijima (Kokusai Kogyo)

- Do you need technology transfer for plotting? What is the status of the northern part of Niger?
- For plotting, 3 members of staff have been dispatched to Japan for training. There has been no technology transfer locally. However, these 3 members have left the IGN. At present the northern part is calm. However the situation at Mali and Libya is restless, so caution is required.

Ishijima (Kokusai Kogyo)

- In the past Japan implemented technology transfer mainly by training in Japan, but now it is mainly by on the job training by carrying out work together with the staff locally.

7. Senegal

- Thank you for the previous cooperation from Japan.
- At present the Directorate of Geographic and Cartographic Works is integrated into the National Land Planning Agency. The reasoning is that map making is important for national land development. The problem with this is the problem regarding requesting support which will be explained later. More transfer is required in addition to the technology transfer currently being carried out as part of the map making project.
- First, we would like experts in map making and databases to be dispatched.
- Also, we wish a technical assistant expert on project preparation and organization modernization strategy to be dispatched.
- At present our department has received a request from the National Land Planning Agency to establish a National Land Surveying Bureau, and this organization will create a database that integrates socioeconomic indices. We are requesting technical and financial assistance for the establishment of this organization.
- Also, we are seeking assistance to update the Atlas that was created in 1977.
- The modernization of working tools such as GPS, databases and the geographical coordinate system is necessary. This is modernization of know-how, and we are requesting training in surveying, map making, databases, etc.
- We are requesting items below.
  - ✓ Vehicles
  - ✓ An assistance to construct a building as an office for our organization
  - ✓ Technical assistance for updating the national land development plan
  - ✓ Technical assistance in this field of a public information and propagation plan is

being formulated to spread geographical data

✓ To prepare databases for a city maps

Takano (JICA)

- When a project is to be carried out in the same country in the same field, we look at the extent to which the technology that has been transferred to the country that has received the project has been retained and developed. Therefore, an essential point for the implementation of the next project is the extent to which the project currently being carried out has been utilized. Can you tell me how to technology transfer currently in progress is to be retained and developed?
- The technology transfer currently being undertaken by the JICA team is progressing smoothly, but the problem is the period is short. Therefore we would like to request an extension to the technology transfer.

Takano (JICA)

- We understand that the project time period is limited. Therefore we would like you to put your maximum efforts into this project, and to eagerly learn what is to be learned.

Ishijima (Kokusai Kogyo)

- In the event that UEMOA implemented cooperation regarding geographical information in the region as a whole, is it possible for example for Senegal to share its experience with third countries, or for Senegal to dispatch personnel to other countries?
- That is a very good idea from the point of view of strengthening cooperation in the region, and we are holding this seminar from that point of view. If these undertakings can be implemented by JICA or UEMOA, I think opportunities for acquiring the latest technology can be obtained.
- Who are the users that are envisaged for the maps that are being created in the project currently underway?
- During the stage of designing this project, we investigated this point of view, and the need to carry out the project was high for prosperous development of national land in the north. Samples of the maps were distributed to the ministries responsible for healthcare, education, water, and environment, and we intend to hold a seminar on the use of the maps in February next year.

Takano (JICA)

- I have high expectations for the 4 sheets currently being produced by you.
- We also, as this is the result of the technology transfer, so we want to produce something good.

8. Togo

The 1/50000 topographic maps were produced in 1958, but the current problems are as follows.

- The organization is unstable, so the responsible ministry changes frequently.

- We have economic problems, and sufficient budget is not allocated.
- We also have problems of public order, and the government does not sufficiently take into consideration development of the country.
- For these reasons human resources do not join the surveying bureau.
- As a result of the change of organization in 2010, the land registry and map making departments were separated. Personnel were lost as a result of this, and our numbers reduced by 19.
- A JICA project is currently being implemented, but the following are the problem points.
    - It was difficult to reach the control points established by IGN due to the bad roads
    - Benchmarks were damaged
    - The Togo Government promised to supply vehicles, but they never materialized
    - Staff were deployed that were transferred from organizations that were not the counterpart
    - We expected that equipment for vehicles would be provided for the project, but this did not materialize
    - We intended to take on staff, but this did not occur because of lack of budget
- Although we have those problems on the JICA project, we have learned many things from the project, and JICA is undoubtedly contributing to Togo. I believe that the completed maps will contribute to various fields (agriculture, road construction, disaster measures, etc.) in the future.
- We want to print hardcopy maps.
- We want technical training in Togo.

Takano (JICA)

- You can use the documents distributed at this seminar for securing budget, etc., in the future.
- Regarding the organizational problems, discuss them with the JICA project team, to find a good solution.

9. At the End of the Seminar from the Two Directors General from Burkina and Senegal as Representatives

－Mr. Tapsoba, Director General, Burkina Faso－

We are all grateful to JICA for holding this seminar on the wide area use of map data for UEMOA and Guinea. I believe we all agree with JICA’s idea of constructing a network over a wide area.

We recognize that geographical information is important as fundamental information of the nation. I hope that each country will continue to participate and that these seminars will continue to be held. Also, with assistance from UEMOA and JICA, we would like to continue to investigate an organization that is capable of providing basic map data.

－Mr. Ndong, Director General, Senegal －

I am very satisfied that in this seminar we were able to share information from Japan, JICA's activities, and the status of surveying in each country. I would like to express my thanks to JICA and UEMOA for providing this opportunity. For the countries participating in the seminar, this will bring new added value for map information.

10. Burkina Faso

- Regarding problem points, at present IGB is undergoing major improvements, so instead of problem points I would like to explain the needs for making these improvements.
- At present we have no problems in any section.
- IGB has made steady progress with the receipt of the first project and the present project from JICA, and the project from EU, but we still have needs.
- As part of this project, we have expressed the wish to the project team to construct a website for advertising our products. This is because these products were not produced for ourselves, but for users. We consider that the internet is a very good tool for this purpose, and if there is any example like this, we can use it as a reference.
- Equipment was provided at the time of the first project. But when the project was completed, there was no assistance for that equipment, so no one provided help when there was a problem. Therefore, in the current project, we want a technical assistant to remain for several years to provide assistance after the project is completed.
- There is a language problem in the technology transfer for the current JICA project, but the project is extremely good, and we have requested that more staff be dispatched for training to Japan. From the start of this project, 2 engineers have participated in training in Japan. We wish that this training should continue for a longer time, and also wish that this training be not only for managerial staff but also for technical staff.
- There is an obligation on the whole organization to improve, so therefore from time to time it is necessary for us to stop and assess the current situation, determine what is good and what is bad, to achieve an even better organization. I believe that cooperation with JICA will be effective in this matter also, in other words JICA assistance for improvement of our organization. In this way, it would be possible to accurately determine the proper policies and our needs.
- Other projects which IGB has requested include large-scale (1/5000 or 1/2000) databases for Ouagadougou and Bobo Dioulasso. These two cities are important urban centers in Burkina Faso, so it is necessary to produce good urban plans for these cities. Through this project we wish to obtain the know-how regarding databases for geospatial information.

Takano (JICA)

- Please tell me about the mutual cooperation network you spoke about during the seminar closing speech just now.

- During his speech at this seminar, Mr. Okazaki said that it was an objective of this seminar to create a network for coordinating geospatial information in this area through the UEMOA member countries. All the countries participating in this seminar agree with this idea, and that it would be good that if this network is actually realized, there could be integration on standards and preparation of basic information, and that this network would assist the development activities of JICA. For example, if one item is to be requested, it would be more effective for many countries to request it as a group, than each country requesting it separately.

Ishijima (Kokusai Kogyo)

- Is it the intention that this network should carry out physical specific activities, rather than being simply an abstract idea? For example, teaching the staff of the IGN of other countries? My reason for this question is that my impression from this seminar is that only Burkina Faso and Mali have the capability of plotting, and I was wondering if they can teach the other countries.
- I discussed this in my speech in which I said it would be good if this network was created, to deepen our relationships, and have specific staff exchanges, and loaning of equipment. This is actually being done, and there are steps to conclude an agreement with Mali. This agreement has not been signed yet, but we are working on it, and in this agreement we would borrow plotting equipment from Mali for one year, and carry out plotting work. Niger has said a similar thing, and the countries that participate in the network will be the same, and it would be good to get the approval of governments. I think UEMOA or CEDEAO or the African Union would be the ideal forum for this. I think that these forums would be able to activate the policies of our network. As confirmed in this seminar, all the countries participating here have the same problems among our governments, but Burkina Faso does not have these problems within the government. The Burkina Faso government supports our activities, and wishes to bring about our experience in other countries. I would like it if the government would listen to our ideas, even a little bit at a time.
- I think it would be good if Burkina Faso would become the leader, but an assistant would also be needed. JICA has much of this experience, so we would look to the experience of JICA.

Table 3-6 Summary of the issues in each country

Country	Issue	Comments, etc.
Benin	• Insufficient staff with advanced technology (digital technology) • Insufficient equipment for digital data	• In the Geospatial Information Authority of Japan, not just digital maps but also analog maps (hard copy maps) are supplied • There is also scope for charging for distribution of map data
Côte d'Ivoire	• Loss of much equipment and data due to	

	the Civil War ・ Technology transfer is required	
Guinea-Bissau	・ Requires opportunities for new technlogy training ・ Updating maps ・ Insufficient budget	・ Make the case for the necessity of geospatial information to the superior organizations
Guinea	・ Insufficient personnel (digital technology) ・ Insufficient equipment ・ Insufficient budget (insufficient understanding of maps by the superior organization)	・ Make the case for the necessity of maps to the superior organizations and to the general populace
Mali	・ Insufficient equipment ・ Unstable political situation	
Niger	・ Updating maps ・ Insufficient equipment ・ Insufficient sharing of information between map data producing organizations within the country (specifications not integrated, budget dispersed) ・ Departure of technical staff (trained)	
Senegal	・ Technology transfer for advanced technology is short ・ Strengthening of organization capability	・ The evaluation of the technology transfer in the current project is an essential point for the next similar cooperation
Togo	・ Insufficient staff (unstable national situation) ・ Departure of technical staff (trained)	
Burkina Faso	・ Extension of technology transfer ・ Construction of tool to provide data (website)	
Overall	・ Integrated specification for West Africa region (work rules, map format, symbols, etc.) ・ Development of geospatial information to the same specification in the West Africa region ・ Exchange of personnel and use of equipment within the West Africa region	・ If effective human resource development and efficient use of equipment can be achieved through a regional network, the cooperation of donor countries will be enabled.

[Output]

There was agreement on a recognition that in order to solve the various problems associated with development of geographical spatial information and promotion of human resource development in the West Africa region, a strong network should be constructed between the participating countries and information should be shared. Specifically, a consensus to make efforts towards establishment of the "map production coordination organization" (provisional name) in cooperation with UEMOA on or after December 19 was obtained under the guidance of Mr. Tapsoba, Director General of IGB.

[Conclusion]

Based on the presentations at the wide-area technical collaboration seminar, the common issues in the NMOs of each country are considered to be the following 4 points.

(1) Budget

Obtaining budget for general work is a major issue in each country. Firstly, the national budget in each country is insufficient. The majority of this small national budget, apart from national defense costs, tends to be allocated to fields closely related to everyday life, such as food and healthcare fields, etc.

Against this background, it is essential to obtain the understanding of the superior organizations of the necessity of geospatial information in order to ensure budget in the fields of geospatial information. One means of achieving this is to make efforts to create an awareness of the benefits and necessity of geospatial information for various national infrastructure development projects, by having more and more people and organizations concerned with infrastructure development working with and using the data. It is considered that the cumulative effect of these efforts will eventually lead to the understanding of the superior organizations. For this purpose also it is necessary to increase public awareness activities such as seminars or explanatory meetings on the use of map data (explanations of the application of GIS, etc. to business plans, urban plans, and infrastructure development) using this data.

On the other hand, it is considered to be important to promote sales of map data (hard copy maps, digital maps) on one's own account to cover the costs by the individual efforts of the national mapping organizations, by effectively using websites as a data provision tool.

(2) Development of human resources

The problems of development of human resources are broadly 2 issues. One is the turnover of technical staff, and the other is technology transfer.

- Turnover of technical staff

  In the national mapping organizations, there is a technological change in progress from analog technology to digital technology, and there is a shortage of personnel that are capable of dealing with this change. The background to this shortage is that those with experience of technical training overseas (Japan, France, Holland, etc.) transfer to private companies making use of that experience and technology, and this is one cause of the shortage of personnel.

  It is necessary that there be measures to prevent this loss of technicians to private companies by providing compensation and guarantees based on proper evaluation of experience and technology.

- Technology transfer

  Also, normally technology transfer is carried out in a map making project, but it cannot be said that the effect of developing human resources is sufficient because the period of technology transfer is short, and the age structure of the employees is high. Of these problems, for technology transfer, it is considered that lectures or technical training can be periodically held in the national mapping organizations of each country, with the highly experienced technicians in the organization of each country as lecturers.

Another measure that can be implemented is to establish a training facility (even if temporary) in a country where the technology is significantly advanced, using UEMOA as the organization, and invite the necessary lecturers and technicians to carry out technical training.

(3) Provision of equipment

The problems of each country are different from each other, and it is considered that the equipment to resolve their requirements is diverse, and difficult to identify. In addition, surveying equipment, computers, and software are very expensive, and periodically the versions are updated, and taking into consideration the present situation that ensuring budget in each country is difficult, it is very difficult financially to maintain the equipment. Similar to development of human resources, a joint system of use should be established within the "map making coordination organization", and construction of joint training facilities and equipment provision should be implemented based on strong cooperation between each country. The plan would be to obtain the support of UEMOA, JICA, etc., when the training facility is operating, to acquire the necessary training equipment.

(4) Organizational strengthening

Even if the problems of budget, human resources, and equipment are solved, the national mapping organization in each country will not necessarily be able to carry out their activities smoothly. In order to comprehensively reform the organization, the following are essential.

- Reduction of overheads and normalization of budget
- Clarification of allocation of work responsibilities
- Activities aimed at improving work efficiency and accuracy

In order to achieve these, it is considered that an organization should be constructed in which administrative departments and technical departments are divided, such as the general affairs department, planning department, technical department, etc., each department has their own responsibility, and they act as a restraint to each other.

Also, it is considered that periodic meetings should be held under the network of geographical institute of member contorries of UEMOA and Guinee to share measures for solving problems, and for exchanging personnel, etc., in order to mutually strengthen the organization of each national mapping organization.

The abovementioned paragraphs of (1) to (4) as described above are interrelated. Therefore, the network of the "map making coordination organization" is important and indispensable.

Also, it is considered that dispatching "experts" to the coordination organization or UEMOA for the purpose of providing comprehensive advice can contribute to the sustainability of geospatial information development and to strengthening the national mapping organizations. The following is the declaration prepared by Mr. Tapsoba, director general of IGB, on the establishment of the "map making coordination organization".

(Text of the speech by Mr. Tapsoba, Director General of IGB, Burkina Faso)

Seminar of the Member Countries of UEMOA and Guinea on Geographical information
Ouagadougou, December 18 and 19, 2012

Resolution regarding creation of a Network of the Institutes and Organizations for production of geographical data

Considering that quality infrastructure of geographical data constitutes an indispensable support for the economic development of their respective countries,

The General managers and Directors of the agencies for production of geographical data of the member countries of UEMOA and Guinea, united at the seminar on geographical information in Ouagadougou December 18 and 19, 2012, and

Decided to create, with the support of the JICA and the UEMOA, a network of the agencies in charge of the production of the geographical data in order to advance the sciences and techniques of geographical information in their region and to promote good practices in their respective countries.

Made in Ouagadougou, December 19, 2012.

The Seminar

3.3 Lecture Tour

IGB and the Study Team conducted a "lecture tour" to an elementary school in Ouagadougou, as an activity to extend the use of maps. The outline of the tour is mentioned below.

Photo 3-11 Lecture by Mr. Bako of IGB in the lecture tour

Photo 3-12 Pupils listening to a lecture and participating in a practice in the lecture tour

[Outline]

1. Organizers: IGB (Geographic Institute of Burkina Faso) and JICA
2. Venue : Paspanga D Elementary School
3. Date : Friday, February 7, 2014

4. Participants : 5th and 6th graders of the school 93
Class teachers and the officials concerned of the Education Supervisory Bureau 26
Total of 119
5. Objective : To raise the interest in maps and improve the knowledge of maps of elementary school pupils (in the upper grades) by making them realize the importance of maps as a tool to learn information on their land.
6. Impact : The interest of the pupils in the work related to map creation and surveying required for the map creation will be raised after they become interested in maps and learn about them.
7. Program (contents)
   - 10:30 Presentation of gifts including maps of Burkina Faso to the officer in charge of the Education Supervisory Bureau and the principal of the elementary school
   - 10:35 Lecture by a staff member of IGB, Mr. Bako
     (1) Presentation on the services provided by IGB
     (2) Presentation on topographic and thematic maps (at the scales of 1/50,000 and 1/200,000)
     (3) Explanation of map symbols (including those for roads, buildings and railroads)
   - 11:00 DVD presentation on how to create maps
     (A DVD produced by the Geospatial Information Authority of Japan was used)
   - 11:30 Question-and-answer session (using questionnaires)
   - 12:00 Conclusion

8. Thoughts
- The team members were impressed by the eagerness of the pupils who listened to the lecture attentively and took notes from it. The lecture seems to have left a significant impression on the pupils as it provided many of them with the first opportunity to see actual maps.
- The lecture also seems to have had a strong impression on the teachers, as well as the pupils, as they requested a lecture on the same topic for teachers.
- This lecture tour should be regarded as the first of a series of lecture tours which should be conducted continuously in the future. The Study Team recommended the continuation of the lecture tours to IGB.
- The lecture tour is a simple but very effective publicity activity. Cooperation to conduct such tours seems to be likely to be found in the actual field of education.
  (Members of JOCV provided the team with assistance in selecting the target school.)

[Questionnaire inquiry and comments]

The Study Team asked the pupils who had attended the lecture to fill in inquiry forms at the end of the lecture tour. The following is the summary of the comments and the questions of the pupils found on the forms and the responses to them from the Study Team.

Comments and Questions found in the inquiry forms and responses to them

・: *Comment or question on the inquiry form*

*: Response from the Study Team

5th graders

・*The lecture was very interesting. I would like to have a lecture like it again.*

・*What is a topographic map?*

*Topography means elevation and shapes of ground surface (*e.g.* plains, hills and mountains).

・*Are there regional maps?*

*Maps of the entire Burkina Faso, including regional maps, are available (at the scales of 1/200,000 and 1/50,000).

・*What is a digital topographic map?*

*A digital topographic map is a map composed of digitized data so that it can be used on personal computers.

・*What it geography?*

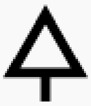
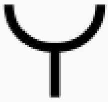
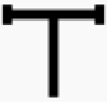
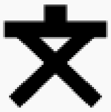
*Geography is the study of (topographic, industrial and social) features and (cultural and customary) affairs of a location.

6th graders

・*I would like to know the map symbols used in Japan.*

*

Symbol	**Character**	**Meaning**	**Example of actual structures represented by the symbol**	**Symbol**	**Character**	**Meaning (Origin)**	**Example of actual structures represented by the symbol**
◎	□	City office		○	□	Village office	

	–	Court			-	Fire station	
	□	Police station					
					〶	Post office	
	–	Meteorological observatory					
	□	Public office (A graphic representation of an unorthodox form of the Chinese character, '公 (public)')			文	Elementary and junior high school	
	□	High school					

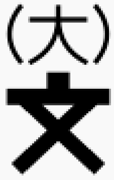
						University	

Figure 3-3　Map symbols for major features used in Japan

・*What is a thematic map?*

*A thematic map is a map on which information on a specific theme (*e.g.* population) is presented for a certain intended use.

・*How many regions are there in Japan?*

*There are eleven regions in Japan (*i.e.* Hokkaido, Tohoku, Kanto, Shin'etsu, Hokuriku, Tokai, Kinki, Chugoku, Shikoku, Kyushu and Okinawa).

・*Is Japan more beautiful than Africa?*

*We would like you to study about Japan in future.

・*How does one obtain information on computers?*

*Information on topography, features, vegetation and place names which should be shown (drawn) on maps are obtained from satellite images, aerial photographs and field survey and digitized and stored in databases.

・*Why was this lecture conducted?*

*We had this lecture to raise your interest in maps and to tell you about IGB.

・*Why was IGB established?*

*It was established to create maps which would contribute to the development of the land of Burkina Faso.

[Newspaper article/TV news piece]

An article on the lecture tour was printed in a newspaper and a news item on it was aired in a news program of a TV station of Burkina Faso, "RTB." The abridged translation of the newspaper article is shown below.

<u>The article on the lecture tour printed in a newspaper, "L'Observateur." (Abridged translation)</u>

<u>Maps of Northern Burkina Faso: Pupils of Paspanga D with Anaglyphic Stereoscopes in Their Hands</u>

A project to create maps of the northern area of Burkina Faso and Ouagadougou by IGB and

JICA will be concluded at the end of March 2014. The two organizations gave a lecture to CM1 and CM2 pupils of Paspanga D Elementary School in the capital on February 7 in order to raise their interest in map creation and topographic maps. The Team Leader of the JICA Study Team, Mr. Takashi Harada, presented maps to the Supervisory Bureau. (The project manager of the IGB Map Project, Mr. Désiré Compaoré, presented maps to the principal of Paspanga D Elementary School, Mr. Moussa Topan.)

In the morning of February 7, 2014, experts of JICA and IGB gave the lecture at Paspanga D Elementary School in Ouagadougou. An expert of IGB explained various types of maps (topographic and thematic maps) and map symbols (roads, railroads, schools, rivers, railroad stations, farming land, etc.) to the pupils. The pupils participated actively in the lecture with clear files and stereoscopes for anaglyphic stereoscopy and maps in their hands and managed to understand, "a map is better than a thousand words." The principal of Paspanga D Elementary School, Mr. Topan Moussa, said to us, "I would like the pupils to learn various map symbols printed on various types of maps and legends that they often see and understand their importance. In fact, maps tell us where the national boundaries are, enable us to make trips and make it possible to promote development in all development sectors." This lecture was conducted as part of a project to create maps of northern Burkina Faso and Ouagadougou being implemented by JICA and IGB.

"The project is to contribute to the development of the country through the creation of 1/50,000 maps of North Block and Ouagadougou Block. As you know, maps are an indispensable tool for planning, you cannot do any planning without maps. For example, all the departments in the Ministry of Health utilize maps as a useful tool when they identify locations appropriate for infrastructure construction. The sizes of the areas of North and Ouagadougou Blocks are 23,000 km^2 and 3,000 km^2, respectively. Topographic data of the block are to be presented on digital maps. This project began in March 2011." explained the Team Leader of the JICA Study Team, Mr. Takashi Harada.

According to the Project Manager of the map project of IGB, Mr. Désiré Compaoré, they are creating maps using satellite images, instead of aerial photographs which were used in the past, and the technology transfer on map creation with digital equipment is in progress. It is important to raise interest of the pupils in this work by teaching how to use a stereoscope.

3.4 2nd Technical Seminar for Wide-Area Collaboration

The First Technical Seminar for Wide-Area Collaboration about Geospatial Information in Burkina Faso was held in Ouagadougou, Burkina Faso, on December 18, 2012. The representatives of the national mapping organizations (NMOs) of nine countries, the eight UEMOA member countries and Guinea participated in the seminar. The theme of the seminar was "To create a common understanding of the current state of the NMOs in West Africa and the problems faced by them and to find solutions to the problems which all of them can use." The participants agreed on "the creation of a mutual cooperation network for the development of geospatial information" in the seminar. On the basis of the agreement, the Second Technical Seminar for Wide-Area Collaboration about Geospatial Information in Burkina Faso was held again in Ouagadougou on February 13 and 14, 2014, simultaneously with a seminar for the promotion of data utilization.

1. Objective

This seminar was intended to contribute to the creation of sustainable mutual cooperation for the development of spatial data infrastructure (SDI), which was recognized as an essential data infrastructure for national development and disaster management, in West Africa through the processes of creating a common understanding of the problems faced by each of the NMOs in the region in the development of SDI and finding solutions to the problems which could be used by all of them.

2. Basic information

1) Title of the seminar : Second Technical Seminar for Wide-Area Collaboration about Geospatial Information in Burkina Faso (held simultaneously with a seminar for the promotion of data utilization)

2)Organized by : IGB and JICA

Supported by : Embassy of Japan in Burkina Faso and UEMOA

3)Date : Thursday, February 13 and Friday, February 14, 2014

4)Venues : Azalaï Hôtel Indépendance, Ouagadougou

5) Participating countries (nine countries): (1) Benin, (2) Burkina Faso, (3) Guinea, (4) Guinea-Bissau, (5) Côte d'Ivoire, (6) Mali, (7) Niger, (8) Senegal and (9) Togo

3. Purposes of the seminar

- To share information on how to utilize SDI effectively with presentations on utilization of SDI in the participating countries by their representatives
- To formulate an action plan through discussion on solutions to the problems which NMOs of the participating countries are facing

- To identify and agree upon the targets of self-help efforts to be made by each of the NMOs of the participating countries

4. Expected outcomes
   - Preparation of an action plan contributing to human resource development (for adopting management technologies and new technologies)
   - Preparation of an action plan contributing to strengthening of the organizational capacity of the NMOs (required for long-term planning of activities)
   - Recognition by the NMOs of the participating countries of common targets of their self-help efforts

Reference:

★NMO: National Mapping Organization

National mapping organization where mapping includes surveying and creation of topographic maps

★Geo-spatial information: SDI (Geo-Spatial Data Information/Spatial Data Infrastructure)

Geo-spatial information consists of positional information and additional information (including elevation, place names, topography and vegetation) that all the objects on the ground surface have. In general, it includes topographic maps, aerial photographs and statistical data. It is frequently used in the GIS (geographic information system)

[Program of UEMOA Technical Seminar for Wide-Area Collaboration]

Program of the Second Technical Seminar for Wide-Area Collaboration about Geospatial Information in Burkina Faso

Theme: Creation and Utilization of Map Data and Associated Problems

1. Organized by : IGB/JICA

2. Supported by : Embassy of Japan and UEMOA

3. Date : Day 1 – Thursday, February 13, 2014 09:00 – 17:00
Day 2 – Friday, February 14, 2014 09:00 – 15:00

4. Venue : Azalaï Hôtel Indépendance, Ouagadougou

5. Number of expected participants: Opening ceremony approx. 100
Technical workshop approx. 50

6. Participating countries: Nine

1) Benin, 2) Burkina Faso, 3) Guinea, 4) Guinea-Bissau, 5) Côte d'Ivoire, 6) Mali, 7) Niger, 8) Senegal and 9) Togo

7. Participants : Two from each country

- A representative of the NMO
- An engineer representing an organization utilizing geospatial information and data in the sector of national land development, mining, agriculture, environmental protection, road or water management

8. Schedule

- <u>Day 1: Thursday, February 13, 2014</u>

08:30	Reception/registration
09:00	Opening Ceremony
09:10	Address by the Director of UEMOA
09:20	Address by the Ambassador of Japan to Burkina Faso
09:30	Address by the Minister of Infrastructure, Development and Transport of Burkina Faso
09:30 – 10:00	Coffee Break
10:00 – 11:20	★Session 1: Creation and provision of geospatial information Moderator: DGIGB
10:00 – 10:50	Presentation on the Digital Topographic Mapping Project in Burkina Faso and Discussion (Mr. Konaté Abdel Aziz)
10:50 – 11:20	Presentation by UEMOA and Discussion
11:20 – 12:30	★Session 2: Presentation of Cases of Utilization of Geospatial Information Moderator: DGIGB
11:20 – 12:30	Cases of the Utilization in Burkina Faso (BUNASOL, BUMIGEB, INERA, ISSP, CONEDD, 2IE)
12:30 – 14:00	Lunch (buffet style)
14:00 – 17:00	★Session 2 (continued) Moderator: DGIGB

Cases of the Utilization in the Other Participating Countries (15 minutes for each country)

14:00 – 14:15	Benin
14:15 – 14:30	Côte d'Ivoire
14:30 – 14:45	Guinea
14:45 – 15:00	Guinea-Bissau

15:00 – 15:20	Coffee Break
15:20 – 15:35	Mali
15:35 – 15:50	Niger
15:50 – 16:05	Senegal
16:05 – 16:20	Togo
16:20 – 17:00	Discussion
18:00	Reception (at IGB)

- Day 2: Friday, February 14, 2014

09:00 – 10:00	★Session 3: Approaches to Solution of the Problems Moderator: DGIGB
09:00 – 09:20	Comments of JICA on the Problems Identified in the First Seminar
09:20 – 10:00	Discussion (on an action plan)
10:00 – 10:20	Coffee Break
10:20 – 12:30	★Session 4: Action Plan and Resolution Moderator: DGIGB
10:20 – 12:30	Discussion on the Action Plan for the Preparation of a Resolution
12:30 – 14:00	Lunch (buffet style)
14:00 – 15:00	Adoption of the Resolution and signing by the Representatives of the Participating Countries
15:00	Closing of the Seminar

3.4.1 Address by His Excellency, Ambassador Plenipotentiary of Japan, Mr. Futaishi]

His Excellency, Ambassador Plenipotentiary of Japan to Burkina Faso, Mr. Futaishi, attended the UEMOA Technical Seminar for Wide-Area Collaboration. The following is the transcript of his address at the seminar.

Photo 3-13 His Excellency, Ambassador Plenipotentiary, Mr. Futaishi at the UEMOA Seminar for Wide-Area Collaboration

This seminar is organized as a part of the technical cooperation project, "Digital Topographic Mapping Project in Burkina Faso," which has been implemented by the Government of Japan since 2012, in cooperation with the Geographic Institute of Burkina Faso (IGB) and UEMOA. Its objectives are creation of a wide-area cooperation network for the development of spatial data infrastructure in West Africa and promotion of utilization of geospatial information data.

I would like to express my gratitude, on behalf of the Government of Japan, to the Minister of Infrastructure of Burkina Faso, the representative of UEMOA, the representatives of the national mapping organizations (NMOs) and officials concerned from organizations utilizing the data in West Africa for participating in the seminar.

I have long taken notice of the importance of geospatial information, or topographic maps. It is needless to say that geospatial information is information with positional information, information on elevation and information on place names correctly entered in it. It is a data infrastructure for national land development, or essential information for promoting wide-area infrastructure development and sustainable economic growth. In addition, its existence is indispensable in our daily life as a data infrastructure for our social life including education, environmental protection, disaster management, tourism and recreational activities.

I, personally, often make inspection tours to various places. Topographic maps are very useful to me when making such tours. Before making one of such tours, I use a topographic map to locate the area where I am going to visit and, then, obtain information of the area including topography, vegetation, roads, railroads, rivers and shapes of city areas. I use the obtained information to deduce the lives and culture of the local people.

Now, I would like to express my opinion on the necessity of the Technical Seminar for Wide-Area Collaboration about Geospatial Information.

I was informed that a common understanding had been established in the previous seminar held in December 2012.

The common understanding is "Since the problems faced by each of the national mapping organizations in the countries in West Africa are problems shared in the entire West Africa, a "sustainable cooperation network" will have to be created for the purpose of sharing solutions to those problems." Since creation of such a network requires more practical activities, it is important to hold a wide-area seminar to provide an opportunity for representatives of all the stakeholder organizations to meet together and share information and exchanges views on such practical activities.

Human resource development and strengthening of organizational capacity are examples of issues to be addressed by all the organizations. I hope that this seminar which is intended for sharing solutions to the issues will provide a very relevant and timely means for the solution to those problems.

In addition, insufficient publicity activities on the existence of developed geospatial information have been pointed out as an obstacle to the extension of its utilization. I have been informed that there will be presentations on the current state of the data utilization by user organizations in this seminar. I think that holding of a seminar like this one is also meaningful as it provides an opportunity to promote the data utilization through publicity activities.

At the Tokyo International Conference on African Development held in Yokohama, Japan, in December 2013, the Government of Japan renewed its commitment to the promotion of cooperation in the development of African countries. The Prime Minister, Mr. Abe, visited three African countries including Côte d'Ivoire last month, December 2013, and strengthened friendly relationships between those countries and Japan. These facts suggest that "responsible cooperation" of the Government of Japan in Africa, and in West Africa, in particular, is expected to be strengthened in future.

Finally, I wish that the efforts of the participants of the seminar and other stakeholders will lead to successful conclusion of this seminar and that outcome of the seminar will lead to further development of geospatial information in West Africa and its utilization as a tool to facilitate further social development in West Africa.

I wish further success in the work to IGB, members of the mapping project and the national mapping organizations, which have sent their representatives to the seminar, before concluding my speech.

[Lists of the Participants of the Seminar]

1) List of the members of the Japanese Delegation

Table 3-7 List of the members of the Japanese Delegation

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2) List of KOD in Burkina Faso who participated in the Seminar

Table 3-8 List of KOD in Burkina Faso who participated in the Seminar

Ambassade du Japon au Burkina Faso	
M. FUTAISHI Masato	Ambassadeur Extraordinaire et Plénipotentiaire
M. KURATOMI Kenji	Conseiller
Mme. KAMEDA Yumiko	3ème Secrétaire
JICA Agence Japonaise de Coopération Internationale au Burkina Faso	
M. KODAMA Akihiko	Adjoint au Représentant Résident
M. GANSORE Cheik Assane Moctar	Chargé de Programme Infrastructure / Gouvernance, Eau et Assainissement Santé
UEMOA Union Economique et Monétaire Ouest Africaine	
M. TOMPIEU-ZOUO Augustin	Commissaire, Département de l'Aménagement du Territoire Communautaire et des Transports, DATC, UEMOA
M. FATY Malang	Directeur, Direction de l'Aménagement du Territoire Communautaire, des infrastructures et des Transports : DATIT
M. TOURE Aboubacar Sidiki	Charge des Systèmes d'informations Routières, DATIT
Mme. SY Aminata	Chargée de l'Aménagement du Territoire, DATIT
Mme. TOKUORI Tomomi	Conseillère à la Coordination des Projets TICAD pour le Développement des Infrastructures des Transports, DATC
M. AMICHIA François Albert	Président du Conseil des Collectivités Territoriales de l'UEMOA
M. BAH Moussa Boubacar	2nd Vice-Président du CCT, Président de l'Association des Municipalités du Mali
M. OCENI Moukaram	Président de la Commission du développement, de la cohésion sociale et de la solidarité du CCT, Maire de Porto-Novo au Benin
M. DIOP El Hadj Malick	Président de la Commission Economique et Financière du CCT, Maire de Tivaouane au Sénégal
M. ILBOUDO Marin Casimir	Membre du CCT, Président de l'Association des Municipalités du Burkina Faso
Intervenants sur l'utilisation des informations géographiques dans les pays	
M. SIDIBE Norbert	CONED
M. SIMAL Amadou	2IE
M. SANGLI Gabriel	ISSP
M. DABONE Ignace	BUMUGIB
M. PARE Tahinow	BUNASOL
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3) Participants from other stakeholder organizations

Table 3-9 Participants from other stakeholder organizations

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42	BARRY Souaïbou	SIDWAYA		
43	BAYALA Ebou Mireille	Observateur		
44	OUEDRAOGO /KAMBOU	SP/CONAD		
45	PILABRE Cathérine	Le Pays		
46	BAMBARA Relarh	Le Quotidien		
47	SAWADOGO Désiré	FASOZINE		
48	BALIMA Théodore	LEFASO.NET		
49	FATAISHI Masato	L'Ambassadeur du Japon		
50	KURATOMI Kenji	L'Ambassade du Japon		
51	GOBE Siaka	L'Ambassade du Japon		
52	KAMEDA Yumiko	L'Ambassade du Japon		
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3.4.2 Contents of the presentations by the representatives of the participating countries at the UEMOA Seminar for Wide-Area Collaboration

Photo 3-14 Presentation by the representative of a participating country at the UEMOA Seminar for Wide-Area Collaboration

1. The Hunger Project - Benin

Operating system for geographic data maps to implement the THP-Benin strategy for epicenters.

- Status and mission of the Hunger Project - Benin

Status:	International NGO established in 1977 and operating in 23 countries (8 of which are in Africa); the head office is in the United States.
Mission:	to contribute to the eradication of hunger and poverty Since 2006, The Hunger Project has selected MDGs as the working framework

- Programs

  Details of these programs are as follows.

  ✓ Social Mobilization and Capacity Reinforcement Program

  ✓ Food Security, Environment and Income Generating Activities (Activités Génératrices de Revenus, AGR) Program

- ✓ Health and Nutrition Program
- ✓ Promotion and Entrepreneurial Program
- ✓ Women Empowerment Program (WEP)
- ✓ Microfinance Program
- ✓ Monitoring and Evaluation Program

- Hunger Project and the strategy for epicenters

  The epicenter concept refers to:

- ✓ An area targeted for a change in attitudes necessary for development
- ✓ Regrouping of villages (size 10-12)
- ✓ A building (composed of the food bank, rural bank, meeting room, health clinic, nursery) and related infrastructures

- Why maps

  In order to better understand and control intervention areas called « epicenters », the Hunger Project - Benin has requested the assistance of the National Geographic Institute (reference national institution for geographic data production) to create maps and tools to facilitate and improve the quality of intervention in the monitoring/evaluation unit.

- How to use the maps

  More specifically, the IGN-BENIN request is to draw up maps in order to:
  - ✓ List the elements structuring the dynamics in the « epicenter » areas;
  - ✓ Indicate the density of THP-Benin interventions per village at the level of each epicenter.

- To this end

  The maps produced by IGN have allowed THP-Benin to utilize a set of printed thematic layers in order to:

- ✓ Identify the relations and trends based on image data;
- ✓ Conduct a spatial analysis;
- ✓ Improve strategies for design, planning and monitoring/evaluation of programs.

- Use

The maps also provided a global view at a scale of 1:5,000, of the intervention in villages, and determined the coverage of program activities, measured the disparity of existing community infrastructures among the villages, and the impacts of activities on the communities.

These thematic layers also provided a more precise modeling of behavior and scenarios in the real world, thus allowing preventive analysis and clearer professional decisions.

- Mapping references

These data maps were developed based on preconfigured information models:

- ✓ Existing aerial photographs of the epicenter zones;
- ✓ Existing maps of communes covering the epicenters;
- ✓ Statistics (education, health, microcredit and other activities) of the epicenters selected for THP-Benin and other structures.
- ✓ Maps of rural lands in the localities concerned.

- Comparative advantages of using maps
  - ✓ To observe the dynamics of activities in villages to achieve MDGs and to assure the self sufficiency of epicenters.
  - ✓ Several villages can be viewed at the same time thus allowing an evaluation of community infrastructures and opportunities provided by each locality (Allows an evaluation of the effectiveness of means deployed)
  - ✓ Reference tool to measure the community dynamics, the level of development, different components of the localities, between time t0 and t1
  - ✓ Partnership tools with communes and other structures, since the maps will show the results obtained and visible impacts of activities implemented in the community

2. Usefulness of topographic mapping for establishing the Urban Master Plan in Grand Abidjan – Côte d'Ivoire

I. The major stages for the planning and development of Abidjan

Several studies were conducted to move forward with the development of the Abidjan urban area since the colonial period

- ➢ Map of Abidjan in 1928 ;
- ➢ Badani plan (1954) ;
- ➢ SETAP plan and SEMA socioeconomic studies (mid-60s);
- ➢ Urban Master Plan of the Abidjan Region Urban Planning Workshop 1974 (Atelier d'Urbanisme de la Région d'Abidjan, A.U.R.A.);
- ➢ Ten-year perspectives of international SCET (1978 – 1979) ;
- ➢ Long-term outline of the Abidjan Urban Planning Workshop 1985 (Atelier d'Urbanisme d'Abidjan, A.U.A.);
- ➢ Urban master plan for grand Abidjan 2000 (National Bureau of Technical Studies and

Development, BNETD)

II. Grand Abidjan Urban Planning Master Plan being developed

a. Context of developing the Urban Planning Master Plan
- Very rapid growth of the urban areas;
- Lapsing of the Urban Master Plan approved in 2000
- Absence of a general planning document for the medium and long-terms
- Resumption of cooperation with Japan

b. Objective of the study

The objective of this study is to revise the Abidjan Urban Master Plan to assure sustainable development and coherence with national reference documents for country planning

c. Components of the study
- Urban planning
- Urban transport planning

d. Contents of urban planning

d.1. Urban Master Plan
- Definition and perimeter of Grand Abidjan
- Planning for the rational growth of Grand Abidjan
- Proposal of spatial options for harmonious urban development of the settlement

d.2. Detailed urban plans
- Land occupation plans
- Specific Urban Planning Regulations

III. Utility of topographic mapping for formulation of the Grand Abidjan Urban Master Plan

a. Definition of the Grand Abidjan perimeter
- Analysis of the property tax base;
- Definition of the favorable development direction of urban extension

b. Rational planning for urban growth
- Development options considering the physical constraints of the sites;
- Reduction of implementation costs of the Urban Master Plan

c. Spatial projection of structuring equipment
  - Airport equipment
  - Sports complexes
  - Telecommunication facilities

d. Establishment of the structural plan
  - Definition of road layouts;
  - Location of crossings

e. Design of detailed urban plans
  - Definition of layouts for primary and secondary roads;
  - Location of crossings
  - Projection of different areas

IV. Conclusion

Topographic mapping is essential for establishing the Urban Master Plan. This is why the JICA Study Team in charge of the Abidjan Urban Master Plan has already produced the topographic mapping of the study area. The Cartography and Remote Sensing Center of the BNETD is in charge of producing maps for 31 county towns in the regions benefiting from the Urban Master Plan.

3. Protected Areas (PAs) in Guinea-Bissau

In the 70s:	awareness of environmental problems in Guinea-Bissau started to reach considerable proportions with the drought and the drastic reduction of rainfall affecting agricultural activities
In the 80s:	initial environmental studies, particularly the forestry inventory differentiating the types of land occupation and use
In the 2000s:	officialization of PAs

- IBAP (Institute of Biodiversity and Protected Areas)

Established in December 14th, 2004, with the following responsibilities
  - To propose, coordinate and execute policies and actions regarding biodiversity and management of PAs in Guinea-Bissau
  - To promote and safeguard ecosystems, biodiversity and PAs, as well as the sustainable economic and social use of resources in the national territory including continental and marine waterways

- Process of defining PAs

IBAP, during the PA definition process, adopted the participatory consultation model with the community, in order to define areas to be protected based on environmental and socioeconomic factors.

- Protected Areas (PAs)

After several years of study, the establishment of a National System of Protected Areas was proposed, which included 4 national parks, one Biosphere Reserve of the Bijagós Archipelago, forest reserves and the traditional management of national resources.

The entire process was completed due to the availability and use of mapping bases, using digitalization which provided the park limits.

To improve ecological connectivity with respect to old parks already improved, there is an ongoing project for the establishment of a new PA.

- National PA System of Guinea-Bissau

  Tools required to draw up the maps are: @trip pc to download GPS CatTraq data of routes, map source of Garmin for display, processing and analysis of the process, Quantum GIS to transform outlines into shp information layers, and ArcGIS for map analysis and layout.

- During maritime surveillance, all boats apprehended within the PA boundaries are referenced using GPS and the data is uploaded into a database system.

- Permanent lots were established by stratified sampling of PAs, with a random selection of points to establish a monitoring system for the conservation status of forest areas, with updating of a database on biodiversity and carbon imprints, to allow comprehension of its dynamics and evolution.

- PA management
  - Aerial photography using kites for protected areas

  The idea is to create an alternative tool for this institution in order to create aerial images adapted to land management.

4. Use of geographic data by the Ministry of the Environment, Water and Forests - Guinea Conakry

I. **Collection of Geographic Data**

- Satellite images / aerial photographs / JICA photo mosaics of 1977 – 78

- Digitalization of existing maps
- Exchange of data with GIS

  Use of the GPS receiver to calculate a geo-reference position: survey (villages), location of seed farms, animal tracks, survey of roads or forests, etc.

II. Actual forest inventory

A forest inventory consists of evaluating the resources of a forest at a given time. Aside from the species and the diameter of each inventoried tree, other parameters may be noted, such as the height of the plants, the type of soil, herbaceous vegetation, animals or their tracks, etc.

Data collected by Forest Technicians, indicated the status, evolution in time and biodiversity potentials of a forest. The Forest Engineer established an inventory file, which will provide all information regarding the inventory.

Mapping will consist of work in the office and in the field:

- establishment of a vegetation and soil occupation map with a satellite image, if the zone is already known. This option will facilitate the inventory.
- delineation of the area to be inventoried with GPS in the field.

- At the office
  - mapping of the study zone and determination of its surface area
  - selection and location of inventory plots with the help of the Forest Engineer
  - printing of geographic coordinates of the plots in a file

- In the field
  - demarcation of the location of plots will be carried out using GPS
  - demarcation through GPS of pertinent areas during the inventory

III. Procedure

- socioeconomic survey and public awareness of the importance of forests
- demarcation and establishment of Forest Cover limits

  Borderline live trees will be grazed and covered with red paint. Later on, red concrete boundary stones and a sign plate will be erected to mark the property.

➢ Processing of data

- data capture in Excel spreadsheet
- classification or coding of data
- thematic analysis
- calculation of inventory data

The final Forest Inventory result from socioeconomic surveys, will be the establishment of a development plan and the creation of a relational database which will include

- the list of species and animals found
- evaluation of resources used (creepers, firewood, pharmacopoeia, etc.)
- location of regeneration zones
- location of fallow lands according to their age
- dynamic analysis of fallow lands (quantity and quality)
- location of lowlands, plains which can be developed, Bowés (local geological term) and tracks
- type of soil

IV. Conclusion

The FI result provided information on the quality and quantity of natural resources available in the forest. Mapping provided us with an overall view of the forest and its composition. The development plan will consider the needs of the population, how to exploit the forest while preserving its resources, or how to intervene at any time. All of these are possible due to geographic data.

5. Production and use of geographic data in Western Africa - Mali

This presentation falls under the second seminar organized by IGB with the financial support of JICA for its partners (including IGM). The subject selected for Mali is country planning.

The presentation includes two parts:

- ➢ Current situation of the production/use of mapping data in Mali
- ➢ Contribution of the IGM map production in spatial planning activities for development

Specific objectives

- ➢ To know the status of the production and use of mapping in Mali
- ➢ To identify major conditions and challenges in mapping for country planning
- ➢ To formulate recommendations for the harmonious development of map production

Current situation 1:

In Mali, the production of basic mapping data is a noble mission of the Geographic Institute of Mali (IGM). However, it has to be admitted that there are numerous actors/producers. To illustrate, aside from the Geographic Institute of Mali, the National Institute of Statistics (INSTAT), Urban Planning and Land Registry Services (CARPOL unit) can be mentioned.

Current situation 2:

There are other producers of thematic maps such as surveyors who are part of the national private sector for mapping and topography. We can also include: i) the Niger Office through its VISION unit (based in Ségou); ICRISTAT, American research center with funds from mapping using satellite images (reliefs, rivers, roads); GiZ with the land registry project in Ségou.

Current situation 3:

The main mission of IGM is the establishment, dissemination and updating of geographic data. The Land Registry Department establishes the large scale topographic and land registry plans, data banks for plots and lands. INSTAT often assigns the identification codes for villages, and produces mapping data for the preparation and dissemination of RGPH or national survey results.

Current situation 4:

IGM data are of two types (topographic, thematic). They are sold to individuals and to other ministries based on production and management costs. The basic topographic map of Mali has a scale of 1/200,000 (digital versions exist in raster format for 136 cuts) dating from the 1960's (recovery project for topographic maps at 1/200,000). IGM has a digital thematic map of Bamako roads at 1/25,000 and maps of eight regional capitals and some capital of *cercles* (*cercle*: sub administrative unit of region in Mali). These maps only indicate blocks, that is the regrouping of plots demarcated by streets.

- Mapping conditions for country planning

I. Country and urban planning documents must be reliable when drawn up, based on precise and exhaustive mapping of the national territory. Development plans will use a lot of thematic maps which will determine the purposes, assign allocations and occupation of lands (soil, water, natural resources, infrastructures, agriculture, land registry, etc.).

II. The superimposition of these maps will result in a structural system providing an image of the territory in the diagram.

III. For the implementation of the action plan under the national development policy, a GIS will be established for country planning. For this purpose, in 2009, DNAT acquired a batch of geographic layers from IGM, with the administrative boundaries of communes, *circles* and regions, as well as road and communication infrastructures used in its geographic information system, but they are still at the under development stage.

IV. As an added value to this purchase, we can cite

i) the annual development of a series of thematic maps to cover the specialization of development activities

ii) the establishment of administrative maps of Mali for land reorganization in 2011 with the creation of new regions

The spatialization of development activities consists of creating in GIS, based on the list of projects/programs of the National Development Planning Department, thematic maps (hydroagricultural development, production/transformation, health coverage, job creation, reinforcement of skills, etc.), the geographic distribution of activities and financial resources, planned or under execution, all superimposed in the administrative layers established by IGM.

V. Map of Bamako City to consider new extensions of the Bamako City boundaries; mapping illustrations contained in the Country Planning Regional Plans (SRAT (Schémas Régionaux d'Aménagement du Territoire) of Ségou, Sikasso, Koulikoro, Mopti and Kayes)

VI. The Mali Atlas produced by Arp Development, is also a good illustration of the added value provided by IGM geographic data.

- Recommendations

I. The proliferation of mapping production sources and multiple references has produced a strong dispersion and disparity of mapping data. The producers must therefore be brought back to references adopted and used in IGM.

II. To satisfy essential mapping information requirements in the medium term of local authorities, census services and/or the Ministry of Territorial and Safety Administration, national commune-based mapping must be carried out by IGM.

III. The improvement of the geographic positioning of characteristic points (geodesic network); the reinforced demarcation of urban and rural communes; the establishment of national borders; public information for a single coding system.

IV. The production capacities of IGM must be reinforced to support the Border Management Department in demarcating and setting up borders with neighboring countries. In Mali, only 2,500 km of borders have been set up for 7,575 km, or 33%.

V. Basic maps at a scale of 1/200,000 of IGM are in raster format, difficult to use in GIS, and must be vectorized.

VI. In the short term, consider regular urban mapping at pertinent scales such as 1/2,000 or 1/5,000 instead of the current city maps which are only urban sketches based on sets of building plot plans.

VII. In the medium term, improve coverage of the territory at an optimal level through basic mapping at a scale of 1/50,000, to guarantee maximum details and precision, often needed in the map background for country planning.

6. Production and use of geographic data – Niger

I. To give more information on urban planning

- Definitions of urban planning

  Urban planning is a study of urban areas to be developed. It gathers several disciplines in an iterative manner and develops an evaluation of the different scales in space and time. Several professionals (planners, architects, engineers, lawyers, etc.) have contributed to the definition of projects and their formalization in the form of plans, programs, technical documents, etc.

- Multiple definitions

  According to the discipline or professional field, the objectives will change. As such, urban planning covers all issues: political, social, economic, legal, standard of living, etc.

- Definitions of the following different professionals

  Urban planner, political scientist, sociologist, philosopher, sociological architect, urban planning architect

II. Examples of using mapping data

As an example of using mapping data, national land development, urban planning and forest management can be given. During the establishment of a national country plan for example, maps with small and medium scales are essential. This type of map allows the urban planner or developer to place the project in its general sub-regional context in UEMOA. For example, they can have certain information regarding the number of regions, departments, distances between all cities in the country, etc.

III. Topographic or thematic maps

Topographic and thematic maps are also necessary and used to have better knowledge of the factors which may constitute constraints or advantages for the establishment of a national, regional or local town and country plan.

The urban framework map of the country, the population map, the vegetation map, etc. are examples of thematic maps generally used.

IV. Planimetry and Altimetry

- Planimetry and Altimetry

  For planimetry and altimetry in particular:

  Planimetry must indicate land occupation,

  Altimetry must be transcribed in contour lines,

  Spot elevations,

- Topographic surveys must be provided (large scale),
- Orthophoto plans providing contour lines,
- Mosaics of aerial photographs, preferably rectified (planimetry only),

Once this information is gathered, based on the type of document concerned, it will be possible to analyze the development project site in order to establish maps for slopes and to define:

- Flood risk areas,
- The functioning of gravity sewer systems,
- Risks of erosion, compartmentalization of the site based on relief,
- Private spaces and public or free spaces for the establishment of infrastructures and equipment,
- Typology of the habitat and soil characteristics
- Risk map of slope and vegetation

- Addressing map

  This addressing map is the result of all the information layers processed. It also provides the establishment of a Geographic Information System for better urban management of the city.

7. Production & use of geographic data in the production and distribution of potable water in the urban area in Senegal

- Production and distribution of potable water, billing/fare collection and relationship with clients for more than 56 important urban sites and more than 400 villages

  - Mastery of geospatial information:
    - To know,
    - To plan, and
    - To manage

- Issues
  - *Establishment of a system to respond to geographic information management requirements (reliability and completeness) of our Technical services and clients*
  - *Consideration of major developments in our activity in the GIS platform, by interfacing with other applications of the company and assuring better data sharing*
  - *To arrive at a high level of mapping information analysis for decision-making in the management and control of the AEP network through an exchange of data to assure more efficient interventions.*

- Purpose
  - Coordination as a form of integrated management
    - Involvement in IDG data collection for all our essential positions
    - Pooling of data in our work related to technical and client matters for decision-making
  - Establishment of a common mechanism for implementation

- Recommendations for the UEMOA countries & Guinea

  - Review of colleagues, Conference for the updating of geospatial information based on specific sub-regional projects with ad hoc agreements of restricted scope and a limited service life among countries in the area

  - Establishment of a Regional Subcommittee for Coordination in order to:
    - create a standard at the sub-regional level
    - establish appropriate policies, tools, mechanisms and standards at the sub-regional level
  - Establishment of an action plan in Ouagadougou among the participating countries
    Establish a unified management framework including all stakeholders with sufficient means and recognized authority

  - Organization of meetings to harmonize procedures, information and sharing between colleagues
    Establish a sub-regional platform for data dissemination
  - Fostering of economies of scale for the production and dissemination of geospatial information

8. Contribution of mapping for the sustainable management of floods in the commune of Lomé – Togo

1. Introduction

Togo, a western African Country bordered on the:

north by Burkina Faso,
south by the Atlantic Ocean,
east by Benin,
west by Ghana.
Surface area : 56,600 km²

Population : 6 million
Capital : Lomé

2. Urban problems of the country

Togo experienced rapid urbanization and a long socio-political crisis during the last three decades. Lomé, the capital, and all the secondary urban centers in the country are suffering from overpopulation, thus creating pressing problems regarding land, infrastructures and social equipment. Furthermore, environmental problems have aggravated this situation: insanitation, sanitation/hygiene, waste management, noise pollution, etc.

3. Problems of flooding, demographic growth, urban concentration and overcrowding in Lomé

From all these problems, sanitation conditions have worsened in the commune of Lomé. In fact, Lomé which was formerly called « a beauty » now presents a depressing picture. In addition, Lomé City suffers from floods every year.

Due to insufficient existing structures, and their poor maintenance, demographic growth and urban concentration have increased occupied spaces, leading to significant runoff of rain water, whose stagnation has produced severe problems and pollution.

To resolve these conditions, in 2010, the Government of Togo obtained a donation of around 27 million US dollars from the World Bank and Worldwide Funds for the Environment, in order to finance the Lomé Emergency Project for the Rehabilitation of Electrical Infrastructures and Services (Projet d'Urgence de Réhabilitation des Infrastructures et des Services d'Électricité, PURISE), which includes rehabilitation of the drainage and sanitation system of the city.

A drainage system was therefore installed in order to prevent flooding during each rainy season.

- This drainage system is composed of: gutters which directly drain water to the lake or to the city in the lower part of town.
- A series of natural depressions were laid out to channel water by gravity to the northern plateau of the commune.

4. Approaches and solutions

A land morphological study will:

- provide a probable explanation for this recurrent phenomenon
- provide more sustainable solutions.

The relief survey based on contour lines showed that the basins are too small to contain the required water retention capacity. This was noted based on the scope of overflowing areas in these basins. Any building or structure in the area will therefore be flooded. Determining the volume of water which spills to the overflow areas will allow a recalculation of the retention capacity of these basins, and subsequently, the parameters required for their resizing.

5. Conclusion

All of the above clearly show that without a topographic map drawn up, no viable drainage system can be built. This work is only a prelude to the major sanitation project for Lomé City and its surroundings. The project is financed by the World Bank and started in February.

9. Road Information System (RIS) - UEMOA

I. Context

RIS serves as a framework to standardize national sectoral policies for infrastructures and transport. It is an information system indicating performance in order to define the objectives and principles for five main roads.
Definition of the 33 community main roads, which will receive specific interventions.

The current situation of RIS is as follows:

- Diversity of driving/navigation systems
  Seven UEMOA member countries have implemented road data banks: Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger and Senegal. Only Togo does not have an electronic BDR.

- Four main software programs used + HDM;
  - Operating systems;
  - Data collection: manual and automatic;
  - Road metering: manual and automatic;
  - Inspection of structures

II. Community road information system (RIS)

a. Objectives of community RIS
   Purpose of RIS:
   To provide a support tool for decision-making in the evaluation of needs, the definition of strategic and operational objectives, the mobilization of resources and the monitoring of performances achieved for road maintenance and road infrastructure projects

   - Good knowledge of the UEMOA road network and its condition, particularly the community network
   - Support for analysis, programming and monitoring of interventions in the community network and in national networks of member countries
   - Support in decision-making for the development of road infrastructures.

- Performance measurement of projects/programs and the community action program
- Production of reliable and regular statistics on road infrastructures in the UEMOA area, specifically for the community network

Information will be reproduced in the form of tables, graphs, overview diagrams and maps.

Two implementation levels of RIS:

- Establishment of a Community Road Information System (RIS) and
- Reinforcement of national road data banks (BDR)

b. Regulatory framework

- Regulation 08/2009/CM/UEMOA

For the Adoption of the Statutes of the Community Road Network of UEMOA and its Management Procedures

- Guideline No.11/2009/CM/UEMOA

For Harmonization of Road Maintenance Strategies in the UEMOA Member Countries

III. Implementation status

- Technical studies;
- Support for countries;
- Investigation of principal suppliers of work applications;
- Selection of application platform;
- Installation, configuration and training;
- Establishment of the core of the deployment system: establishment of a reference framework

a. Technical guidance

Application platform accessible through the Internet

- Geomap GIS Application
- DBMS driver: SQL Server
- Equipment for inventory and the survey of the network conditions
- Geographic data applications
- Specific database applications: OPA, axle load, transport, etc.

Inventory equipment composed of a tablet equipped with GPS and an odometer, to establish the layout of the roads in geographic coordinates (XY or longitude/latitude) and curvilinear coordinates (PR + abscissa).

It is connected to the mapping and data server, which allows downloading of part of the network for field operations and to restore information gathered in the server.

Equipment to find degradations based on VIZIR and VIZIRET models (degradations in asphalt-paved roads and dirt roads respectively in a tropical area) are developed by the Central Laboratory for Bridges and Roads of Toulouse and adapted to the regional context.

b. Definition of a common reference

The establishment of an information system requires the organization of data into basic units "atoms in the machine" constituting the different recordings of the road data matrix. The sectioning of the network will respond to this need.

IV. RIS

a. User profile

Access to RIS is subject to restrictions according to the users group with rights of access

- At the community level
  - Regional administrators
  - Professional users
  - Occasional users
- At the national level
  - National administrators
  - National users

b. How information is shared

Information is shared around several basic principles

- The establishment of a data validation mechanism (at the national level and the community level) before their integration into the system
- Data feed to RIS by national or community BDR managers. Service providers (research office, companies) have no access to capture/modify data
- RIS and BDR will mutually provide data through a validation mechanism to be defined.

c. Perspectives

Financing of PIR 10th FED:

- Consolidation of the current system installed
- Geographic extension of the system
- Development of supplementary modules: data on heavy traffic, statistics in PCJ
- Purchase of operational equipment and materials
- Reinforcement of the capacities of participants

V. Conclusion

The establishment of RIS will allow the UEMOA commission and member countries to use a monitoring tool in the transport sector particularly the road infrastructure. It will also be a tool for dialogue and exchange with technical and financial partners.

10. Division for Capacity Development, Information and Environmental Monitoring (Développement des Compétences, de l'Information et du Monitoring en Environnement, DCIME)/ National Council for the Environment and Sustainable Development (Conseil National pour l'Environnement et le Développement Durable, CONEDD)

- Current situation,

  DCIME is building an underground dam for projects to combat desertification. By monitoring the environment, it will maintain solid relations with IGB, and may receive mapping data (the most recent) in the future.
- Relation with maps

  Maps will be used to select appropriate project intervention areas with reference to data, particularly concerning reliefs, ground objects, etc.

Examples of using topographic data

I. Introduction

Objective of the presentation = to provide information on examples of using national topographic data produced by IGB

These are examples for using the unit, which is not only a partner of IGB, but also controls or drives PNGIM: national framework for the coordination of production, management, information dissemination activities, where IGB is part of.

PNGIM (National Program for Management of Information on Environment) is a unit created by the Inter-ministerial Decree of MET/MARA/MTPHU of 11/02/1993 as a coordination framework for production, management and information dissemination activities on the environment.

II. Use of IGB topographic data

Two types of activities are conducted:

- ➢ By members of the network: an activity is regularly conducted for the adoption of IGB topographic data as reference data.
- ➢ At SP/CONEDD, for the creation of thematic mapping products.

Example 1. Use of different layers of BNDT in LEIS (local environment information system)

- ➢ LEIS is a model and integration and spatialization software for human/environment dynamics to support decisions for the management of resources and country planning at the local-level.
- ➢ LEIS is developed under the International Convention to Combat Desertification (Lutte contre la désertification, LCD), and Multilateral Agreements on the Environment (Accords Multilatéraux sur l'Environnement, AME) (Desertification, Biodiversity, Climate change).

III. Information layers integrated in LEIS

- ➢ For BNDT = almost all layers (communities, roads, hydrology, topology)
- ➢ The followings are associated: soil, occupation of land topology, climatology and socioeconomic fields, etc.

IV. Conclusion

The existence of quality basic topographic data is a very important asset for a country. Activities conducted by IGB to establish and update them are applaudable. This is why a structure which not only manages environmental issues, but also conducts activities in the PNGIM network, is working for the adoption of these data as reference data, in order to facilitate data sharing.

11. Institute for Agricultural Research and the Environment (INERA)

- Current situation

  This institute conducts research for agriculture and the environment (research on traditional cereals, horticulture, rice, cotton, livestock and forestry, as well as the protection and improvement of natural forest resources)
- Relation with the topographic map

  Maps are principally used (as a thematic map) for the selection of adapted cultivation and forest protection measures.
- The digitalization of the map is much awaited. Media database mapping for topographic designs and developments

  - ✓ Map: privileged means of sharing discoveries with others (my findings or that of a third person).
  - ✓ Two basic means of expressing content to be transmitted to others:

    Illustration (imprecise location) or – allowing rediscovery (precise location)
  - ✓ Through community, national or international agreements and standards, a map will be used to provide the community, the nation or the entire world with important

information regarding a phenomena occurring in the world

- ✓ Topographic map: very important element for the development of mapping activities for planning, development, including perspectives.

- National inventory of lowlands
  - ✓ Formally considered as marginal lands, events (1970/1980) and drought pockets have produced interest in this area from 1990.
  - ✓ Specific objectives:
    - to secure agriculture production,
    - to develop off-season cultivation, and increase the revenue of producers
  - ✓ Procedure: in three phases
    - Special food security program/ FAO (in 1998),
    - Sahel Integrated Lowlands Ecosystems Management (SILEM) of PNGT2 (in 2002)
    - Action Plan for the Rice Sector (in 2002)
  - ✓ Collaboration :

    IGB, Regional Departments of Agriculture and Regional Departments of Animal Resources, Lowlands Consortium/ADRAO (now Africa Rice).
    - Basic data: aerial photographs at a scale of 1/50,000, Landsat ETM+ images (1999/2000), hard copy of topographic maps at a scale of 1/200,000, BNDT digital file (national topographic database), digital file on catchment basins, INSD data on the population census, data on protected areas
    - Methodology: photo-interpretation, shape digitalization, field surveys (biophysical and socioeconomic), GPS, verification of toponymy, division into lowland units (sections of 1 to 5Km), coding of sections, Building of database under ACCESS
  - ✓ Note: PSSA/FAO/PNUD inventory: PVA

    PAFR inventory: Landsat ETM+ Images

    SILEM inventory: PVA
  - ✓ Results: National database on lowlands
    - Mapping documents in IGB format (1/200,000-scale and 1/50,000-scale)
    - Knowledge of lowlands potential in Burkina Faso: 1,957,520 ha for 23,916 sections.

      Close to 500,000 ha can be developed

- Users
  - ✓ PAFR: types of lowland developments carried out, with protected dikes (riprap):
    - 177 lowland units or 2,416 hectares developed in the 13 Regions of Burkina Faso in 2004 to 2008 (project period)
    - Total number of beneficiary producers = 10,383 with 3,695 in enterprise and 6,688 in Rice Producer Groups

- ✓ Implementation of rice production policies:
  Example of Mouhoun Water Agency (AEM). The development of lowlands to partially control floods is considered in combination with small-scale irrigation by pumping during the dry season when surface water resources are available.

- Mapping and creation of a GIS database in the PDSET/Oncho intervention zone
  - ✓ Specific objectives: Establishment of a geospatial database to help in decision-making for the project in its extension phase, participation in the implementation of an economic and social integration project among Burkinabé and Ghanaian communities in transborder zones free from onchocerciasis or river blindness, proposal of development systems
  - ✓ Collaboration: BUNASOLS
  - ✓ Database: National Topographic Digital Database (BNDT)-2003, topographic maps at a scale of 1/50,000, village file on 2006 communal elections, data on socioeconomic infrastructures (schools, dispensaries, markets, drillings, etc.), data on fauna and protected spaces, Landsat ETM+ images (2000)
  - ✓ Methodology: Gathering of available data, control for coherence and consistency of data gathered with respect to actual data, creation of the database, gathering of missing data in the field, analysis and proposal of the development system
  - ✓ Results: Database with MS Access and MapInfo, Development Systems (based on millennium objectives for development (MDG) and international and national standards for socioeconomic development, GIS analysis was conducted to propose the building of schools, dispensaries, markets, roads, passable roads, bridges, basemats, livestock corridors, vaccination clinics and drilling fields)

- Inventory of trees in urban communes in Burkina Faso
  - ✓ Specific objectives: to establish a statistical and georeferenced database on wood potential in 49 urban communes, to plan replanting activities and the maintenance of trees in public spaces, to assist local authorities of regional and municipal councils in decision-making.
  - ✓ Database: BNDT file (national, provincial and departmental roads), land registry files of the Association of Municipalities of Burkina Faso (Association des Municipalités du Burkina Faso, AMBF).
  - ✓ Collaboration: 2nd National Forest Inventory Project (IFN2), AMBF
  - ✓ Methodology: Statistical survey of two bases (List of main roads of the commune

composed of alignment trees or plants, and the communal area defined by the surface area of each commune for trees under concessions and outside concessions)

- ✓ Actual results: Demarcation of the urban area, updating of the road network for urban communes, validated methodology
- ✓ Perspectives: Inventory of all communes

- Conclusion

  The topographic map is indispensable for mapping development, even if sometimes replaced with a satellite image map (default).

  Some recommendations

  - Improve the coherence and consistency of data at the national level (e.g. with MATDS)
  - Regularly update topographic data (roads, localities, road infrastructures).
  - Enrich the national topographic digital database (BNDT) to accommodate new information

12. Higher Institute of Population Sciences (ISSP)

(Research center in the University of Ouagadougou)

The contribution of a research and academic institution on population sciences: ISSP

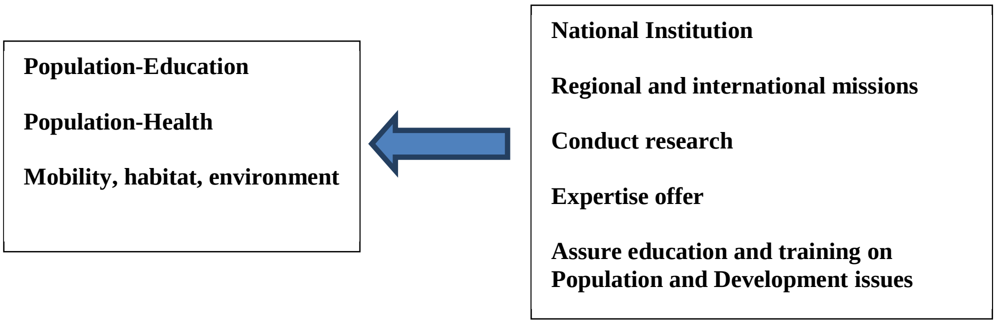


Figure 3-4 Diagram Correlating Demographic Science Researches

- A double demand: updated and fine-scale representation:

  Changing the scale will change the perspective. In social science, the fine-scale is essential to perceive the eventual spatial segregation of social phenomena. The scale underlies the representation of phenomena and consequently, the facts will provide their scale of expression. This is why fine-scale maps will offer greater potential for research and analysis. Between establishing a presence and giving its identity (geometric form) in space, nuance is important and implications are far reaching. The need for fine information requires data gathering using GPS. This will require coherence with IGB-based support so that even the non-experts can use.

- Some recommendations

  IGB can provide better information for the updating of available maps since the topology of mapping elements has not always been achieved. The creation and holding of a forum for the exchange of skills in the field of mapping and GIS may allow us partners to be informed of IGB developments and also allow us to provide our contributions.

13. International Institute of Environmental and Water Engineering (2IE)

Example of using topographic maps at 2iE

- Elements of a topographic map
  - ✓ Artificial elements: roads, buildings, urban development, borders and boundaries, railroads, LV & HV electrical lines, etc.
  - ✓ Natural elements

    Hydrography: lakes, rivers, watercourses (streams), marshes
  - ✓ Vegetation: forested and deforested areas, etc.
  - ✓ Relief: Contour lines, etc.
  - ✓ Toponymy: names of areas, names of hydrographic elements, names of roads, etc.

- Mission of 2iE

  International Institute of Higher Studies and Research

  In Africa, to train competent and innovative engineers/entrepreneurs capable of responding to development challenges in the continent
- Training fields
  - ✓ Water & Sanitation
  - ✓ Hydraulic Networks & Infrastructures
  - ✓ Energy & Electricity
  - ✓ Civil Engineering
  - ✓ Mines
  - ✓ Management sciences

- Examples of the use of topographic maps
  - ✓ Digital modeling project for underground flows at the SANON experimental site, and use of water for sustainable supply to populations in the locality

- ✓ Use of the map in 2iE training programs

- Objectives
  - ✓ Inventory of water points in the area: wells, drills, piezometers
  - ✓ To determine coordinates of water points
  - ✓ To demarcate the catchment basin
  - ✓ To trace the topographic profile

- Methodology
  - ✓ Establishment of the survey plan of water points in the topographic map
  - ✓ Planning of trajectory
  - ✓ GPS survey of water points
  - ✓ Report on water points in the topographic map

- Conclusion

  Data submitted by the hydrogeological team for modeling and the water supply project

  The topographic map remains an indispensable support for development project studies

- Impressions

  As a whole, the IGB topographic map data are used as thematic maps. In the future, digital data requirements and updated data must be increased. For IGB, we recommend creating topographic maps to serve as a basis for solid thematic maps.

14. Bureau of Mines and Geology of Burkina (BUMIGEB)

- Current situation

  BUMIGEB has produced 13 thematic maps (geology) using an IGB map at a scale of 1/200,000. These maps are mainly used for:
  - ✓ Precise identification of drilling sites
  - ✓ Analysis of the geological quality of the surface layer through profiles established from topographic maps

- Perspectives

  The maps, which up to this time have used the coordinate system (UTM, Abidjan: source in Sudan), must be modified to the coordinate system (UTM, WGS84: polar coordinates as source). With digital data used from this time, the thematic maps (geological maps) must be developed with GIS.

Use of topographic maps in BUMIGEB: Specific case of geological mapping at a scale of 1/200,000

1. Introduction

The geological coverage of the survey at a scale of 1/200,000 for the entire territory is one of the missions assigned to BUMIGEB. This geological coverage which started from 1960 has had several phases in its development:

The first phase, after independence, which produced an edition with several maps;

The second phase, conducted from 1997 to 2003, in cooperation with BRGM under a large-scale project which allowed the editing of 13 maps;

Then the third phase, ongoing since 2004, which will finalize the maps with square degrees.

To create a geological map, a multitude of geoscientific information and data, including topographic information, are needed.

Topographic data are used in all geological mapping stages, during the preparation phase in the office and for field activities, up to the editing phase of the geological map.

2. Importance of topographic maps before conducting field excursions

- to provide an idea of the accessibility of the study area: the presence or absence of forest zones, stretches of water, the specific geomorphology, and especially, the density of communication means;
- to define fieldwork methodologies based on gathered topographic information.

3. Use of topographic maps in the field

- Geological survey at 1/200,000, used mainly for roads and tracks. These topographic maps will be very useful for orientation.
- They will also be used for reporting observation points in the field, which will allow the creation of a “field minute”.

4. Use of geographic data to create the geological map

- To create the geological map, we will use a topographic background with all the necessary geological information: boundary of layers (lithology), geochemical data, structural data, etc.
- So as not to overload the map, only the necessary topographic information will be provided. The information to be included and their qualification will be indicated beforehand.
- The geological map will therefore be created based on a topographic support, well defined and adapted to the need.

5. Conclusion

The use of geographic data is indispensable for the geological and mining mapping of BUMIGEB. However, some difficulties remain regarding their use, such as:

- the projection system for topographic maps (UTM, Adindan) which differs from the system used in BUMIGEB (UTM, WGS84);
- data were acquired several decades ago, which often shows a difference with the current reality in the field.

We consider that this project is highly beneficial since it will allow an updating of the BNDT databases and provide users with new data of better quality.

3.4.3 Q&A in the Presentation on Geographic Institute of Burkina Faso (IGB)

(Q&A in Session 1 on February 13)

Cote d'Ivoire →Burkina Faso

Q. Regarding access to IGB geographic information, it will be interesting for the UEMOA area research offices to have access to digital information from the website, without having to go to Ouagadougou. For this purpose, are you allowing electronic payment and downloading of digital geographic information from your site?

A. IGB has decided to first install a system to allow access to its data with direct downloading of some of these. Users may identify their selected data, check the costs and make orders from the website. Delivery is still carried out manually. When possible for us, we will conduct electronic sales which will allow payment and access to data from your computer.

Electronic payment is a complex system requiring agreements with financial institutions and perfect mastery of the technology. We think that it will be more prudent to proceed more slowly and safely.

Benin UNDP → Burkina Faso

Q. What are the dates of the topographic maps being updated and with coverage at a scale of 1/50,000?

A. Maps being updated were edited in the 60s, based on aerial photographs from the 50s.

Maps with at a scale of 1/50,000 date back to the 80's.

Mali → Burkina Faso

Q. For the numbering of sheets, we recommend starting from the millions divided to the scale of 1/200,000. There is an international numbering adopted for this. For regional coverage, this numbering system must be used. How are the sheets named?

A. These sheets are divided according to the international standard. However, if a sheet only covers a small surface area of Burkina Faso, we will extend the sheet, to allow economy in printing.

For sheets which previously had the names of localities belonging to a neighboring country, new names were selected from localities in the sheet concerned. Generally, the name of the most important locality was selected..

Senegal→Burkina

Q. The procedure adopted by Burkina Faso complies with the rule which extends a sheet to include a small part of the territory in a map, or what is called an extension (crevé).

Under the ongoing project with JICA, what will be the coverage rate of the country for the map at a scale of 1/50,000?

A. The coverage rate will be from around 36% to 40% upon completion of this project.

Guinea → Burkina Faso

Q. How many sheets are being produced with JICA?

A. Forty sheets, with 36 for the north and 4 for Ouagadougou.

Niger → Burkina Faso

Q. How is the Commission of Toponymy structured and how does it function?

A. In Burkina Faso, a National Commission of Toponymy was created in the 80s for the revolutionary regime which made major changes in the names of certain areas. This includes the country which was renamed from Upper Volta (Haute-Volta) to Burkina Faso. However, it did not work out as planned.

The need to improve the quality of maps being produced has led Burkina Faso to create a new National Commission of Toponymy.

We selected two departments, one administrative (Ministry of Territorial Administration) and the other, technical (Ministry in charge of IGB). The chairmanship is assumed by the Ministry of Territorial Administration and IGB assures the secretariat. The secretariat is assisted by a toponymy office created under IGB to prepare documents to be submitted to the national toponymy commission. We were lucky to have technical assistance which enabled us to obtain the help of a UN expert with long experience in the National Commission of Toponymy of France.

3.4.4 Q & A on the presentation of the UEMOA

Senegal → UEMOA

Q. In the community town and its country planning department and infrastructures, are there themes other than roads which will be covered by the establishment of a geographic information system?

What was the data gathering process and what was the contribution of the different participants at the country level?

What was the result of the work carried out by UEMOA?

Togo → UEMOA

Q. You said that you have supported participants of the road information system in the countries. What does this support consist of? I also wish to inform you that Togo has finalized its complete mapping coverage at the scale of 1/50,000 through its cooperation with JICA. We are now studying the means to allow users to access it.

Cote d'Ivoire → UEMOA

Q. The reference system must be harmonized to avoid the overlapping of data. Is there a time chart for the signing of partnership agreements with geographic mapping institutions and the adaption of a reference system to establish the different themes on the same mapping base?

A. We are already using the topographic map at the scale of 1/20,000 as a reference map, but it is outdated and unadapted.

Niger → UEMOA

I am worried about the UEMOA procedure. UEMOA called us to a meeting in Dakar in 2010 to discuss the observation project for the community planning. Maps were provided to define the reference system for the integration of data gathered in the member countries. A study for the adoption of a reference for UEMOA was again presented and exchanges were fruitful, but while listening to the presentation, it seemed like the results of the study were not yet provided.

Mali → UEMOA

Q. What are the criteria used to determine community main roads in relation to the national roads? An overloaded map is less legible. Are you including all the sectors in a reference?

The total length of national roads in South Africa is 100,000 km.

In Algeria, it is 90,000 km.

The UEMOA area only covers 1,000 km.

What is the possibility of extending the main community roads?

A. UEMOA will introduce a server to hold the minimum shared mapping support. The UEMOA internet was installed in 2013 to improve the work. The rest may be studied based on themes, means and centers of interest. UEMOA will work to assure that the community system is compatible with national systems. Since it cannot conduct an inventory every year in the countries, it is the member countries themselves who must do so. We think that in two years, the system will be perfectly operational in the internet. It will allow all users to check ongoing infrastructure projects, including congestion problems in the main roads and the volume of traffic in the different corridors.

We have a time chart based on financing agreements. In the beginning of March, a financing agreement will be signed between UEMOA and the EU. We exchanged data with CEDAO and the question is how to jointly develop the process. Road classification began in 2001 and will end before the end of 2014. We need the corridors to boost integration. International roads will connect a national capital with different ports, and will connect the countries with each other. Since 2010, we are in the process of extending community networks. Accessibility is not a problem. For the road information system, we equipped the member countries with computer hardware in order to allow an exchange of data with the commission. Once the software program is considered acceptable after the information test in Burkina Faso, we will extend it to all these member countries. UEMOA may integrate thematic data of all sectors in its database. We therefore need the cooperation of all mapping institutions to build a geographic information system. We suffered a delay due to the retirement of an expert in charge of the project, but his successor has been recruited to make up for lost time and to assure progress of the operation

Comments of moderator (DGIGB)

We recently demonstrated the need to work together in collaboration with UEMOA which may significantly enhance our objectives.

3.4.5. Q & Users of Geographic Information

UNDP Benin to CONEDD

Q. Why will you not make IGB thematic maps in spite of their known usefulness?
Is IGB using thematic mapping data to enrich its basic maps?

CONEDD

A. There are around forty units using the geographic information. IGB is mainly in charge of the work assigned by the government under its mission to produce geographic information. I think that it will be difficult for IGB to take charge of themes outside its heavy task of basic topographic mapping. However, the thematic maps should use the same database. If needed for thematic mapping, IGB may contribute with its knowhow and mastery of the information systems.

BUMIGEB

A. It will be appropriate if the competent units can establish their themes according to their center of interest, since IGB will not be able to interpret specific data as geological layers and granite layers

2IE

A. The guidelines have assigned IGB with the basic topographic mapping responsibility. Users will establish their thematic maps based on geographic data produced by IGB

Niger (comment)

We have exceeded the quality level of Google Earth since GPS is easy to use and indispensable for field work.

DG/IGB

A. Since the Google Earth images do not have the required geometric quality, they can be used only for purposes of display. Geographic institutes must never use the Google images to produce maps without assuring their geometric quality, since the satellite camera is not stable in its orbit. This instability of the vector has led to distortions in the aerial photos or images which must be corrected, but Google does not always do this.

Basic topographic mapping is under the responsibility of IGB. It requires high qualifications and financial means. Different thematic sectors are aware of the importance of basic mapping. Together through different forums, we must convince the policy makers to invest in the high objectives of development participants to create basic topographic maps for their program planning.

Production must comply with rules in order to enrich topographic mapping. Our geographic institutions must emphasize the importance of topographic mapping to our political decision makers.

UNDP Benin INERA

Q. What is the scope of the inland valleys in Burkina Faso? What is the scale limit to identify and closely investigate the inland valleys of a small surface area?

A. The inland valley consortium was established for the development of inland valleys for rural inhabitants. It organized a workshop to define the inland valleys in 1995. Criteria selected were considered during photo-interpretation. The width of the inland valleys in Burkina Faso is 20 to 55m and zones exceeding this dimension are defined as alluvial plains. Aerial photographs at a scale of 1/50,000 were used for stereo photo-interpretation. Topographic data at a scale of 1/200,000 were enlarged by 1/50,000 for areas where information at a scale of 1/50,000 was not available. After interpretation, verification in the field was conducted.

S.E.M Ambassador of Japan

I would like to extend my heartfelt thanks to DGIGB and all representatives of national mapping institutions and units of geographic information in nine countries.

Personally, I often travel and use the topographic maps produced by your institutions. It allows me not only to locate my destination, but also to have information on the relief, vegetation, roads, railways, rivers, as well as the life and culture of the inhabitants of the region concerned. It is therefore very practical in all fields. While listening to your interventions, I realized that the topographic map is related to our everyday life: agriculture, education, the environment, disaster prevention, tourism, transport, which essentially rely on the availability of geospatial information.

On behalf of the Japanese government, I would like to convey the determination of Japan to assist in the effort of the authorities of the African countries, and especially in Western Africa.

3.4.6 Q & A Presentation of countries participating in Seminar.

Burkina→Guinea

Q. What is the topographic mapping situation in Guinea?

A. Topographic maps at scale of 1/50,000 (1/3 of the territory) and at a scale of 1/200,000 were produced during the colonization period (1940 – 1960). We have mapping data updated in 1982 through the Japanese cooperation program. Since a year ago, the mapping project at a scale of 1/50,000 is ongoing within the framework of Japanese cooperation program..

Burkina → Guinea Bissau

Q. We have protected forests in southwest of Burkina Faso. Do you have a problem of anarchic occupation of forests protected by the population?

A. Protected forests are found in the islands or in mangrove parks. The forest management committee monitors and protects biodiversity. Since the population residing in protected areas respect the rules for the protection of natural resources, we have no management problem. Last year, a JICA Study Team arrived in Guinea-Bissau, but due to the political situation, Japanese cooperation has not progressed since then. We are now greatly relying on the Japanese cooperation program..

Senegal → Burkina

Q. We congratulate you on the provision of better geospatial information as a result of the JICA topographic mapping project at a scale of 1/50,000.

Do you have a strategy for enhancing digital data for sub-regional development? Is there a copyright problem?

IGB

A. The government has approved the topographic mapping at a scale of 1/50,000 throughout the country as a priority in the mapping guideline system. However, it has no financial means for mapping and must look for support from its development partners such as JICA. IGB is actively working to increase public awareness on the importance of geographic information through the media or the IGB Open Door (planned for April, 3 days a week) and to explain the use of the information.

Last year, the prime minister visited IGB to learn the mapping process. Maps are on sale in IGB at a low price, only to cover minimal costs. The project plans the creation of a website to provide users with access to data and to make orders without the need to go to IGB. If our products are not available, they will be of no use for the users.

Senegal →Mali

Q. What do you mean when you say that the basic topographic map at a scale of 1/200,000 can be used for decentralization?

A. There are two types of basic topographic maps. The basic map used for decentralization is different from the basic topographic map covering the entire country. For example, we had a food crisis in 2004. To analyze this situation, the establishment of the information management center was considered, but due to the reticence of some institutions, the idea did not bear fruit. Given the necessity of publicizing data on the website, we are working in this direction. At present however, we do not have enough data..

Senegal →Niger

Q. Are addressing data used for other products derived from GIS?

A. Information on Niamey City (habitat, trade, roads, width/length of roads) was collected and the database is already established.

Benin (comment)

Most participants presented sectoral themes such as mines, forests, flooding, but they did not present a global vision. To plan for national development, it is possible to produce a theme on the different basic domains in the basic topographic map. Will it be necessary to relate the use of the topographic map and the follow up and evaluation mechanism regarding the development policy to evaluate the evolution of the situation? We must make several recommendations at the end of the seminar, and must have recourse to mapping organizations for the production of sectoral thematic maps (upstream and downstream).

Benin → UEMOA

Basic data produced by mapping organizations are used in the different domains. Since the geographic data currently available to us were produced before our independence, it will be necessary to update and standardize these data. We are asking UEMOA to establish unified standards.

Presentation of M.TAKANO

a. Training of personnel

In the field of geospatial information, the personnel must be trained to acquire new technologies to manage information. In order to do this, I recommend the following points:

- Active participation in training given by ING in Japan
- Technology transfer through experts from advanced countries
- Exchange of personnel in the sub-regional area
- Appropriate treatment of personnel according to their technical level to prevent the departure or the brain drain of personnel who have received training (in Japan, France, the Netherlands)
- Establishment of the GIS and mapping training center for UEMOA member countries and Guinea, and the organization of third country training in this center.

b. Reinforcement of organizational skills

The reinforcement of organizational skills constitutes the basis of all activities. It is important to establish a long-term vision on the management of national basic maps. Activities will be conducted based on the objectives.

I propose the following points.

- To establish a long-term plan with a long duration perspective
- To provide the budget and personnel required for the long-term program
- To redeploy NMO and clarify the distribution of tasks to be accomplished
- To reform the work environment through the assignment of appropriate personnel to raise work morale and encourage research in new technologies
- To promote publicity for use of the GIS and topographic mapping data
    - To obtain the support of people
    - To obtain a budget

3.4.7 Discussion

DGIGB

Personnel skills must be reinforced and trainees must remain in our organization instead of looking for more lucrative work in other areas such as the mining sector.

The Ministry of Infrastructures is presently studying a policy to prevent the flight of personnel to other sectors. This problem is a common challenge throughout our country. Based on the specific features of each country, we must draw up an appropriate collaborative approach to remedy this situation.

Mali

Mali started the digital topographic mapping project since 1996. Among the 6 trainees, there are only 2 who remained after the training program. Under the mapping project at a scale of 1/50,000 (48 sheets), JICA provided technology transfer but the mapping service was not included. As an example, it would be ideal to require the trainee to remain in the organization for 5 years after the training program.

UNDP Benin

All development sectors are confronted with the problem of the flight of personnel from one sector to another. It is to be expected that the personnel will always look for better working conditions. Therefore, it will be important to establish an incentive system such as career planning for the personnel. At the same time, a manual of technical procedures must be drawn up. In China, they say that the correct tool is required to carry out good work. UNDP is emphasizing the evaluation of personnel skills to understand the level of competence required at each stage.

Guinea

We have difficulties to understand the policy makers on the importance of topographic mapping, as the Department of Public Works is the supervision of the Geographic Institute of Guinea is subject to an assessment of their performance on the state of road development. Policymakers do not see it as the role played by the Institute.

DG/IGB

Geographic information covers various fields. Should the Ministry in charge of the geographic institute be a sectional Ministry, such as the Ministry of the Economy and Development, or should it be it be the Prime Minister’s Office? However, this matter is for the government to study, and not IGB.

2iE

To reinforce personnel skills, career planning is important. A seminar, short training or a degree course may provide good incentives for the personnel. 2iE has been giving a degree course since 2012. About thirty people were trained in 2013, but in 2014, there were no trainees due to the absence of financial means. We are therefore asking for JICA support. We have organized training on the geospatial system in collaboration with IGB between 1997 and 1998. We are also providing training on remote detection in Bacs+2.

GIS / UNDP Benin

Aside from reinforcing the skills of personnel and organizations, we must have a systemic vision, since the mapping sector is constantly evolving. There will always be persons who will lead the sector after their training, irrespective of the incentive measures provided, and new personnel will arrive from other sectors. We must therefore consider the diversification of personnel.

Senegal

The national mapping organization is under the national agency for country planning, which was created in 2009 to manage various fields. It was successful in retaining its personnel.

The Mapping Project in Western Senegal includes technology transfer, with a short training program conducted by Japanese experts. It proved to be very useful, but mastery of technical knowhow requires a longer training period. We wish to consolidate our knowledge obtained through the long history of cooperation between Japan and Senegal. We therefore submitted a request to Japan for the 2nd phase of the project.

Guinea Bissau

The problem is to keep personnel in all organizations. To resolve this matter, it will be necessary to establish a contract system to retain personnel for five or six years after their training.

DG/IGB

Accounting has no problem qualified personnel, but the mapping area is not the case.

Each representative shall submit to JICA for its return, a query on the capacity building of staff

M.TAKANO

This seminar was a good opportunity for JICA to exchange viewpoints with the participants.

It also allowed you to exchange your opinions with the Japanese expert. JICA wishes to promote sub-regional cooperation through UEMOA, at the same time as bilateral cooperation. I will report your resolution to the JICA Headquarters.

Mali → JICA

Does the project on five corridors in Africa discussed during TICAD cover North Africa and other sub-Saharan countries?

A. The project has not yet materialized. (JICA)

Guinea

In the speech of his Excellency, the Ambassador Plenipotentiary of Japan, he mentioned the determination of the Japanese government to provide support to African countries declared during TICAD.

Does this support cover the geographic information field?

A. Cooperation in this area is being studied.

As UEMOA has spoken, it is a good opportunity to link the proposed corridors in West Africa with the development of geographic information that projects are closely linked. (JICA)

Closing speech of Mr.TAKANO

It is a great pleasure for JICA, implementation of bilateral cooperation to be able to meet the member countries of the WAEMU and Guinea to the seminar organization. Personally, I loaded up this topographic mapping projects in Burkina Faso, Guinea, Ivory Coast and Mali. JICA will continue its bilateral cooperation. This sub-regional seminar was a new test for JICA. This is thanks to the strong leadership of DGIGB the seminar was successful.

The signing of the resolution on common issues (strengthening organizational capacity, staff exchange, awareness of policy makers on the importance of geographic information) is of significant importance. JICA wants to continue its support as your special partner.

3.4.8 Resolution of UEMOA Technical Seminar for Wide-Area Collaboration

The UEMOA Technical Seminar for Wide-Area Collaboration adopted the following resolution on the development, and use and application of the geographic information by all the participant countries before its closing:

Resolution of
the Seminar on Development, Use and Application of Geographic Information by the UEMOA Member Countries and Guinea

On February 13 and 14, 2014 at Ouagadougou

- *In considering that geographic information is an indispensable media for planning, monitoring and assessing national policies, programs and projects;*
- *in consideration of the increasing necessity of having geographic information as a tool to contribute to decision making;*
- *in consideration of the necessity of using the standardized model system, especially for development of the regional database;*
- *in considering that the responsible national agencies for geographic information development in the UEMOA region and Guinea are facing various difficulties in performing their services;*
- *in considering that the responsible national agencies for geographic information development committed to network making under the resolution as of December 2012;*
- *in the consideration of the necessity of producing the synergy effects among the national agencies that approved the network concept for building up the capacity of each agency; and*
- *in consideration of the political intention to support the African economic and social development that Japan declared in the Yokohama Action Plan in TICAD-V,*

we, the delegates of the agencies for developing and using map data in the member states gathered at the seminar held on February 13 and 14 in Ouagadougou and made the following commitments:

1. *To endeavor to strengthen our organizations and build up their practical capacity.*
2. *To exchange information on the technology in digital data development.*
3. *To promote the exchange of human resources among our national agencies.*
4. *To enlighten the policy decision makers of each of our countries on the necessity of giving the higher priority to geographic data development.*

In addition, we petition the following:

1. *We request Japan for its cooperation in offering its technical and financial assistance and relevant advice thereon for building the framework to build up the capacity of our human resources;*
2. *We request UEMOA for:*
   - *its support for making the network of the geographic data development agencies; and*
   - *promoting the geodetic infrastructure development and the creation of the standardized regional map models that has already been started.*

On February 14, 2014, in Ouagadougou

Signed by the delegates of the participant countries:

1. *The Republic of Benin*
2. *Burkina Faso*
3. *The Republic of Côte d'Ivoire*
4. *The Republic of Guinea*
5. *The Republic of Guinea-Bissau*
6. *The Republic of Mali*
7. *The Republic of Niger*
8. *The Republic of Senegal*
9. *The Republic of Togo*

3.4.9 Problems Common to the NMOs in West Africa and Solutions to the Problems

(1) Standardization of the specifications and accuracy

In West Africa, most of the geospatial information has been developed in the form of small- and medium-scale (1/25,000 – 1/200,000) maps. However, the specifications including map format and symbols and accuracy of those maps differ among the countries in the region. Geospatial information of standardized quality is essential for planning and implementation of projects for improvement and development of wide-area infrastructure. Solution to the problem concerning the map specifications and accuracy, which is required for the creation of topographic map data usable in the entire West Africa, requires creation of common specifications and standards for the data creation, "including standardization of geodetic reference system (coordinate system)," among the NMOs in the region. It is considered beneficial to have UEMOA collaboration seminars and workshops on a regular basis, as a venue to exchange views and have discussion on the creation of such specifications and standards.

(2) Promotion of development of organizational capacity and human resources

At present, there is a gap in the organizational and technical capacity and human resource development among the NMOs in West Africa partly because of the difference in the conditions including the state of economy among the countries. However, the establishment of a wide-area collaboration network as an output of the two seminars is expected to spread success at a point (in a country) to an area (multiple countries) and, thus, lead to balanced regional development. Human resource development expected to be achieved through the established network, in particular, is expected to lead to an increase in the number of trained engineers and adoption of new technologies (transition from analog technologies to digital technologies) and, consequently, contribute to facilitation of technical exchange among the NMOs and creation of new employment opportunities in the region.

3.4.10 Conclusion of the Second UEMOA Technical Seminar for Wide-Area Collaboration

The table below shows the main areas where the utilization of the topographic map data is recommended and the necessity for the data in the areas presented as the conclusion of the seminar.

Table 3-10 Main areas of recommended utilization and the necessity of the topographic map data

Area	Reason for the need for topographic maps	Practical ways to utilize topographic map data	Outcome
Hunger Project	(1) To monitor the entire project (2) As a tool to control the project (3) As a tool to improve the quality of project evaluation	・1/50,000 topographic maps shall be used to determine target areas of projects to be implemented in villages and communities in need of community infrastructure (programs)	・The use of the data has been proven to be an effective tool for planning and implementation of plans by the administration as it enables evaluation of levels of social infrastructure development with simultaneous presentation of data of many villages and communities. It has also improved the quality of study and discussion on the plans.
Urban planning	(1) For land use planning which determines the general purposes of urban planning (2) For preparation and proposal of a master plan for coordinated urban development	(1) Creation of thematic maps (including land use, land cover, soil, vegetation and population distribution maps) for land use planning (2) In principle, so-called large-scale 1/2,000 to 1/5,000 map data are useful in urban planning. However, since such data have not been created and are expected to be created in future, the use of 1/50,000	・The data utilization is useful as a tool for the preparation of a master plan for urban planning and in the evaluation of the progress of urban development.

		topographic map data is the best option available at the moment. ・Measures against the urban sprawl ・Taxation measures (including tax collection methods) ・Promotion of reasonable planning for urban growth (development of airport, port and sports facilities, telecommunication systems and selection of efficient traffic routes (bus routes and intersections) to be improved)	
Environmental measures Disaster reduction measures (with emphasis on measures against floods)	(1) To monitor forest reserves (2) To monitor wildlife and eco-systems (1) To acquire knowledge of local geography and topography (2) To locate villages and to know their population sizes	・ Acquisition of positional information of points for the monitoring of forest conservation and creation of biodiversity and carbon databases from the topographic map data to acquire comprehensive knowledge of forests Topographic map data are useful in learning how to conserve forest resource from the knowledge. (1) Acquisition of knowledge of shape of terrain (elevation, in particular) (at the scale of 1/25,000 – 1/200,000) (2) Acquisition of knowledge of courses and directions of flow of rivers (at the scale of 1/25,000 – 1/200,000)	Database construction i) Animal species found in forests ii) Distribution of trees iii) Locations of regenerating and idle land iv) Soil v) Sandbars, flat land available for development (1) Analysis of topographic map data enables simulations including that for damage estimation (2) Selection of evacuation routes and shelters
Agricultural development	(1) To acquire knowledge of local river systems (2) To assess the state of access roads (3) To find optimal soil	(1) Acquisition of geographic information (topography, elevation, vegetation, state of road development, rivers and their catchment areas, locations of irrigation facilities including reservoirs, locations of villages, precipitation, etc.) of land (areas) (at the scale of 1/25,000 – 1/200,000)	(1) Selection of crops appropriate for local soil (2) Establishment of transport and sales routes (3) Preparation of annual planting plans and establishment of a system for annual crop forecast (4) Development of effective irrigation facilities
Measures to extend educational and health services	(1) To support administration by the national and local government in education and health services on the ground	(1) Construction of a GIS with map data including statistical data relevant to environmental, population, health, food security problems at the global level	(1) Better understanding of the current state causing various problems that the country has and an increase in the interest to participate in measures

	(2) For efficient placement of schools and health facilities (including employment and assignment of teachers and doctors)	(2) As a tool for implementation of administrative measures for urban and community development in the education and health sectors	against those problems (2) Reduction of the gaps between different areas (villages)

Chapter 4 Technology Transfer Work

The technology transfer was carried out as shown in the following figure. The details are as described in the main text.

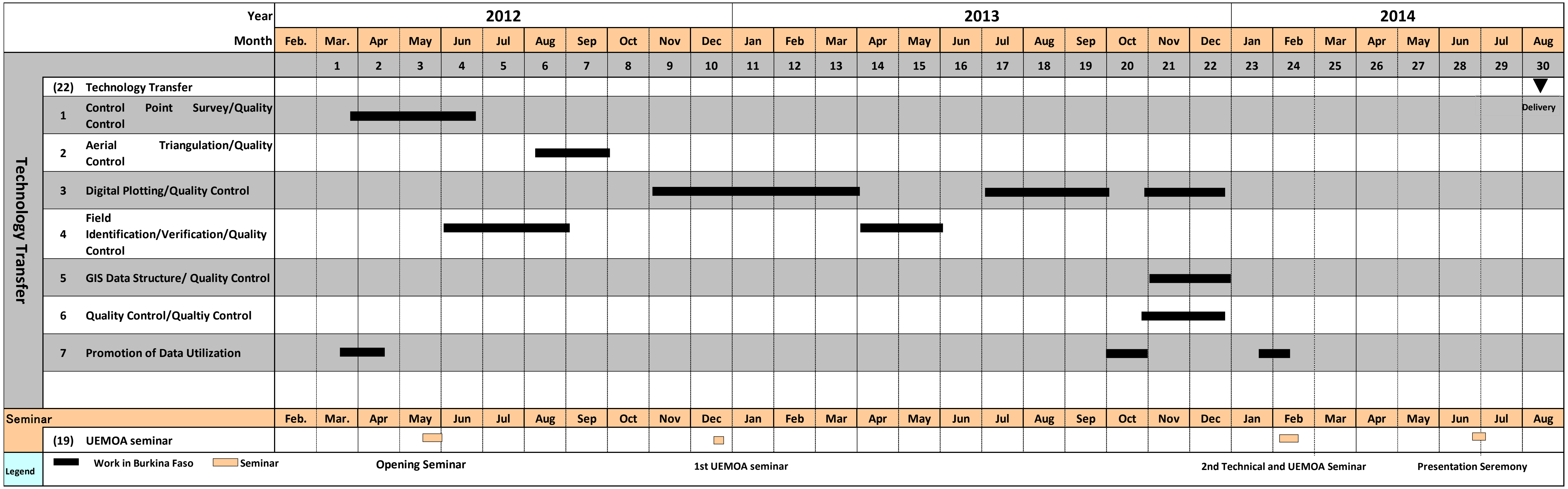


Figure 4-1 Technology transfer work

The technology transfer was carried out with the following objectives.

(1) To strengthen the capabilities of the Institut Géographique du Burkina (IGB) of Burkina Faso through the technology transfer so that they can develop and update maps themselves.

(2) That the digital topographic maps developed will be used as geospatial information to effectively further the national development plan.

The basis of the technology transfer was a review of past technology transfers, etc., as the background to the present technical capability of IGB, preparation of rules for map symbol specifications, etc., and topographic mapping.

The work associated with the technology transfer is summarized in the following table.

Table 4-1 Content of technology transfer work

No	Technology transfer work	Work content	Transfer method
①	Ground control point survey	・ Selection of ground control points ・ GPS observation ・ Pricking ・ GCP pricking point detail register ・ Quality (accuracy) management	Learning work process through OJT
②	Aerial triangulation	・ Aerial triangulation of satellite images ・ Aerial triangulation for digital plotting and creation of orthophoto data ・ Quality (accuracy) management ・ Work manual preparation	Learning work process through OJT
③	Digital plotting / digital compilation	・ Reconfirmation of small scale topographic map symbols ・ Appropriate data classification of acquired data ・ Identification of unclear or problem areas ・ Input of collected data (administrative boundaries, names, road classification, etc.) ・ Quality (accuracy) management ・ Work manual preparation	Learning work process through OJT
④	Field identification / field verification	・ Interpretation key preparation ・ Survey and summary of unclear and problem areas	Learning work process through OJT
⑤	Digital Data structurization	・ Topographic data structurization ・ Preparation of basic data ・ Quality (accuracy) management ・ Work manual preparation	Learning work process through OJT
⑥	Map symbolization	・ Method of operating symbolization software ・ Preparation of data using map symbol specifications ・ Layer management ・ Quality (accuracy) management ・ Work manual preparation	Learning work process through OJT
⑦	Promotion of utilization/ construction of system of usage	・ Workshops/seminars for the promotion of utilization ・ Survey of existing organizations for the establishment of a system for data utilization ・ Awareness creation activities (lecture tours)	Learning work process through OJT
⑧	Construction of website	・ Understanding of the systems in use	Learning work

		• Partial correction of data requiring updating and upload of the corrected data • Methods of map data management • System maintenance methods • Preparation of work manuals	process through OJT
⑨	Quality control	• Provision of Overseas Mapping (National Base Map) Standard Specifications (English version) • Implementation of accuracy control in accordance with the Overseas Mapping (National Base Map) Standard Specifications	Learning work process through OJT
⑩	Partial correction	• Correction of existing topographic maps using satellite images • Preliminary interpretation of secular changes using satellite images • Correction for secular changes using orthophoto data	Learning work process through OJT

4.1 Details of the Technology Transfer Work

The details of the technology transfer work implemented are as follows.

4.1.1 (1) Ground Control Point Survey

The following points were implemented in the technology transfer through OJT of 4 IGB technicians. The IGB technicians that received the technology transfer on ground control point survey were as follows.

Mr. COULIBALY.R Mr. SOMANDE.B Mr. COMPAORE.S Mr. OUEDRAGO.B

Photo 4-1 IGB technicians participated in the technology transfer on ground control point survey

[Selection of ground control points]

Selection of ground control points was carried out referring to Google Earth and ALOS images, based on the ground control point arrangement scheme in the implementation plan. In the selected areas that can be recognized on the ALOS images and on the Google Earth images, the Study Team selected planimetric features that can be pricked. The members tried to obtain access routes to the ground control points on site efficiently using the latitude and longitude obtained from the 1/200,000 topographic maps and Google Earth, and using the handheld GPS receiver.

Ouagadougou Block was an appropriate field for the OJT on pricking because many features in this area could be easily identified on the images. Meanwhile, the pricking work, such as selection of features and identification of the selected features on images, in North Block was expected to be difficult unlike in Ouagadougou Block. The counterparts sometimes had to revisit the field to conduct the pricking work for the second time because of inaccuracy of the original pricking work revealed in the quality control.

The training on the selection of ground control points in Ouagadougou Block was conducted with focus on transfer of the technologies for point selection mentioned below:

- Point arrangement scheme on satellite (ALOS) images
- Point selection on ALOS images, taking into consideration Google Earth images
- The point arrangement scheme arranges points uniformly over the whole area being considered, but with priority to the overlapping portions of satellite images

- Points are arranged within the area of overlap of satellite images, so that the subsequent aerial triangulation could be carried out efficiently and with high accuracy
- Planimetric features (corners of fences, road intersections, corners of buildings, individual trees, etc.) that could be clearly distinguished on the satellite images are selected as points

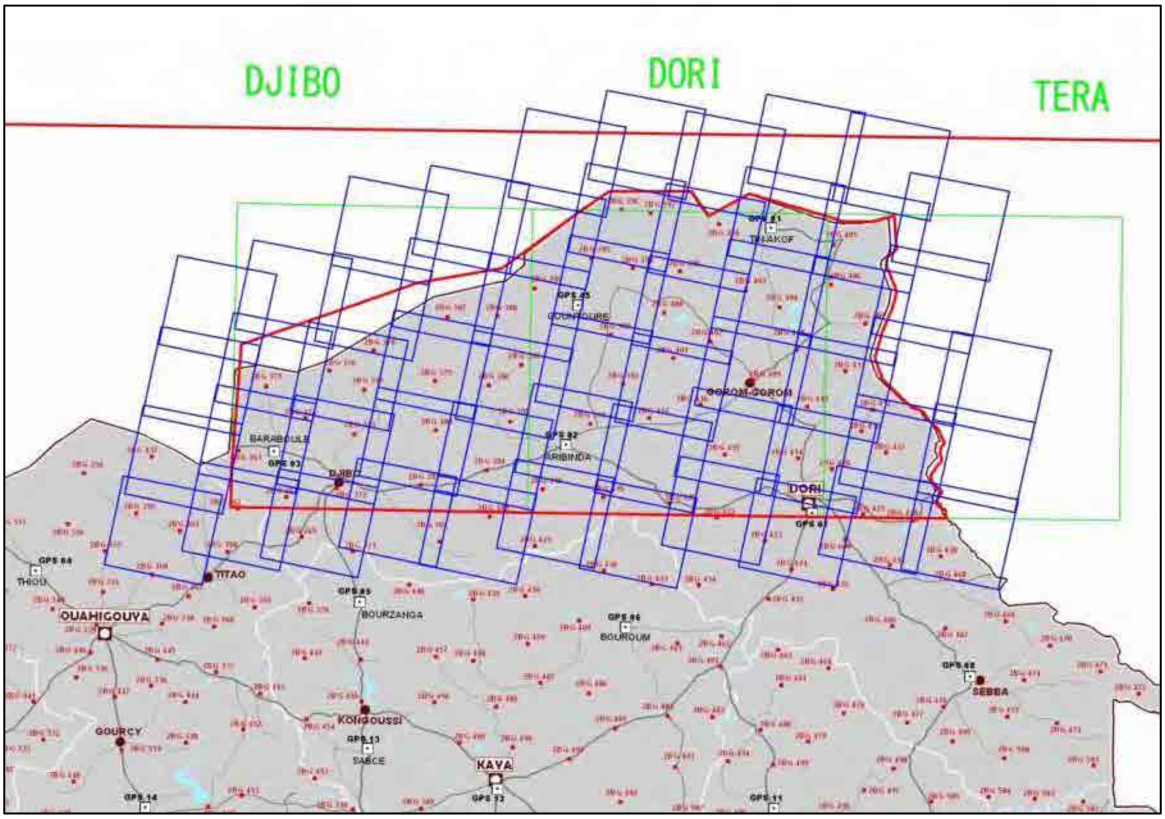


Figure 4-2 Control point arrangement scheme (North Block)

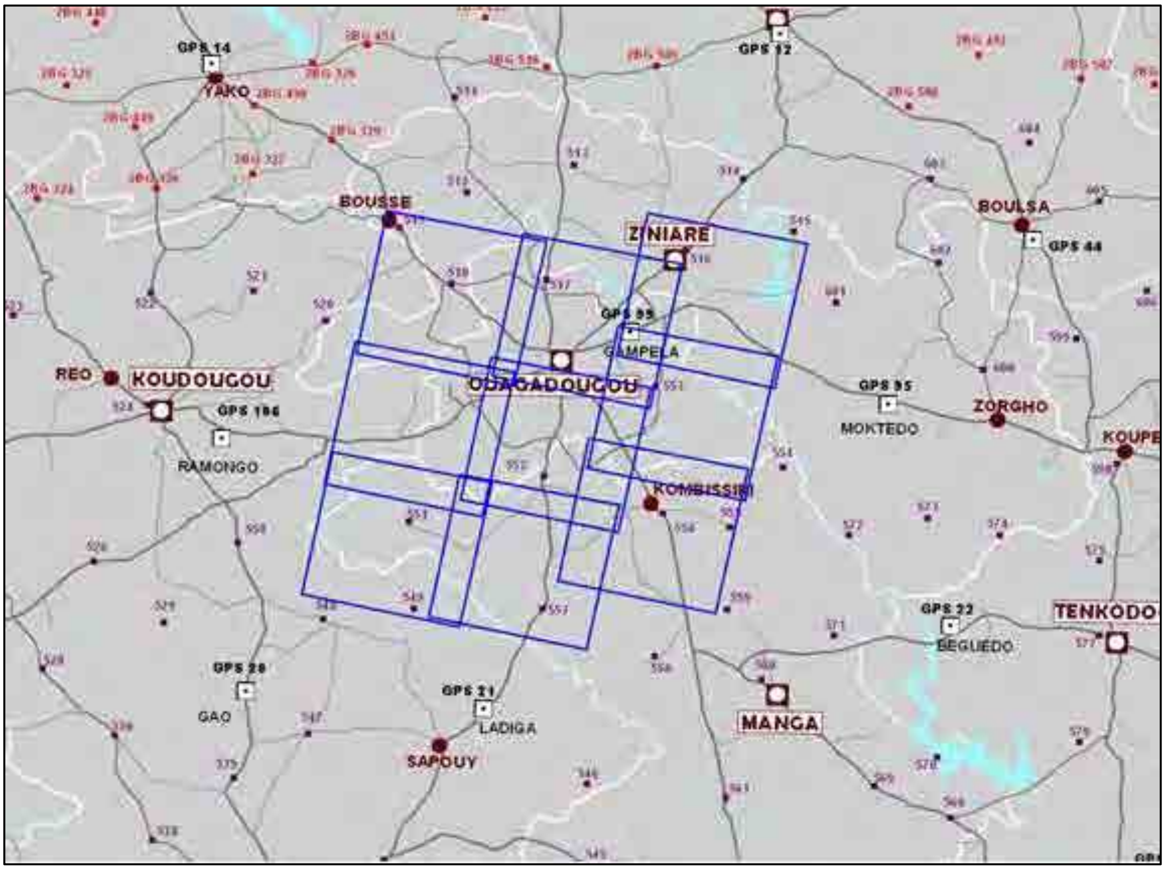


Figure 4-3 Control point arrangement scheme (Ouagadougou Block)

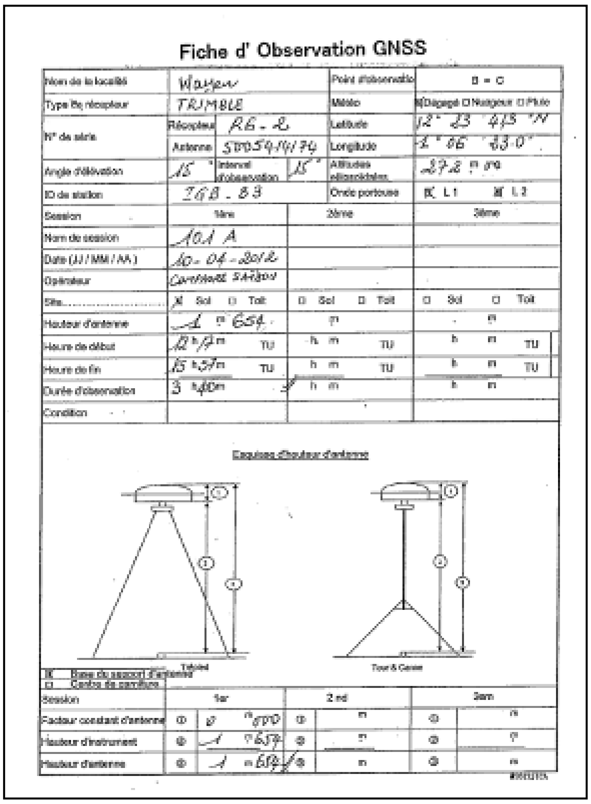
[GNSS measurements]

In previous technology transfer from the European Union (EU) for IGB technicians, GNSS receivers (Trimble R6-2) were used in control point survey, so it was not necessary to explain the measurement procedures and methods of using the antenna pole and carrying out functional inspections before measurements with the measurement equipment were carried out. The technology transfer actually performed was as follows.

- Functional inspection of measuring equipment before operation, to determine that there was no fault in the rotating parts of the equipment, etc.
- In order to eliminate the loss of auxiliary observation equipment, the waste of work, organize storage method according to the numbering management
- Preparation and display of measuring procedures plan, so that it is visible to the Study Team and those involved in IGB
- Preparation of GNSS measurement plans
- Explanation and instructions regarding GNSS measurement time, based on work standards
- Instructions to ensure midair of view as much as possible to receive satellite signals, in order to avoid re-surveying GNSS survey
- Two sets of 2 m length antenna extension poles were provided, in order to obtain better

satellite signals (elevation angle 15° or larger)

- Method of setting tripod
- It was essential to enter the GNSS survey record. A French version of GNSS survey record was prepared by Study Team, and provided with examples of entries.
- Simultaneous measurement is important for GNSS survey. Communication between survey teams was always carried out by mobile phone.
- The positions of ground control points were determined as geocentric direct coordinates (3-dimensions), so the height of the GNSS antenna was carefully measured in millimeter units.
- Configuration and naming of folders for storing GNSS measurement data, etc.



Fiche d' Observation GNSS

Nom de la localité	Wayen		Point d'observation	B = C
Type de récepteur	TRIMBLE		Météo	☒ Dégagé ☐ Nuageux ☐ Pluie
N° de série	Récepteur	R6 - 2	Latitude	12° 23' 413" N
	Antenne	5000591474	Longitude	1° 06' 33.0"
Angle d'élévation	15°	Intervel d'observation 15"	Altitudes ellipsoïdales	272 m
ID de station	268 . 83		Onde porteuse	☒ L1 ☒ L2

Session	1ère	2ème	3ème
Nom de session	101 A		
Date (JJ / MM / AA)	10 - 04 - 2012		
Opérateur			
Site	☒ Sol ☐ Toit	☐ Sol ☐ Toit	☐ Sol ☐ Toit
Hauteur d'antenne	1 m 654	m	m
Heure de début	12 h 17 m TU	h m TU	h m TU
Heure de fin	15 h 57 m TU	h m TU	h m TU
Durée d'observation	3 h 40 m	h m	h m
Condition			

Esquisse d'hauteur d'antenne

Trépied

Tour & Canne

☒ Base du support d'antenne
☐ Centre de centrifuge

Session	1er		2nd		3em	
Facteur constant d'antenne	①	0 m 000	①	m	①	m
Hauteur d'instrument	②	1 m 654	②	m	②	m
Hauteur d'antenne	③	1 m 654	③	m	③	m

Figure 4-4 GNSS measurement record

Photo 4-2 GNSS measurement instruction

[Baseline analysis]

Data received from the GNSS receiver "Trimble R6-2" was converted into RINEX format. Downloading of measurement data and baseline data was carried out in accordance with the procedures manual of the training session that was implemented in association with the purchase of the LeicaLGO (Leica Geo Office) software.

Many items regarding points of evaluation of baseline analysis results were explained, and understood.

[Network adjustment]

It was confirmed that the IGB technicians that received the Leica LGO training had not attained the

level of being able to carry out network adjustments, so 3D network adjustment was carried out based on the procedures manual of the "LGO" network adjustment software, mainly by the Study Team.
IGB asked IGB technicians to carry out the network adjustments in all areas for technology transfer, and they accepted it.

[Simple leveling]

Inspection and verification was carried out by direct leveling the elevations of GCPs summarized from the EGM geoid model. Technical instruction was provided on inspection of measurement equipment before operation, measurement methods, leveling staff positioning method, etc.
Instruction on the limitation on two direction measurement values in the rules was given and applied.

Photo 4-3 Instruction on leveling survey

Photo 4-4 Instruction on installing a barcode leveling staff

[Accuracy control]

Instruction was given on methods of accuracy control and process control based on Overseas Mapping (National Base Map) Standard Specifications.
Instruction was given on carrying out GNSS accuracy control by the closure difference between existing set points (ΔN, ΔE, ΔU). IGB implemented all the accuracy controls on site. Because the survey operations were greatly delayed, the final accuracy table was mostly prepared by the Study Team, and partly prepared by IGB for technology transfer.

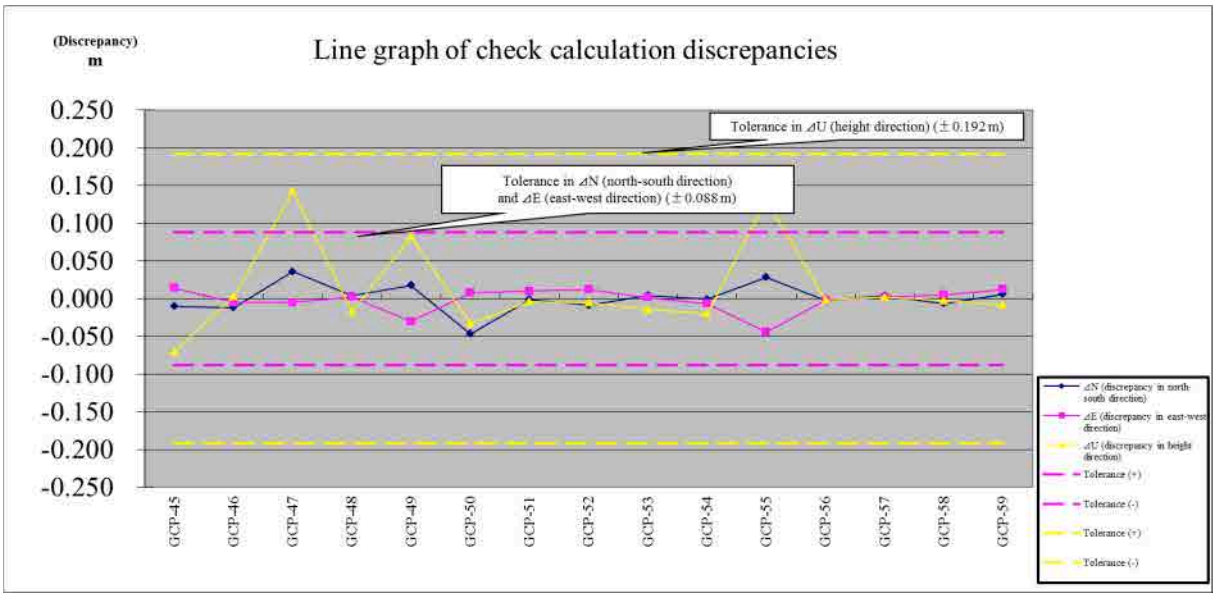


Figure 4-5 Check calculation discrepancy (Ouagadougou district)

[Summary of ground control point results]

From the 3D network adjustment results by GNSS survey, a "Description sheet of ground control point" was prepared, and explanation and instruction was given on these operations. The IGB technicians recognized the important data using the aerial triangulation, and it is expected that they will reach the level of being able to prepare the "Description sheet of ground control point" on their own.

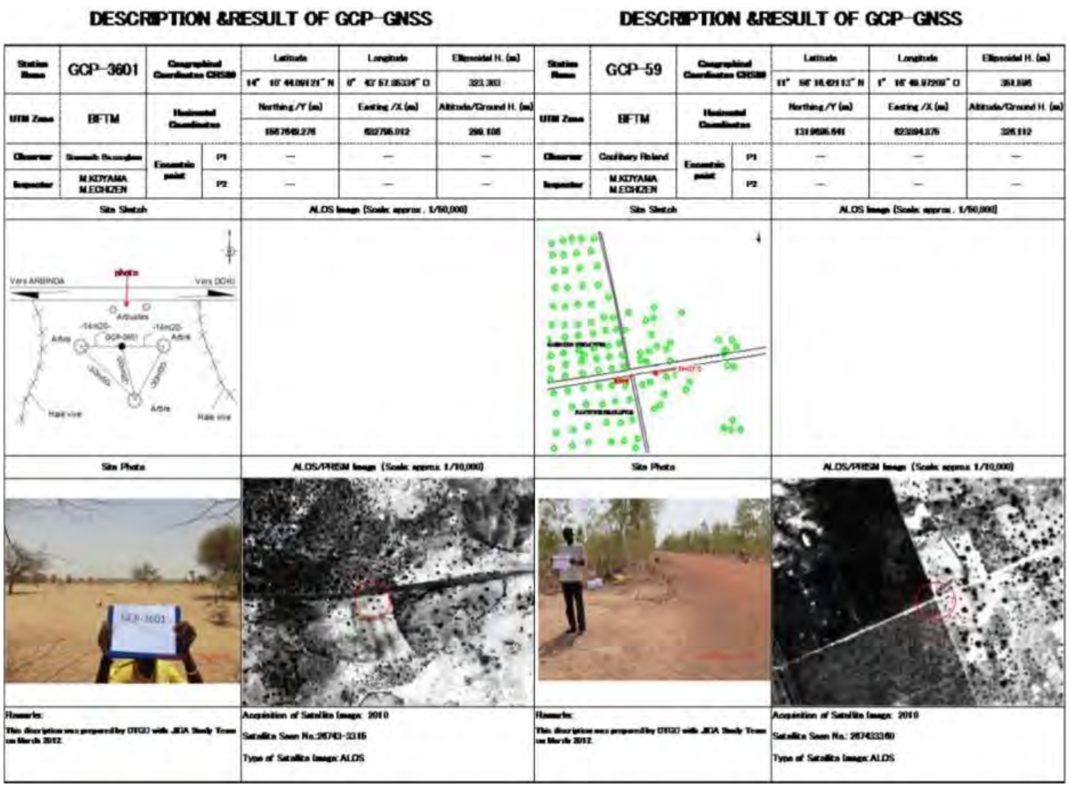


Figure 4-6 Example of "Description sheet of ground control point"

Table 4-2 Ground control point coordinates network adjustment results

No.	Cartesian Coordinates			Latitude / Longitude (GRS80)		Ellipsoid	Coordinates (UTM Zone 28)		Altitude
	X(m)	Y(m)	Z(m)	Latitude	Longitude	(m)	Easting (m)	Northing (m)	(m)
CP01	5876634.549	−1720159.878	1779318.312	16° 18′ 23.46149″ N	16° 18′ 55.34142″ W	36.267	359472.302	1803294.046	5.174
CP02	5881518.7	−1730619.023	1753004.876	16° 03′ 32.16160″ N	16° 23′ 46.89425″ W	32.1	350632.562	1775957.885	1.249
CP03	5886744.16	−1737538.468	1728644.695	15° 49′ 47.87833″ N	16° 26′ 40.39978″ W	40.493	345300.663	1750659.386	9.873
CP04	5879658.75	−1691091.439	1796980.391	16° 28′ 22.37685″ N	16° 02′ 46.13850″ W	35.03	388332.615	1821533.258	4.24
CP05	5888646.539	−1700446.043	1758564.68	16° 06′ 40.38392″ N	16° 06′ 25.07580″ W	34.106	381623.485	1781555.089	3.735
CP06	5896075.768	−1713637.371	1720807.263	15° 45′ 22.72239″ N	16° 12′ 21.58194″ W	59.986	370805.286	1742349.503	29.852
CP07	5887177.131	−1665460.533	1796303.945	16° 27′ 59.43823″ N	15° 47′ 45.63983″ W	34.172	415031.633	1820706.62	3.835
CP08	5896130.919	−1678463.182	1754637.056	16° 04′ 27.37570″ N	15° 53′ 24.60270″ W	36.624	404791.586	1777355.645	6.599
CP09	5901470.436	−1685888.483	1729610.842	15° 50′ 20.44805″ N	15° 56′ 35.47835″ W	51.485	399002.475	1751354.968	21.692
CP10	5894016.424	−1636450.201	1800546.724	16° 30′ 23.26448″ N	15° 31′ 01.56850″ W	45.848	444815.287	1825029.504	15.189
CP11	5899036.847	−1643112.426	1778073.379	16° 17′ 41.10796″ N	15° 33′ 52.55646″ W	52.88	439681.188	1801623.06	22.447
CP12	5904456.119	−1646611.721	1756876.867	16° 05′ 43.02470″ N	15° 34′ 57.05785″ W	56.365	437704.398	1779563.074	26.122
CP13	5907893.94	−1658660.354	1733993.792	15° 52′ 48.62520″ N	15° 40′ 56.13037″ W	57.348	426959.275	1755799.925	27.492
CP14	5901268.738	−1606353.191	1803834.895	16° 32′ 14.93129″ N	15° 13′ 38.09133″ W	36.14	475752.43	1828403.705	4.625
CP15	5906357.287	−1614686.47	1779832.284	16° 18′ 40.63885″ N	15° 17′ 23.93206″ W	61.879	469022.842	1803390.899	30.653
CP16	5911990.316	−1623674.892	1752944.248	16° 03′ 29.79265″ N	15° 21′ 25.65405″ W	65.896	461801.398	1775414.461	35.06
CP17	5907430.425	−1574578.466	1811618.224	16° 36′ 39.08918″ N	14° 55′ 29.09868″ W	37.566	508026.241	1836508.54	5.637
CP18	5916196.738	−1587551.716	1771647.987	16° 14′ 03.15294″ N	15° 01′ 15.18586″ W	75.456	497768.107	1794842.683	43.756
CP19	5924120.075	−1596104.405	1737378.613	15° 54′ 42.96592″ N	15° 04′ 43.85738″ W	73.972	491560.105	1759195.746	42.631
CP20	5916410.187	−1551868.487	1801989.986	16° 31′ 12.2036″ N	14° 41′ 51.1059″ W	49.052	532276.897	1826486.763	17.277
CP21	5920991.607	−1561043.778	1779101.745	16° 18′ 15.79303″ N	14° 46′ 10.90883″ W	70.737	524602.898	1802619.324	39.035
CP22	5926588.101	−1567474.372	1754837.088	16° 04′ 33.75802″ N	14° 48′ 52.12145″ W	78.216	519841.776	1777355.853	46.571
CP23	5920733.733	−1521208.342	1813783.199	16° 37′ 52.56243″ N	14° 24′ 33.41051″ W	40.151	563000.676	1838857.677	8.147
CP24	5929933.516	−1528180.52	1777817.06	16° 17′ 32.36443″ N	14° 27′ 03.75582″ W	58.794	558648.348	1801349.829	26.976
CP25	5935731.004	−1539491.312	1748748.493	16° 01′ 07.62532″ N	14° 32′ 23.51224″ W	81.19	549226.469	1771067.796	49.487
CP26	5933080.735	−1494918.271	1795332.692	16° 27′ 26.41489″ N	14° 08′ 31.42780″ W	42.196	591583.188	1819718.844	9.117
CP27	5940882.551	−1510904.703	1756081.507	16° 05′ 15.96753″ N	14° 16′ 08.90309″ W	69.954	578163.467	1778782.057	37.669
CP28	5947949.527	−1479184.059	1759057.274	16° 06′ 56.94737″ N	13° 57′ 55.70997″ W	46.543	610626.591	1782023.915	13.003
CP29	5956120.71	−1455419.572	1751290.123	16° 02′ 33.91898″ N	13° 43′ 53.53874″ W	52.956	635695.243	1774079.887	18.883
CP30	5961697.908	−1458936.2	1729557.804	15° 50′ 18.23581″ N	13° 45′ 03.85202″ W	96.847	633740.93	1751457.961	63.268
CP31	5963841.976	−1426483.249	1748817.433	16° 01′ 10.27179″ N	13° 27′ 06.37024″ W	47.667	665648.726	1771712.299	13.777
CP32	5972883.796	−1441442.673	1705642.789	15° 36′ 49.91902″ N	13° 34′ 04.16891″ W	101.118	653535.266	1726740.745	67.681
CP33	5979337.166	−1408853.721	1710028.003	15° 39′ 18.54817″ N	13° 15′ 29.63403″ W	48.085	686695.532	1731556.774	14.794
CP34	5981910.048	−1418169.837	1693453.166	15° 29′ 58.52272″ N	13° 20′ 14.07454″ W	73.12	678358.614	1714275.792	39.689
CP35	5992221.053	−1387784.515	1682123.479	15° 23′ 36.32097″ N	13° 02′ 22.83158″ W	49.884	710394.764	1702796.694	16.835
CP36	5997997.806	−1395303.367	1655498.425	15° 08′ 37.89363″ N	13° 05′ 44.52222″ W	106.854	704621.643	1675126.154	73.528
CP37	6006593.456	−1366411.333	1648285.513	15° 04′ 35.22957″ N	12° 48′ 57.03618″ W	60.238	734779.016	1667946.41	27.678
CP38	6010515.418	−1378659.988	1623928.092	14° 50′ 54.59595″ N	12° 55′ 07.43230″ W	100.541	723951.776	1642612.102	67.468
CP39	6013460.421	−1346208.874	1639904.02	14° 59′ 52.87311″ N	12° 37′ 06.67819″ W	59.768	756093.356	1659484.92	28.024
CP40	6018742.35	−1353152.765	1615014.577	14° 45′ 54.48332″ N	12° 40′ 14.66395″ W	117.626	750744.588	1633648.542	85.205
CP41	6022775.222	−1324570.452	1623347.03	14° 50′ 35.43693″ N	12° 24′ 12.33009″ W	54.278	779437.279	1642603.657	23.131
CP42	6034765.701	−1332927.302	1571769.197	14° 21′ 40.69546″ N	12° 27′ 18.77349″ W	122.95	774458.221	1589197.874	91.024
CP43	6034235.761	−1299338.849	1601184.661	14° 38′ 09.80864″ N	12° 09′ 06.59501″ W	56.592	806822.071	1620001.12	25.965
CP44	6041374.3	−1310440.778	1565107.857	14° 17′ 57.43325″ N	12° 14′ 18.58452″ W	70.405	797928.982	1582600.669	39.239
CP45	6047520.007	−1323571.724	1530443.875	13° 58′ 33.78325″ N	12° 20′ 42.74087″ W	137.383	786814.236	1546683.315	106.385
CP46	6050999.107	−1291780.362	1543608.039	14° 05′ 55.49593″ N	12° 03′ 02.63113″ W	112.804	818482.206	1560645.478	82.285
CP47	6056734.805	−1296583.23	1516928.461	13° 51′ 01.13314″ N	12° 04′ 59.16920″ W	87.234	815322.27	1533094.6	56.916

Note) For IGB20 the position of the existing control point and its results were used.

4.1.2 (2) Aerial triangulation

The IGB technicians named below participated in the technology transfer on aerial triangulation.

Mr. KABORE Sylvain Ms. SOUGUE Maimouna Ms. KABORE Verigine Mr. KONATE Aziz

Photo 4-5 IGB engineers participated in the technology transfer on aerial triangulation

[Objective]

The objective was to acquire the work processes and methods of operation of the software for aerial triangulation using ALOS/PRISM data with the RPC model which was used in this project. Also, this process is considered to be a preparatory process for digital plotting, so instruction was also provided on the technology (pan-sharpening process) for synthesizing PRISM sensors (monochrome images) and AVNIR-2 sensors (color images) to create high resolution color images used in the digital plotting process.

[Outline]

a) Period

- September 21 to October 12, 2012

b) Participants at course

Initially there were 6 (six) participants on the course, but 1 (one) dropped out so effectively the number was 5 (five), of which the number of technicians with work experience was 3.

c) Software used

The software used in the technology transfer was as shown in the following table. In each case the software was provided by this project.

Table 4-3 Software used for aerial triangulation

Name of software	Purpose
LPS 2011 (by Intergraph Corporation)	Aerial triangulation
* ERDAS IMAGINE 2011 (by Intergraph Corporation)	Pan sharpening process

* ERDAS IMAGINE is image processing software that is automatically installed when installing LPS, as the platform for LPS. In the latest version the LPS interface is integrated with IMAGINE.

[Method of implementation]

Prior to the technology transfer, a questionnaire survey was carried out among the participants, to confirm their fields of specialty and whether or not they had experience of aerial triangulation including aerial triangulation processing. The results showed that one of those with experience of aerial triangulation had no experience of aerial triangulation using satellite images, and this was the first time to use LPS. Therefore the technology transfer proceeded mainly as practical training with appropriate information explained as necessary.

Table 4-4 Questionnaire results

Item \ Subject	A	B	C	D	E	F
No. of years involved	7 years	5 months	32 years	5 years	23 years	16 years
No. years' experience of aerial triangulation	No	No	11 years	2 years	3 years	4 years
No. years' experience of photogrammetric work (other than aerial triangulation)	1 year	No	—	2 years	5 years	6 years
Experience of use of satellite images (not limited to aerial triangulation)	Yes	Yes	No	Yes	Yes	No
Experience of stereo plotting	No	No	Yes	No	Yes	Yes
Experience of use of photogrammetric software	No	Yes	Yes	Yes	Yes	Yes

[Contents of training and results]

a) Aerial triangulation

1) Preparation work

Explanations of ALOS satellite sensor information, scene IDs, RPC models, etc., were given. Also, the necessity and methods of changing scene IDs and the associated image creation methods, etc., were explained. There are complexities involved with changing scene IDs and the associated processes, so their explanation was given after first the participants had carried out the complete series of aerial triangulation processes with the original IDs, so that the participants could recognize the necessity.

2) Creation of block files (various settings)

Technology transfer was carried out for the following preparatory operations which are necessary for implementing aerial triangulation with LPS. This operation is essential when a stereo plot or a DEM extraction or ortho is created with the RPC model only, without performing aerial triangulation. The participants acquired the general process flow using original data, and the flow using files created in the preparation operation in the previous item without problem.

- Setting the sensor model
- Photographical information setting and registration method
- Registration of satellite images
- Registration of RPC model files
- Preparation of pyramid files

3) Point measurement process

The point measurement process is the operation of measuring ground control points and tie points (points connecting multiple photographs) on images.

[Tie point measurement]

This process requires most time in aerial triangulation, so much time was devoted to practical training. In the general operation flow, first tie points are automatically acquired using the software, and then acquisition omissions and acquisition error locations are checked and corrected interactively. However, first the manual measurement method was explained, so that it would be possible to know in advance that the acquisition accuracy would not be good and that it would be possible to recognize the points of difference in aerial photographs. Through this an understanding of the position and arrangements of points and the number of light rays (the number of images measured) and of software operation was obtained. Then methods of use (setting methods) of tie point automatic acquisition tools and semi-automatic measurement tools for manual measurement tools were explained and practiced, and the technology of efficiently measuring tie points was transferred.

Also, ALOS are triplet images, so image overlaps are greater than other satellite images or aerial photographs, so it is extremely difficult to determine the necessary number of light rays from multiple displayed images. Therefore the process given was finely divided, and advice was given to properly complete each step before proceeding to the next step, in order to make it easy for the participants to understand. Also, a form was provided for entering the calculated results in each process, and instruction was given to enter the results every time. In this way the understanding of the participants of the tie point measurement process was deepened, and it was possible to determine the progress of the work.

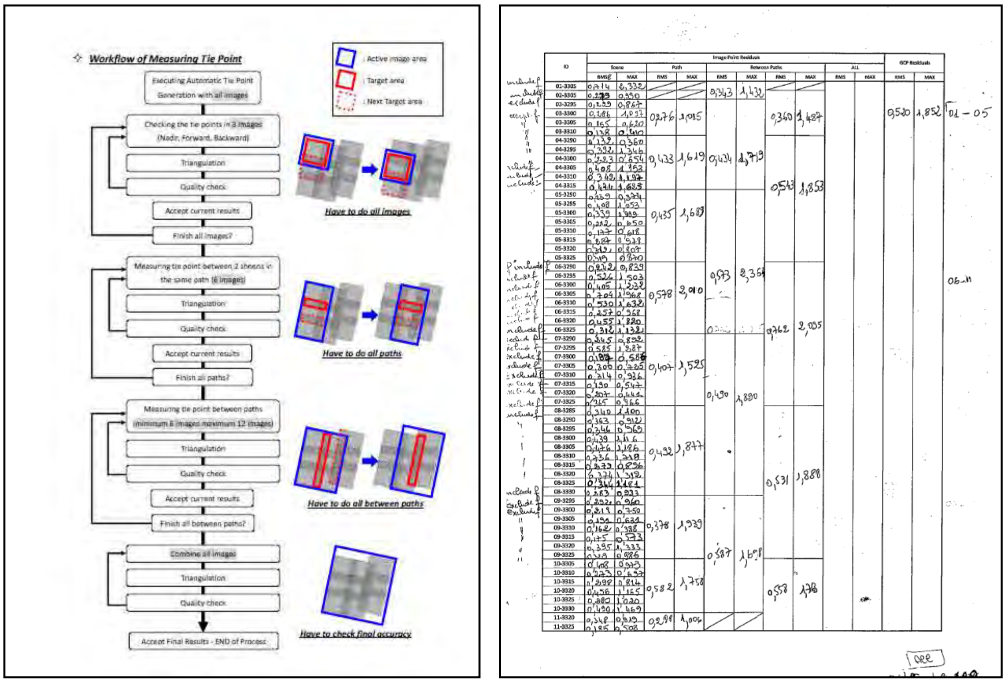


Figure 4-7 Left: Tie point measurement process
Right: Record table of calculation results for each sheet

[Ground control point measurement]

The method of importing the 3D coordinate values of the ground control point measurement results and the technology of measuring the ground control points on the images using a detailed register was transferred. Displaying all the images on which the relevant ground control points can be measured from the RPC model and the 3D coordinates of the ground control points in LPS, general rules, measuring all the images that can be measured, the effect of the accuracy on the overall accuracy, etc., were explained. In addition to the above, the participants recognized how aerial photographs taken on site reflected the ALOS images (and how they differed), and from this they understood the importance of selection of ground control points.

a) Calculation processing and quality management

In order to readjust the RPC model, methods were transferred for carrying out aerial triangulation survey calculation (parameter setting method) using the RPC model, the ground control point and tie point coordinates, and ground control point results (3D coordinates), evaluating calculation results (intersection residual error, control point residual error), and based on the evaluation deleting the error points, re-measurement, and additional measurement. Also methods were transferred as far as confirming the final results, including checking images whose accuracy was not good by carrying out calculation in scene units changing the combination of each direction view, and the considerations when deleting from the calculations were explained.

Photo 4-6 Aerial triangulation technology transfer

b) Pan sharpening process

Using color images in topographic mapping is effective from the point of view of improving readability. ALOS/AVNIR-2 images are color images, but the resolution is about 10 m, so it is not sufficient for producing 1/50,000 scale topographic maps. On the other hand, the resolution of ALOS/PRISM images is 2.5 m, which is sufficient resolution for preparing 1/50,000 scale topographic maps, but the images are monochrome, so it requires interpretation to read planimetric features. As a means for solving this problem, the color information (RGB, etc.) of low-resolution color images is synthesized with high-resolution monochrome images to produce high-resolution color images known as pan sharpened images. This process is widely used in the remote sensing field using optical satellite images. In this project also pan sharpened images are used in digital plotting and production of ortho images. Therefore the technology of the pan sharpening process was transferred in this technology transfer.

The participants were able to acquire this technology because they had experience of use of satellite images and knowledge of the pan sharpening process, and although the process (software operation) is slightly complex the concept is simple, so this method is easier to understand compared with aerial triangulation.

4.1.3 (3) Field identification / field verification

The IGB technicians named below participated in the technology transfer on field identification/verification.

Mr. NIKIEMA Sagadogo	Mr. KOUDOUGOU Sibiri	Ms. COULIBALY Safiatou	Mr. KONATE Aziz
			

Photo 4-7 IGB engineers participated in the technology transfer on field identification/verification

[Field identification / Field verification]

Technology transfer was carried out for field identification/field verification by OJT by carrying out the actual operations as described previously. Also, ground photographs and coordinates were obtained using a GPS camera for important buildings, planimetric features, etc., which helped to improve the interpretation accuracy during plotting. The technology transfer was mainly taking ground photographs using a GPS camera to assist in interpretation. The transfer items and their details are as follows.

- Methods of obtaining ground photographs and coordinates to assist interpretation
  - Method using a GPS camera, method of taking photographs

    In particular it was considered difficult for IGB technicians to become familiar with the method of taking photographs including "tags" on which a map symbol code was input, so the Study Team helped them to master this operation during the OJT in the Ouagadougou Block.
  - Coordinates of the planimetric features photographed

    Coordinates are automatically read into the GPS camera. The method of reading the coordinates from the camera memory into the computer, and processing the data, etc., was transferred.
  - Use of the tablets

    The tablets were used to improve efficiency of the work. The use of the tablets improved the efficiency of the survey by enabling every surveyor to reach destination with ease.

- Understanding of map symbols and acquisition criteria
  - Map symbol specifications

    An understanding of the correspondence with the planimetric features was given.
  - Acquisition criteria

The acquisition criteria were reconfirmed prior to the start of field identification, based on the acquisition criteria specification agreed in discussions of specification.

- Material collection
  - Material was collected for matters that could not be confirmed on site, to be used as reference data for subsequent digital plotting and compilation operations.

4.1.4 (4) Digital plotting, digital compilation

4.1.4.1 Digital plotting

The IGB technicians named below participated in the technology transfer on digital plotting.

Mr. NIKIEMA Sagadogo

Mr. KOUDOUGOU Sibiri

Ms. COULIBALY Safiatou

Mr. KONATE Aziz

Ms. SOUGUE Maimouna

Photo 4-8 IGB engineers participated in the technology transfer on digital plotting

[Objective]

The objective is to provide technical instruction through OJT for an understanding of the fundamental concepts of digital plotting, implementing digital plotting in accordance with map symbol specifications, methods of operating digital plotting software, and methods of accuracy control, so that IGB themselves can prepare 1/50,000 topographic maps using ALOS images, and that IGB themselves can complete 4 map sheets of the project area.

[Outline]

a) Period
   - First: November 27 to December 22, 2012
   - Second: August 15 to September 30, 2013

b) Participants

There were 7 (seven) participants, of whom 3 (three) had work experience. 2 (two) had experience in acquisition of contour data.

c) Equipment used

An Intergraph LPS2011 and Bentley MicroStation were the equipment provided for the technology transfer. Details of the software used are shown in the following graph.

Table 4-5 Software used for plotting

Software or module name	Application
LPS 2011 Core (by Intergraph Corporation)	Registering images and settings such as control point information, coordinate system information, etc.
LPS 2011 Stereo	Module for stereoscopic viewing
LPS 2011 PRO600	Digital plotting module (* it is essential that MicroStation be installed)
MicroStation V8i (by Bentley Systems, Inc.)	CAD software for digital plotting

The following photograph shows the hardware configuration of the digital plotting system, which consists of a PC, a stereoscopic viewing monitor, a sub monitor, a TopoMouse input device, etc. In the upper and lower screens of the stereoscopic viewing monitor satellite images that were acquired from different positions are displayed, and by fixing a special light polarizing mirror a stereoscopic image can be seen, and it is possible to obtain the 3D coordinates of planimetric features such as roads, etc.

Photo 4-9 Digital plotting hardware configuration

[Method of implementation]

The participants had no experience of plotting work using LPS, and although 2 persons had experience of MicroStation, their experience was of an older version. Therefore, it was decided to first explain the various settings, files used, and documents before start of plotting, and thereafter to carry out the actual plotting work. The functions of MicroStation and PRO600 are diverse and complex, so the technology transfer was implemented by explaining the minimum necessary functions, and thereafter providing instruction on the concepts of the necessary functions in each case.

[Target areas]

The time for technology transfer was limited, so the target areas were chosen to be 3 surfaces in the north block for which IGB were responsible, without providing a practice area. The target areas are shown below.

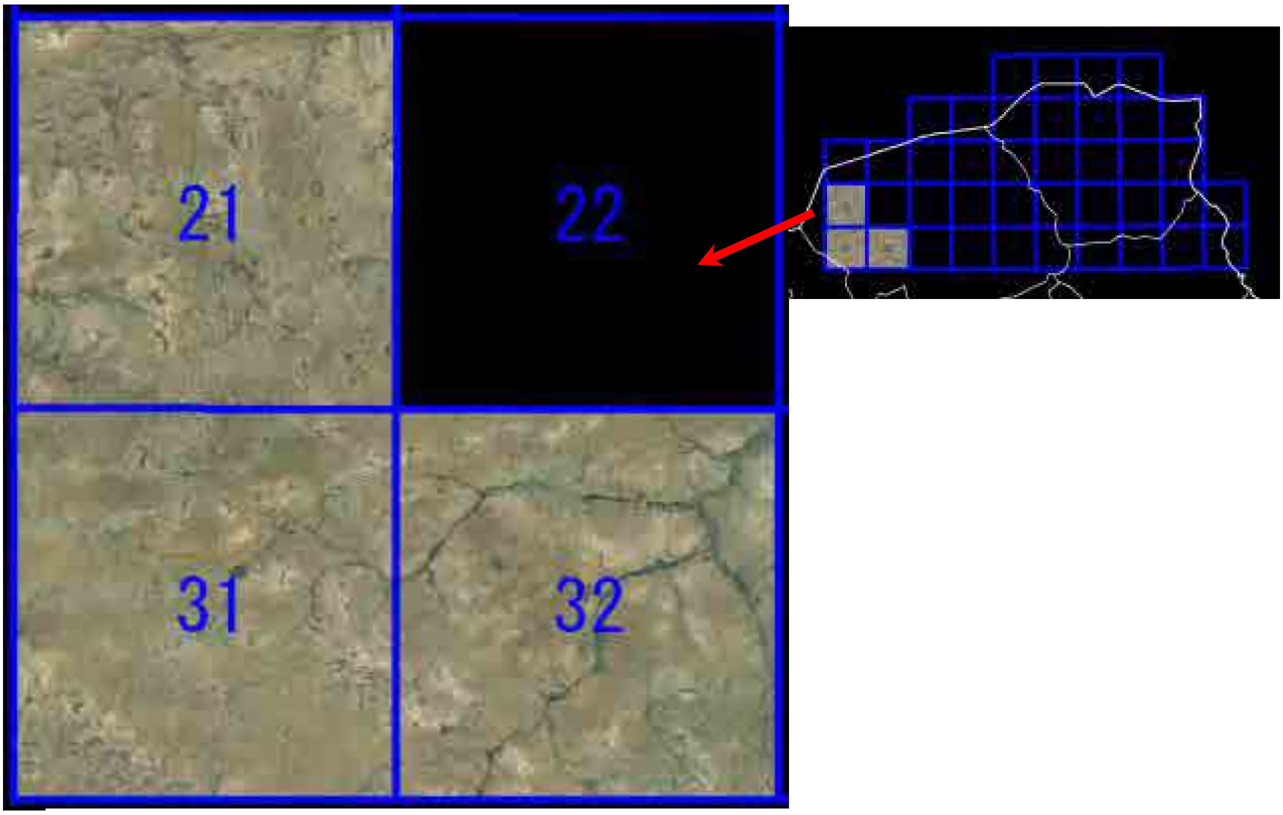


Figure 4-8 Target areas for technology transfer on digital plotting

[Implementation contents and results]

The following were implemented in the technology transfer on plotting:

- Explanation of the outline of the digital plotting procedure;
- Explanation of initial settings and basic operation of software used in the plotting, *i.e.* LSP and PRO600;
- Explanation of operation of the data input device, TopoMouse;
- Digital plotting of the study area;

- Acquisition of contour data; and
- Logical check and correction of the outputs with PRO600.

The figures below show the outputs created by trainees without assistance from the Study Team during and after the technology transfer. They had almost completed planimetric plotting of temporary sheets Nos. 31 and 32. However, as the field verification was in progress at this stage, not all the results of the verification were incorporated in the outputs. Newly-added map symbol items had not been incorporated in the outputs, either. The Sheet No. 21 was plotted without assistance by the two (new) trainees who participated in phase 2 of the technology transfer.

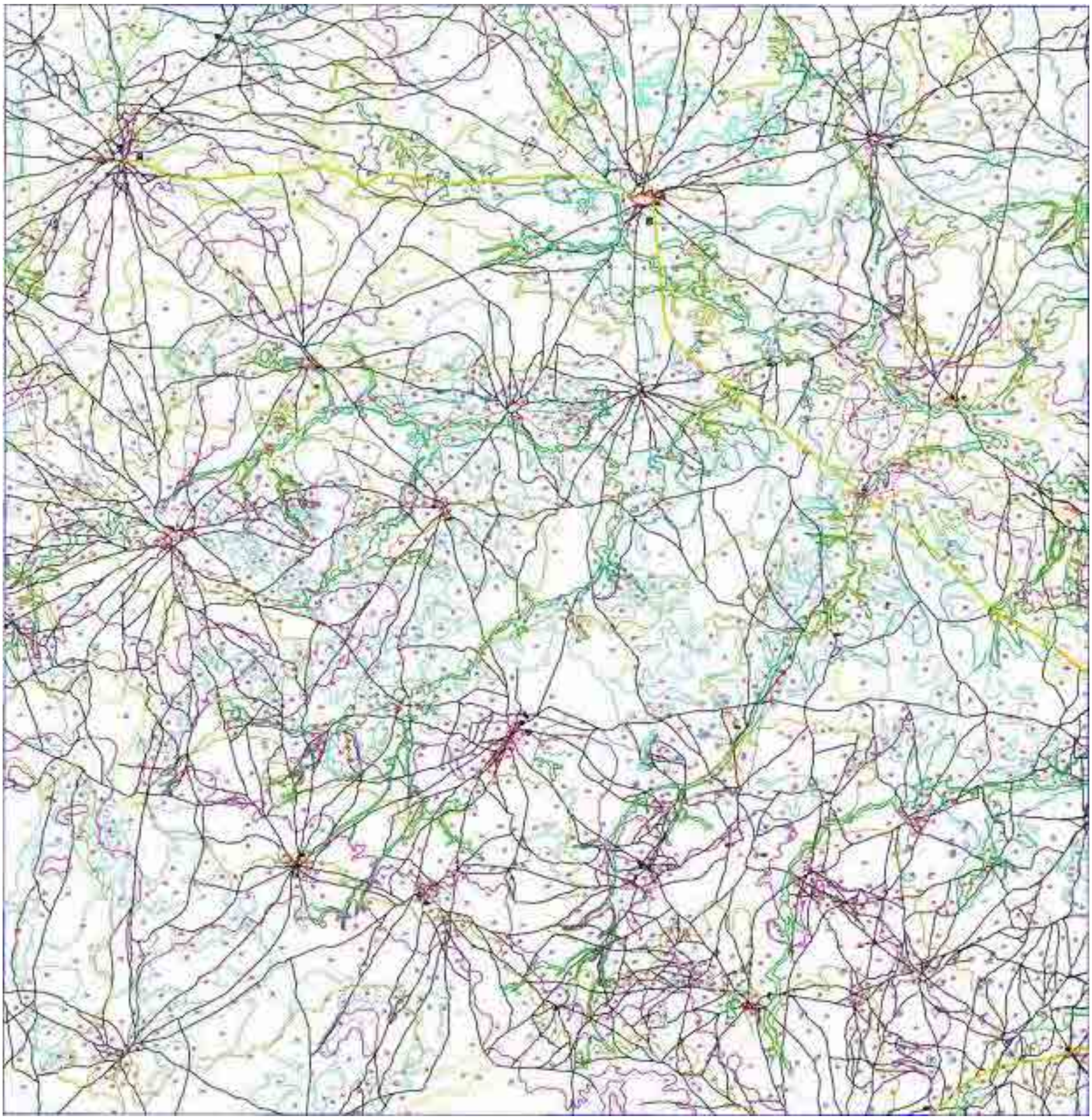


Figure 4-9 Digital plotting by IGB engineers (ND30XVII-1a)

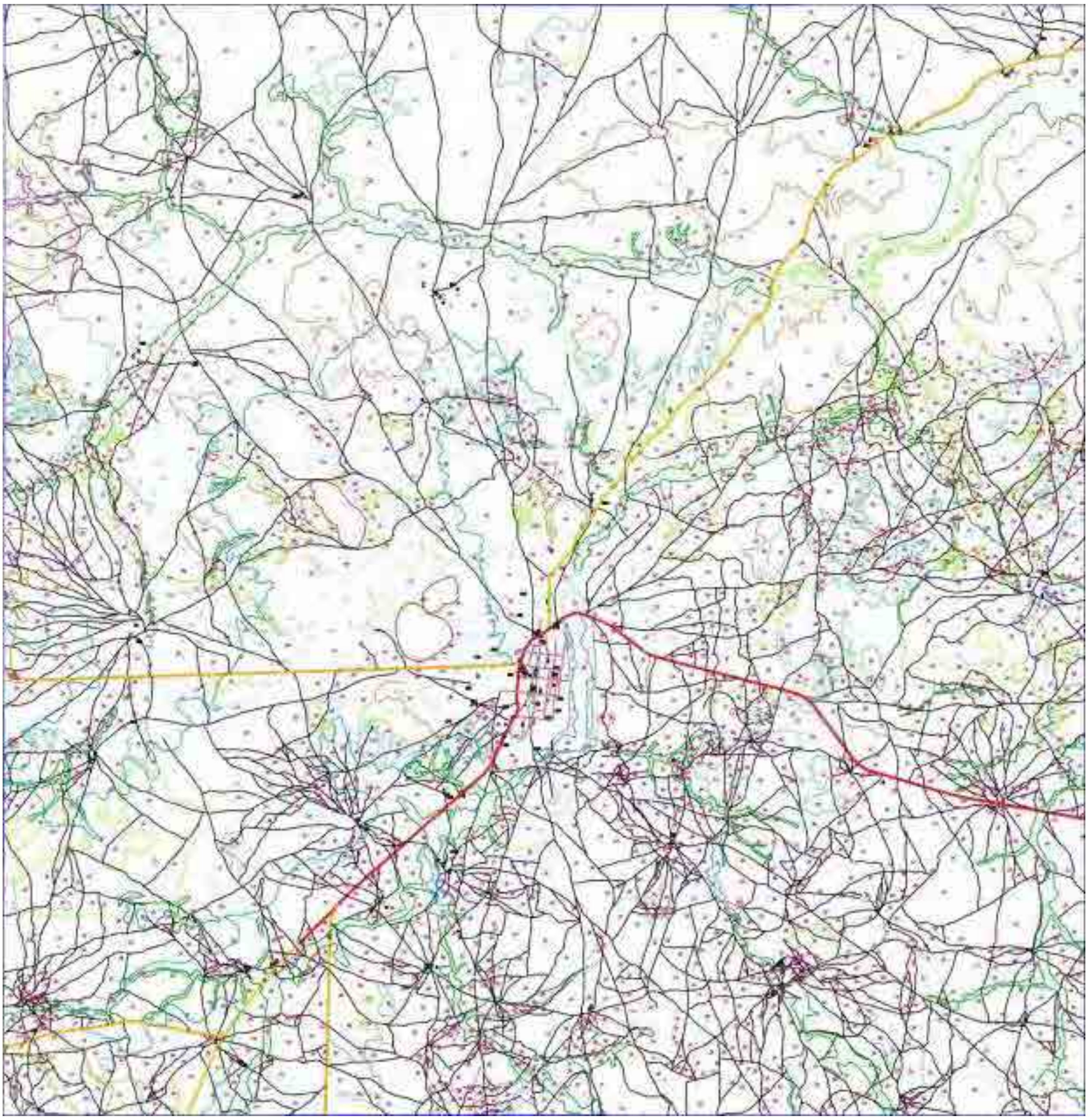


Figure 4-10 Digital plotting by IGB engineers (ND30XVII-1b)

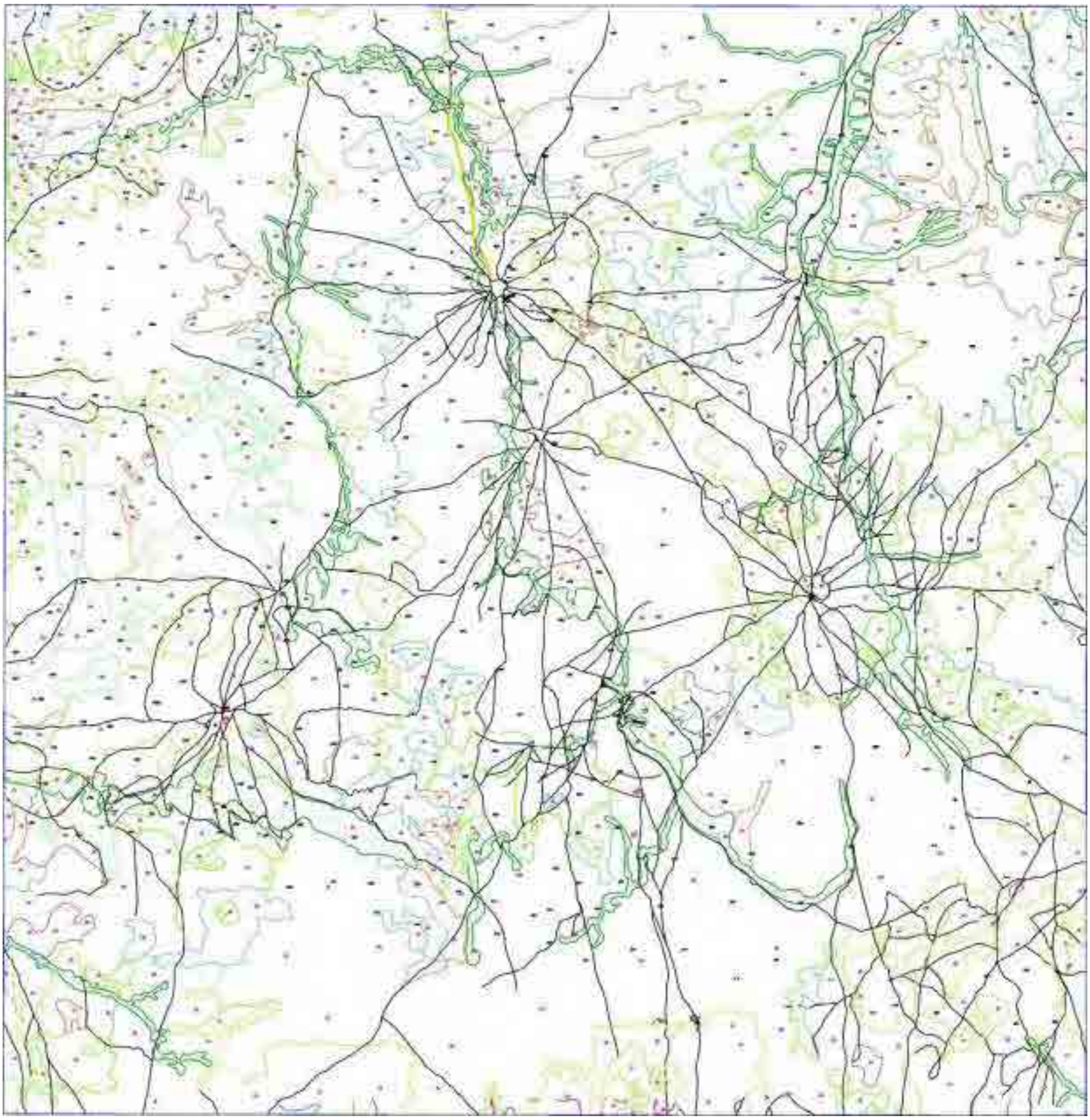


Figure 4-11 Digital plotting by IGB engineers (ND30XVII-1C)

4.1.4.2 Digital Compilation

The technology transfer on digital compilation at IGB began with the preparatory work implemented after the output data of the preceding stage of the digital plotting had been made available and before the implementation of actual digital compilation work began.

The instructor of the Study Team in charge of the digital compilation taught basic operation of each piece of the software in the digital compilation system used in this project to the trainees in this technology transfer. Because the trainees had never used the software used in this project before, a particularly large portion of time was spent on training on its basic operation. Then, the instructor provided the trainees with training on advanced operation of the software required for the digital compilation in accordance with the 1/50,000 map symbol rules used in this project.

[Periods and trainees]

The technology transfer on digital compilation was implemented in two phases. The table below shows the period and number of participants in each phase. All the trainees were technicians of IGB. The two trainees in the second phase had practical experience in digital compilation, while the two in the first phase had no experience at all in digital compilation.

Table 4-6 Periods and numbers of trainees in the technology transfer on digital compilation/digital compilation after field verification

No.	Implementation period	Number of trainees
Phase 1	August 6 – September 27, 2013	2
Phase 2	November 5 – December 16, 2013	2

[Equipment used (software)]

The pieces of software used in the Project mentioned below were used in the technology transfer.

- MicroStation V8i
- Bentley Map V8i

[Description of the technology transfer]

The Study Team decided to implement operation-oriented technology transfer consisting of repetitions of a series of lectures and practices on the five subjects mentioned below in order to ensure mastery of the technology by the trainees.

a. Understanding of the 1/50,000 map symbol rules

Data of a planimetric feature interpreted on a model had been acquired and processed as those mapped on one of the layers (a type of feature) in a pre-configured environment in the digital plotting/compilation implemented at IGB. However, applicable specifications (the 1/50,000 map symbol rules) should be the basis of data acquisition and processing in the creation of topographic map data. Therefore, the instructor explained the map symbol rules for the 1/50,000 topographic maps being created in this project in detail to make the trainees understand feature items to be acquired, the acquisition standards and the data types. He also emphasized and explained to the trainees the importance of the issues in data acquisition and processing stipulated in the rules mentioned below.

- When an unclear feature was identified, an operator should not make his/her own judgment on it. Instead, s/he must identify the area where the unclear feature is located as a verification area and study it on the ground.
- Data input (typing) shall be implemented meticulously. Erroneous data typing shall be corrected.

[Technology for basic operation of the software in the digital compilation system used in the Project]

Since no one at IGB had experience in using the CAD software used in the Project, MicroStation V8i (hereinafter referred to as V8), the instructor provided technology transfer focused on basic user interface, tools and operation methods so that the trainees would understand them. He explained basic operation methods of Bentley Map V8i also used in the project and difference in operation methods between it and V8. The explanation of Bentley Map V8i facilitated the implementation of the technology transfer and understanding by the trainees.

[Technology to configure an environment for the digital compilation in accordance with the map symbol rules]

In the beginning, the trainees used the symbols and line types, elements of an environment for digital compilation, to be used on output maps of topographic map data, prepared in accordance with the map symbol rules and provided by the Study Team. However, as they would have to implement digital compilation without outside assistance after the completion of the project, the instructor taught the trainees the procedure and method to create the symbols and line types adopted in the 1/50,000 topographic map symbol rules and the method to configure an environment with the procedure and the method in the technology transfer.

The instructor taught the trainees how to define the created symbols and line types and how to retrieve them in the technology transfer on environment configuration for V8.

[Basic operation required for the digital compilation]

Since no one in IGB had experience in working with V8 as mentioned above, and some of the trainees had no experience at all in digital compilation, the instructor taught the trainees the four subjects mentioned below in the technology transfer focused on operation and tools of V8 required for the work carried out in this project which was to be carried out by them in future:

- Tools in general;
- Shortcut functions;

- Creation of command files; and
- Creation/correction and inspection of topology.

[Quality control and data management]

The instructor taught the trainees a method of logical check of digital data with V8 and Bentley Map and a method of analog inspection of data output maps as quality control methods in the technology transfer. He explained to the trainees that these quality control procedures were extremely important because output data of the digital compilation were to be used in the subsequent stages, data structurization and map symbolization, and gave them advice on quality control methods.

[Results of the technology transfer]

The results of the implementation of the technology transfer on digital compilation were as follows:

- Understanding of the 1/50,000 map symbol rules

  The trainees tried to solve the problems of unclear features by changing layers arbitrarily. However, such arbitrary actions may have adverse effect on work in subsequent stages. The instructor told them that the map symbol rules had to be consulted at any time when cases of unclear features are handled and that observance of the rules was very important in such cases and urged them to recognize the importance of the rules.

- Technologies for basic operation of the software in the digital compilation system used in the project

  Although none of the trainees had experience in using V8, they managed to learn the basic operation of V8 without problem in the technology transfer because the instructor spent a significant amount of time on the training on the basic operation. However, as some trainees seemed to be a little confused with the arrangement of tools, the instructor solved their confusion by rearranging the layout of the user interface with the customization function of V8 to better match operators' sense.

- Technologies to configure environment for the digital compilation in accordance with the map symbol rules

  The transfer of the technology to create map symbols had been completed with little problem partly because the trainees can actually see the created symbols. As the instructor expected that it would take a long time for the trainees to learn creation of line types because it required definition of a great variety of parameters, he used a strategy of beginning with creation of simple line types and proceeding gradually to more complex ones as a measure for smooth transfer of the technology.

  The instructor also taught the trainees technologies required for the configuration of an environment for V8 including definition of created symbols and line types and their retrieval.

- Basic operation required for the digital compilation

  * Tools in general

    The instructor gave the trainees an explanation and a demonstration of each of the tools required for creation of 1/50,000 digital topographic maps and taught them how those tools worked by letting them practice the tools.

  * Shortcut functions

    Since the trainees of IGB did not have experience in using keyboard shortcut functions, the instructor demonstrated how to use shortcut functions both with a keyboard and with a mouse to them and provide them with time to learn the method by practicing it. Although one can use shortcut function only by pointing and clicking a mouse, s/he can use them much more efficiently with combined use of shortcut keys on a keyboard and a mouse.

  * Creation of command files

    The trainees learned the methods to create command files which created data automatically to a certain extent and those in which set parameters of layers can be modified and deleted in the technology transfer. The trainees need more experience in creating such files, because they had never done it before this technology transfer.

  * Creation/correction and inspection of topology

    The trainees learned how to use Bentley Map to verify whether polygon data stipulated in the map symbol rules had been created correctly or not, and how to create correct data by correcting erroneously created data in the technology transfer. The instructor urged the trainees to reconfirm the importance of the rules and how to use them effectively again.

[Quality control and data management]

- Data check

  A function to perform logical check of data automatically has been added to MicroStation V8. The instructor taught the trainees how to use the said function to check and correct data and the trainees learned it. Errors which occurred during the check process were used as a basis for deciding to which feature items attention had to be paid in the digital compilation in order to reduce the number of errors. This method is expected to improve the efficiency of the digital compilation process.

- Data output and visual inspection

  The trainees learned the methods to print out the topographic map data created in the digital compilation and inspect them visually by comparing the printouts with the photographs taken in the field identification in the technology transfer.

- Optimization of data file management

  Before the technology transfer, output data files of each process had been managed not centrally but personally by individual technicians who had created them. Therefore, the instructor urged the trainees to understand the necessity for centralized management of digital data and the risk of loss of personally managed data. He advised them to create a folder for each process for centralized data management and create a backup of each folder to prevent data loss.


Photo 4-10 Practicing trainees

4.1.5 (5) GIS Data Structurization

The software used in this Project, ArcGIS 10.1, was used in the technology transfer on structurization of digital data. Because the trainees of IGN of this technology transfer had practical working experience with this software, time shorter than originally planned was spent on basic operation of this software in the technology transfer on digital data structurization with the software. Instead, the focus of the technology transfer was placed on the explanation and application of tools of the software associated with the digital data structurization (so-called structurization of topographic map data) that the trainees performed routinely.

[Period and trainees]

Period : November 14 – December 20, 2013

Number of trainees : 1 (Mr. Konate was supposed to participate in this technology transfer. However, he was unable to attend most of it because he had to participate in the place name survey as it was an activity of higher priority.)

Ms. KABORE Verigine

Mr. KONATE Aziz

Photo 4-11 IGB engineers participated in the technology transfer on GIS data structurization

[Equipment used (software)]

One licensed copy of ArcGIS 10.1 of a U.S. company, Esri, used in the project was used in the technology transfer.

[Description of the technology transfer]

1. Practice of basic operation

In order to assess the level of mastery of ArcGIS by the trainees, the instructor in charge of data structurization of the Study Team asked them to practice the subjects mentioned below with sample map images of Ouagadougou district:

- Geometric correction of raster data (coordinate value data entry);
- Geometric correction of raster data (with MapToMap);
- Digitization (of point, line and polygon data);
- Addition of attribute data; and
- Creation of layout for printing maps.

The instructor found that, although the trainees had general knowledge of the software operation, the level of their technical capacity in using it was low. Both of them were at the beginner level in the use of MapToMap.

2. Conversion of DXF files created in the digital compilation into Shape file format supported by ArcGIS

The Shape file format is the standard data structure and the main data format used in the data operation and management of ArcGIS.

In this project, data created in the preceding digital compilation were provided in the DXF file format to the digital data structurization. As the Shape data file format was defined as the GIS data file format in this project, conversion of data file format from DXF to that which enables data operation with ArcGIS was required.

Two methods to convert data file format to the Shape format, one using ArcToolbox and the other using ArcCatalog, were taught in the technology transfer. After the instructor explained how to convert annotation, point, line and polygon data and configuration of the tools to be used for the conversion, the trainees practiced the data conversion and tool configuration in the technology transfer on the data conversion.

3. Data structurization

Topology was constructed by sorting topographic map data converted into the Shape data file format by feature class created in advance which defined the contents of DGN files in accordance with DGN layer information.

The instructor explained the methods required in the structurization mentioned below and the trainees practiced the methods.

- A method to correct topology with ArcToolBox;
- A method to connect features which are disconnected at the edges of map sheets;
- A method to add attribute to each feature; and
- A method to subdivide data into defined feature classes

4. Definition of data projection methods

The instructor explained a method to define data projection methods with ArcGIS and the trainees practiced the method. Since some of the projection methods used in this project were not supported by ArcGIS 10.1, the instructor instructed the trainees to practice only the methods to create projecting methods using the definitions of projection methods prepared by the Study Team.

5. Definition of symbols

The instructor explained methods to define and create a map symbol of each feature with ArcMap and the trainees practiced the methods. In the practice, the trainees were to create original symbols of point, line and polygon elements.

6. Creation of map layout

The instructor explained the methods to display attributes as labels and to display all symbols of a certain feature in a certain orientation using printed 1/50,000 maps as teaching materials and the trainees practiced the methods. The instructor also explained data driven pages which enabled use of the same marginal information on maps of an entire area using the 1/50,000 map grid data as teaching materials and the trainees practiced creation of data driven pages.

7. Creation of data for WebGIS

As the plan was to distribute data in a unit of map sheet with WebGIS, the instructor explained a method to divide data by map sheet and the trainees practiced the method. The instructor also explained that the same method can be used to divide data by administrative boundary.

Photo 4-12 Structurization of digital data

8. Attendance record

The table below shows the attendance of the trainees to the technology transfer for reference. The trainees were unable to attend the training because they had other duties to perform or because of sickness on many occasions.

Table 4-7 Attendance record of the Technology Transfer on GIS Data Structurization

Date/Name		Konate	Kabore	Remarks
Nov. 11 (Mon)	AM			
	PM			
Nov. 12 (Tue)	AM			
	PM			
Nov. 13 (Wed)	AM			Selection of the trainees
	PM			
Nov. 14 (Thu)	AM	×	∆	Preparation for the place name survey in the afternoon
	PM			
Nov. 15 (Fri)	AM	×	×	To participate in the place name survey
	PM	×	×	To participate in the place name survey
Nov. 16 (Sat)	AM			
	PM			
Nov. 17 (Sun)	AM			
	PM			
Nov. 18 (Mon)	AM			
	PM			
Nov. 19 (Tue)	AM			
	PM			
Nov. 20 (Wed)	AM			
	PM	○	×	Poor physical condition caused by chronic illness
Nov. 21 (Thu)	AM	○	×	Poor physical condition caused by chronic illness
	PM	○	×	Poor physical condition caused by chronic illness
Nov. 22 (Fri)	AM	○	×	Poor physical condition caused by chronic illness
	PM	○	×	Poor physical condition caused by chronic illness
Nov. 23 (Sat)	AM			
	PM			
Nov. 24 (Sun)	AM			
	PM			
Nov. 25 (Mon)	AM	×	×	To participate in the survey of North Block/poor physical condition caused by chronic illness
	PM	×	×	To participate in the survey of North Block/poor physical condition caused by chronic illness
Nov. 26 (Tue)	AM	×	○	To participate in the survey of North Block
	PM	×	○	To participate in the survey of North Block
Nov. 27 (Wed)	AM	×	∆	To participate in the survey of North Block/engagement with other duties
	PM	×	∆	To participate in the survey of North Block /to repair a broken personal computer
Nov. 28 (Thu)	AM	×	○	To participate in the survey of North Block
	PM	×	○	To participate in the survey of North Block
Date/Name		Konate	Kabore	Remarks
Nov. 29 (Fri)	AM	×	○	To participate in the survey of North Block
	PM	×	○	To participate in the survey of North Block
Nov. 30 (Sat)	AM			
	PM			
Dec. 1 (Sun)	AM			
	PM			
Dec. 2 (Mon)	AM	×	×	To participate in the survey of North Block/examination at a hospital
	PM	×	○	To participate in the survey of North Block

Dec. 3 (Tue)	AM	×	○	To participate in the survey of North Block
	PM	×	○	To participate in the survey of North Block
Dec. 4 (Wed)	AM	×	×	To participate in the survey of North Block/engagement with the National Commission of Toponymy
	PM	×	○	To participate in the survey of North Block
Dec. 5 (Thu)	AM	×	×	To participate in the survey of North Block/engagement with the National Commission of Toponymy
	PM	×	○	To participate in the survey of North Block
Dec. 6 (Fri)	AM	×	○	To participate in the survey of North Block
	PM	×	×	To participate in the survey of North Block/poor physical condition
Dec. 7 (Sat)	AM			
	PM			
Dec. 8 (Sun)	AM			
	PM			
Dec. 9 (Mon)	AM	×	○	To participate in the place name survey
	PM	×	○	To participate in the place name survey
Dec. 10 (Tue)	AM	×	○	To participate in the place name survey
	PM	×	○	To participate in the place name survey
Dec. 11 (Wed)	AM			
	PM			
Dec. 12 (Thu)	AM	×	○	To participate in the place name survey
	PM	×	○	To participate in the place name survey
Dec. 13 (Fri)	AM	×	△	To participate in the place name survey/poor physical condition
	PM	×	△	To participate in the place name survey
Dec. 14 (Sat)	AM			
	PM			
Dec. 15 (Sun)	AM			
	PM			
Dec. 16 (Mon)	AM	×	○	Self-training week
	PM	×	○	Self-training week
Dec. 17 (Tue) Dec. 18 (Wed)	AM	×	○	Self-training week
	PM	×	○	Self-training week
Dec. 18 (Wed) Dec. 19 (Thu)	AM	×	○	Self-training week
	PM	×	○	Self-training week
Dec. 19 (Thu) Dec. 20 (Fri)	AM	×	○	Self-training week
	PM	×	○	Self-training week
Dec. 20 (Fri) Dec. 21 (Sat)	AM	×	○	Self-training week
	PM			Self-training week
Dec. 21 (Sat) Dec. 22 (Sun)	AM			
	PM			
Dec. 22 (Sun)	AM			

[Results of the technology transfer]

The technology transfer on GIS data structurization produced the following results:

- The trainees learned the method to correct images which had no positional information.
- They learned the technology to convert topographic map data in the DXF data file format into data in the Shape file format.
- They learned the technology to create GIS data from the topographic map data converted into the Shape file format including how to sort the converted data by feature class, construct topology with the sorted data and detect and correct errors in the constructed topology.
- They learned the technology to add attribute data by combining attribute data in MS

Excel files with the topographic map data.

- They learned the technology to create map symbols with ArcGIS.
- They learned how to use data driven pages.
- They learned the technology to divide data to create data to be used in WebGIS.

4.1.6 (6)Map symbolization

The goal of the technology transfer on map symbolization was to enable IGB to create data for printing 1/50,000-scale topographic maps without outside assistance. The output data of the digital compilation after field verification (in the DXF file format) were used in this technology transfer.

[Period and trainee]

Some of the details of the technology transfer on map symbolization were as follows:

- Implementation period :November 14 – December 24, 2013
- Number of trainees :1(one)

The trainee had no practical experience in map symbolization or using Adobe Illustrator used in the map symbolization.

Ms. SOUGUE Maimouna

Photo 4-13 IGB engineer participated in the technology transfer on map symbolization

[Equipment used (software)]

The graphic software used in this project, Adobe Illustrator CS6, was used in the technology transfer on map symbolization.

[Description of the technology transfer]

In order to implement the technology transfer efficiently in a limited time, output data of the digital compilation after field verification created in the Project (in the DXF format) were used in the technology transfer. The subjects of the technology transfer were as follows:

a. Lecture on printing environment

The instructor of the Study Team in charge of the map symbolization provided the trainee with a lecture explaining a printing environment and conditions required for data import on the assumption that the data created in the map symbolization were to be printed in large quantities.

- Explanation of DTP (desktop publishing)
- Conditions required for data to be imported for printing
- Overprinting
- Film output
- Other necessary matters

b. Basic operation of Adobe Illustrator CS6

The focus of the technology transfer was placed on the functions used in the creation of topographic map data for printing. In practice, the trainee learned the methods mentioned below in the technology transfer.

- How to use the selection tools
- How to draw shapes accurately with digital data input
- How to enlarge, reduce, rotate and move shapes
- How to use Group, Lock and Hide commands
- How to fill shapes and draw lines
- How to manipulate layers
- How to create patterns and brushes
- Others

c. Preparation for the map symbolization

The trainee learned the methods mentioned below for the creation of objects required for the creation of topographic map data for printing in accordance with the map symbol rules in this technology transfer.

- Explanation on how to define swatch colors (process colors)
- How to create and define vegetation patterns
- How to create and define brush patterns
- How to create symbol marks
- Creation of a pallet file to be used as a library
- Creation of a work template file

d. Map symbolization

The trainee practiced the map symbolization processes mentioned below using the data created (in the DXF format) in the digital compilation after field verification (a work in Japan). (Map sheet No. NE28IV2c)

- Changing the scale of the data files (in the DXF format)
- Definition of stacking order of layers
- Conversion of objects in accordance with the map symbol rules
- Correction of inconsistencies
- Trimming of topographic maps

Photo 4-14 Technology transfer on map symbolization

e. Attendance record

The attendance record of the trainee is shown below for reference:

Table 4-8 Attendance record of the technology transfer on map symbolization

Date/Name		Sougue	2	3	4	5	6
Nov. 11 (Mon)	AM						
	PM						
Nov. 12 (Tue)	AM						
	PM						
Nov. 13 (Wed)	AM						
	PM						
Nov. 14 (Thu)	AM	○					
	PM	○					
Nov. 15 (Fri)	AM	×					
	PM	×					
Nov. 16 (Sat)	AM						
	PM						
Nov. 17 (Sun)	AM						
	PM						
Nov. 18 (Mon)	AM	Self-training					
	PM	Self-training					
Nov. 19 (Tue)	AM	Self-training					
	PM	Self-training					
Nov. 20 (Wed)	AM	Self-training					
	PM	Self-training					
Nov. 21 (Thu)	AM	○					
	PM	○					
Nov. 22 (Fri)	AM	○					
	PM	○					
Nov. 23 (Sat)	AM						
	PM						
Nov. 24 (Sun)	AM						
	PM						
Nov. 25 (Mon)	AM	○					
	PM	○					
Nov. 26 (Tue)	AM	○					
	PM	○					
Nov. 27 (Wed)	AM	○					
	PM	○					
Nov. 28 (Thu)	AM	×					
	PM	○					
Nov. 29 (Fri)	AM	○					
	PM	○					
Nov. 30 (Sat)	AM						

	PM						
Dec. 1 (Sun)	AM						
	PM						
Dec. 2 (Mon)	AM	○					
	PM	○					
Dec. 3 (Tue)	AM	○					
	PM	○					
Dec. 4 (Wed)	AM	○					
	PM	○					
Dec. 5 (Thu)	AM	○					
	PM	○					
Dec. 6 (Fri)	AM	×					
	PM	○					
Dec. 7 (Sat)	AM						
	PM						
Dec. 8 (Sun)	AM						
	PM						
Dec. 9 (Mon)	AM	○					
	PM	○					
Dec. 10 (Tue)	AM	○					
	PM	○					
Dec. 11 (Wed)	AM						
	PM						
Dec. 12 (Thu)	AM	○					
	PM	○					
Dec. 13 (Fri)	AM	○					
	PM	○					
Dec. 14 (Sat)	AM						
	PM						
Dec. 15 (Sun)	AM						
	PM						
Dec. 16 (Mon)	AM	○					
	PM	○					
Dec. 17 (Tue)	AM	○					
	PM	○					
Dec. 18 (Wed)	AM	○					
	PM	○					
Dec. 19 (Thu)	AM	×					
	PM	○					
Dec. 20 (Fri)	AM	○					
	PM	○					
Dec. 21 (Sat)	AM						
	PM						
Dec. 22 (Sun)	AM						
	PM						
Dec. 23 (Mon)	AM	○					
	PM	×					
Dec. 24 (Tue)	AM	○					
	PM						
Dec. 25 (Wed)	AM						
	PM						

[Results of the technology transfer]

a. Configuration of printing environment

The instructor explained the difference between printing film output and the conventional plotter (RGB) output and the significance of overprinting in preventing press misregistration to the counterpart, who managed to understand the overview of printing digital data with the explanation provided to her.

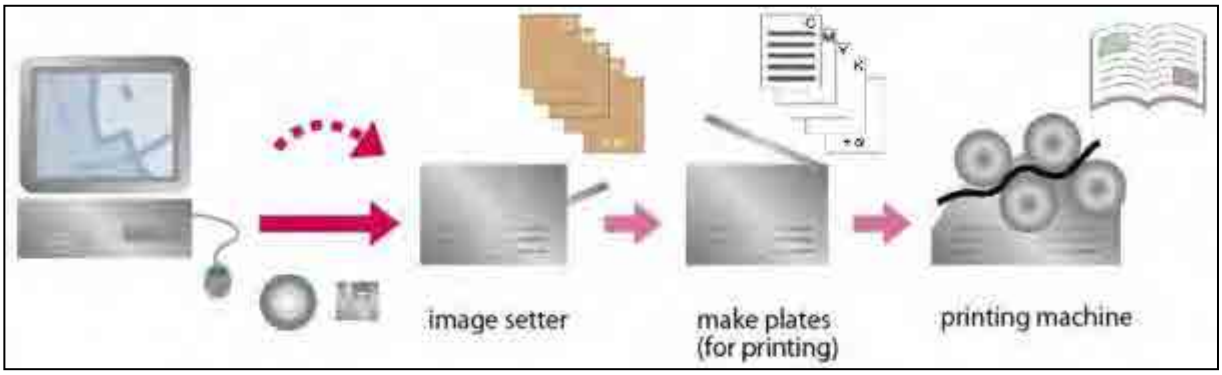


Figure 4-12 Flow of printing digital data

b. Basic operation of Adobe Illustrator CS6

The instructor explained the operation of Adobe Illustrator required for the map symbolization using the basic operation manual specifically designed for the map symbolization in this project and provided her with technology transfer in the form of problem-solving training. The counterpart had mastered almost all the operation. The instructor spent a particularly large amount of time in the technology transfer on operation of layers and creation of patterns and brushes which were useful particularly in map symbolization.

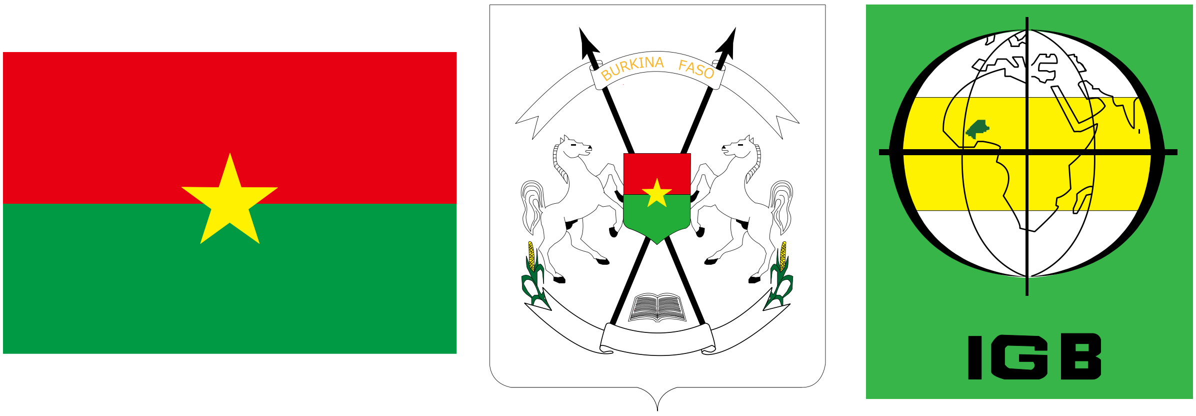


Figure 4-13 The national flag and the national emblem of Burkina Faso and the logo of IGB created by the trainee of IGB

c. Preparation for the map symbolization

- Definition of swatch colors

  Colors to be used in the map symbolization (swatch colors) were created in accordance with the map symbol rules. Creation of swatch colors enabled change of color of multiple patterns, brushes and symbol marks created with the same swatch color with a batch operation of changing the definition of the swatch color concerned, when the need for such a change arose.

- Creation of a pallet file

Vegetation patterns, symbol brushes (marks) and line brushes (depression, boundary, etc.) required for the symbolization were created in accordance with the map symbol rules and each of them was placed on a layer with the same name as the corresponding map symbol code in a single file. Use of this file enabled efficient conversion of DXF files into files of the format of the symbolization specifications.

	Name	colour			Name	colour			Name	colour	
	Red	C 0 M 100 Y 100 K 0			Bronze	C 8 M 22 Y 46 K 28				C M Y K	
	Orange	C 0 M 70 Y 100 K 0			Beige	C 7 M 5 Y 24 K 16				C M Y K	
	Green	C 65 M 0 Y 100 K 0			Magenta	C 0 M 100 Y 0 K 0				C M Y K	
	Gray	C 50 M 40 Y 30 K 0			DarkBrown	C 30 M 100 Y 100 K 80				C M Y K	
	LightGray	C 0 M 0 Y 0 K 20				C M Y K				C M Y K	
	Blue	C 100 M 30 Y 0 K 0				C M Y K				C M Y K	
	LightBlue	C 50 M 10 Y 0 K 0				C M Y K				C M Y K	
	Yellow	C 0 M 0 Y 100 K 0				C M Y K				C M Y K	

No	Layer	Description	Symbol	Sub-Layer	Colour	Over print	
1	100100	[illegible]		100100F 100100	Red100 K100	Off On	Idropper
2	100200	[illegible]		100200F 100200w 100200	Red100 CMYK0 K100	Off Off On	Idropper
3	100300	[illegible]		100300F 100300	Orange100 K100	Off On	Idropper
4	100400	[illegible]		100400F 100400w 100400	Orange100 CMYK0 K100	Off Off On	Idropper
5	100500	[illegible]		100500F 100500	Y100 K100	Off On	Idropper
6	100600	[illegible]		100600F 100600w 100600	Y100 CMYK0 K100	Off Off On	Idropper
7	100700	[illegible]		100700k 100700F 100700	K100 Magenta100 K100	On Off On	Idropper
8	100800	[illegible]		100800F 100800	CMYK0 K100	Off On	Idropper

No	Layer	Description	Symbol	Sub-Layer	Colour	Over print	
105	700210	Forêt claire ou savane boisée		700210	Pattern	Off	Swatches
106	700310	Savane arborees ou arbustives		700310	Pattern	Off	Swatches
107	700410	Steppe au Prairie		700410	Pattern	Off	Swatches
108	700510	Brousse tigrée		700510	Pattern	Off	Swatches
109	700610	Formation ripicole et forêt galerie		700610	Green80	Off	Idropper
110	700710	Limite de foret classée de réserve de flore ou faune	Lineweight 2.00mm	700710	Green100	On	Idropper
111	700800	Haie (ou cloture)	φ 0.40mm 0.25mm φ 0.25mm	700800	K100	On	Pattern Brushe
112	700910	Culture		700910	Pattern	Off	Swatches

No	Layer	Description	Size	Symbol	Sub-Layer	Colour	Over print	Font
129	900130	Capitale d'Etat	6.0mm	OUAGADOUGOU	900130	K100	On	Idropper OUAGADOUGOU
130	900230	Chef-lieu de Région	4.5mm	DORI	900230	K100	On	Idropper DORI
131	900330	Chef-lieu de Province	4.0mm	DJIBO	900330	K100	On	Idropper DJIBO
132	900430	Chef-lieu de Commune	3.5mm	Oursi	900430	K100	On	Idropper Oursi
133	900530	Village administratif	2.0mm	Gana	900530	K100	On	Idropper Gana
134	900630	Hameau de culture	2.0mm	HC	900630	K100	On	Idropper HC
135	900730	Fleuves frontalières, Cours d'eau primaire, Cours d'eau secondaire temporaire	1.5mm 2.0mm 3.0mm	Volta Volta Volta	900730	K100	On	Idropper Volta Volta Volta
136	900930	Village Non administratif	2.0mm	Nakomko	900930	K100	On	Idropper Nakomko

Figure 4-14　Pallet file including layer information (in part)

- Creation of template file

  A file for the map compilation including the information on the stacking order of layers (map symbols) was created. Creation of this file made it possible to arrange stacking of map symbols to be displayed in the map symbolization efficiently by pasting copied DXF data in the file.

d. Map symbolization

- Changing the scale of DXF data

  By using the reduction ratio of 2 % when the DXF data which do not have an absolute scale were imported in Illustrator, the scale of 1/50,000 was achieved accurately.

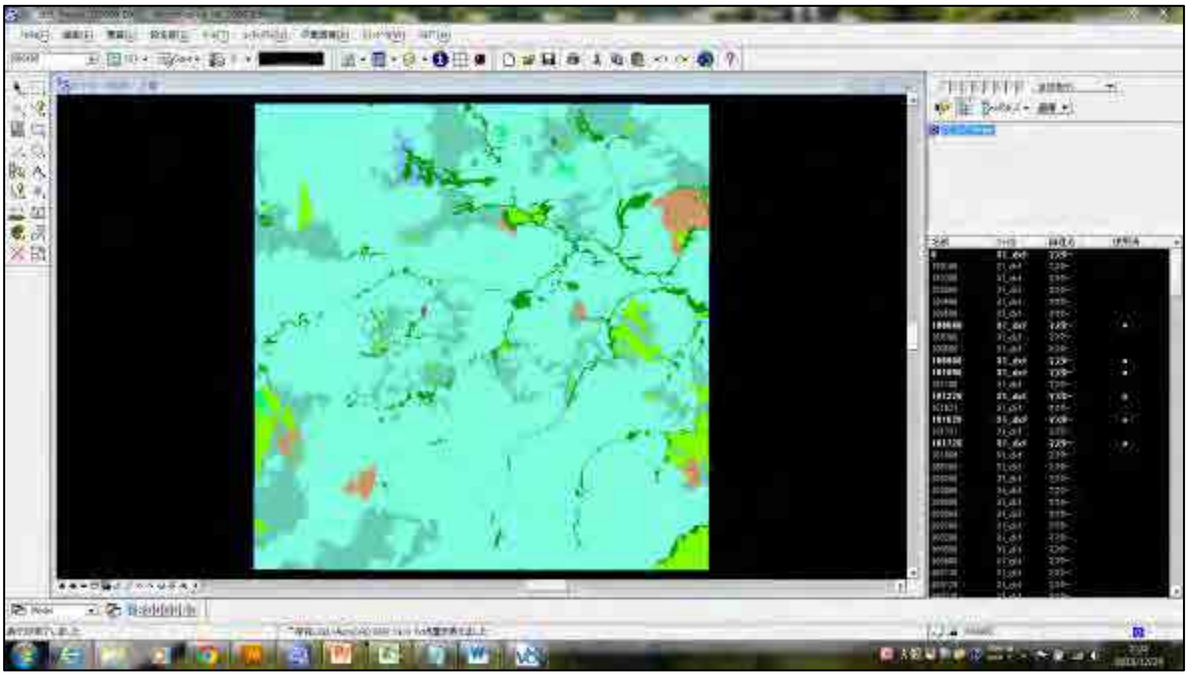


Figure 4-15 Output DXF file of the digital compilation (MicroStation)

- Definition of stacking order of layers

  A stacking order of layers to be displayed in the map symbolization was defined by copying the DXF file imported into Adobe Illustrator and pasting it in the “template file” prepared in the preparatory stage.

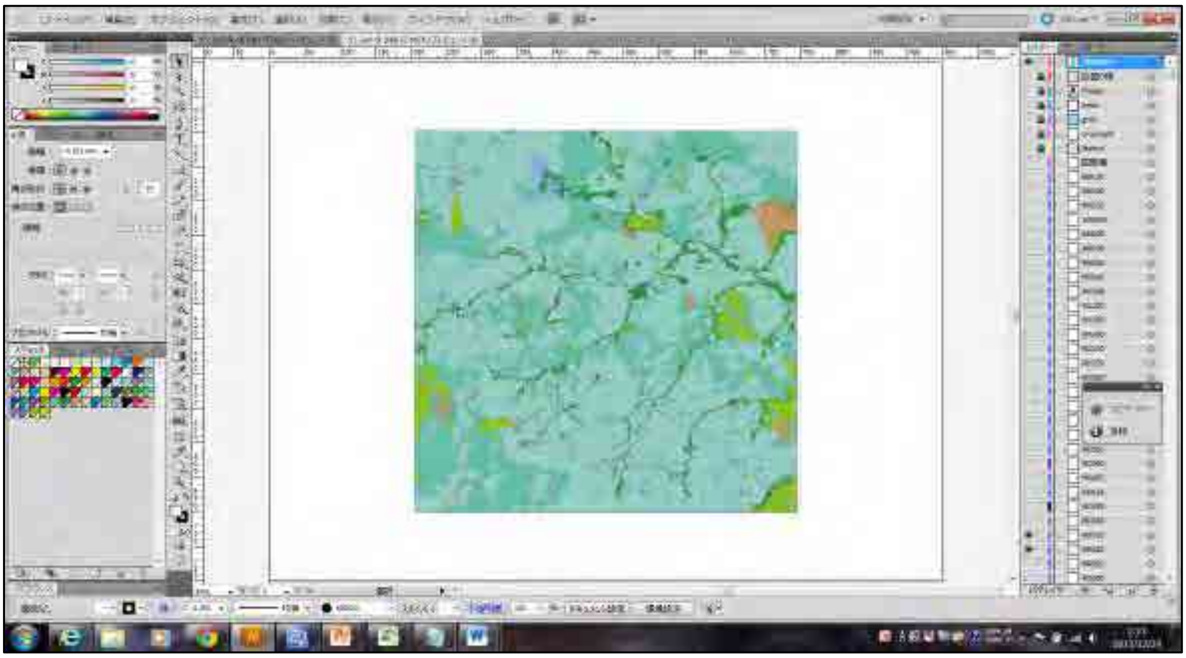


Figure 4-16 DXF file with a defined layer stacking order on the template file (Adobe Illustrator CS6)

- Conversion of objects in accordance with the map symbol rules

  Eyedropper Tool was used to copy the map symbols in the “pallet file” created in the preparatory stage and to paste them on the objects on layers. In this way, the map symbol specifications were applied to objects on layers.

Colors of polygons were changed, polygons were filled with patterns, types, colors and widths of lines were changed and fonts, sizes and color of annotations were changed in each layer (map symbol code) in this technology transfer. Double lines representing roads (representation of roads with one upper and one lower line) were displayed with one layer to display one of the double lines and an additional layer to display the other. The trainee learned the series of operations mentioned above.

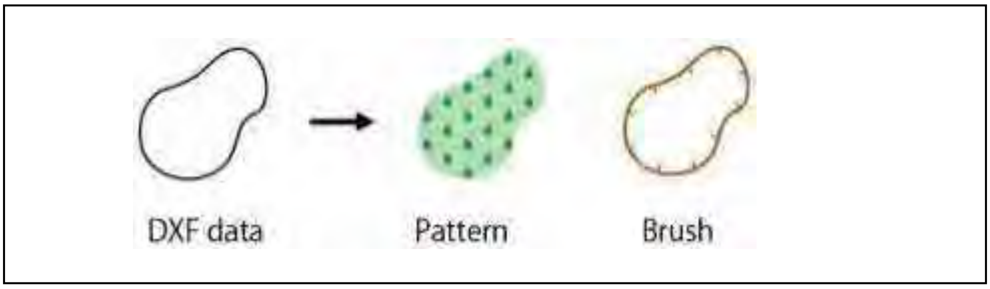


Figure 4-17 Conversion of DXF data with a pattern and a brush

Figure 4-18 An example of a map symbol displayed with multiple layers (code: 100100)

- Correction of inconsistencies

  When a line brush is used for a batch attribute conversion of data in the DXF format represented by single lines such as those of cliffs and railway lines, some inconsistencies will be generated. Those inconsistencies are eliminated either by cutting lines in pieces and correcting parts with inconsistencies manually or using the "Simplify" or "Round Corner" command which reduces the number of segments (points) without changing shapes of lines. The trainee learned the methods mentioned above in the technology transfer.

- Trimming of maps

  All objects of the data crated in the digital compilation after field verification (in the DXF format) are cut by neat lines. Because of this, some objects lose part of their data near and inside neat lines. The loss of data of objects with line widths such as roads is solved by extending the lines representing the objects beyond neat lines and erasing parts outside neat lines with a layer operation tool, “Clipping Mask.” The trainee also learned this method in the technology transfer.

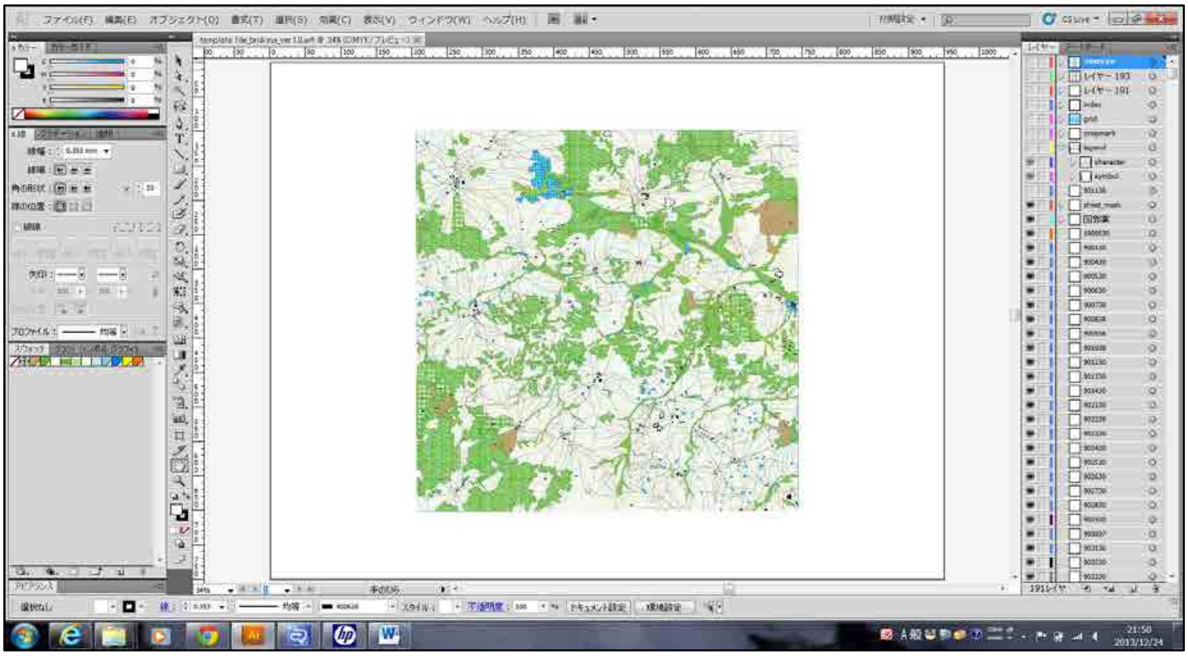


Figure 4-19 Output file of the map symbolization (ND30XVII-1a)

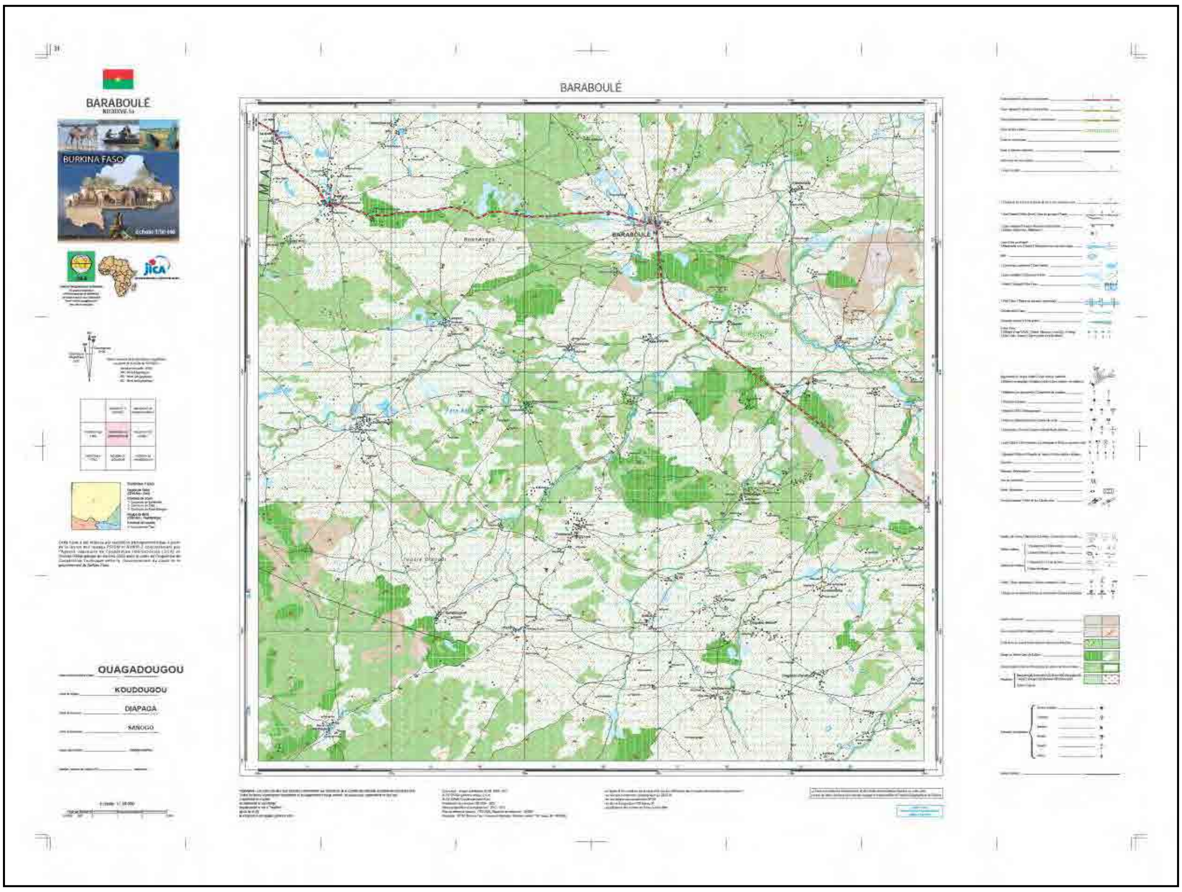


Figure 4-20 Final topographic map file for printing (ND30XVII-1a)

e. Creation of topographic map data files for printing by combining topographic map data and marginal information data

The trainee learned the method to create topographic map files for printing by combining a basic marginal information file which included data of trim marks (called "*tombo*" in Japanese) and created topographic map data and replacing the information of map number, destinations and title in the technology transfer.

4.2 Evaluation of Technology Transfer by Subject

1) Ground control point survey

Technology transfer for GNSS measurement, etc., for ground control point survey was carried out in the Ouagadougou district (Capital city district) in the form of OJT. In the Dori and Djibo districts (in the North-East), because of safety problems, instruction on process management and accuracy control was carried out at the residences in Dori City. It was confirmed that IGB were capable of implementing accuracy control themselves on site.

Because of a delay in submitting an “Application for Operation Permit” to obtain a government operation permit, and because the procurement of funds for operations did not proceed in accordance with plan, departure to site for site operation process control was delayed. It is expected that it will be utilized in upcoming process control.

The four IGB technicians had experience of control point survey by GNSS implemented by EU, so they had the skills for carrying out GNSS survey. However, only one technician had experience of ground control point survey, and the remaining three were inexperienced, so as a result of the effect of the OJT carried out in the Ouagadougou district, they were able to safely complete the GNSS survey in the Dori and Djibo districts within the schedule.

The methods of sorting and managing the GNSS survey documents were untidy, so instruction was provided on filing in A4 files, filing in time sequence, providing contents page, etc. It is considered that it takes a considerable amount of time before the IGB technicians became proficient at filing, sorting, and setting in order documents.

Through the work, the impression was received that the awareness of equipment management was low within IGB. The Study Team prepared an equipment management shelf, and provided instruction on methods of sorting and setting in order. From measurement accuracy, work efficiency, work environment, etc., it is expected to implement the 3S (sorting, setting in order and standardizing) for IGB.

2) Aerial triangulation

To confirm the level of proficiency at the end of the training, the series of operations was performed again in the same area. Although in some areas incorrect selection when registering images, confirmation errors of the arrangement of tie points or the number of light rays, slack measurement accuracy, etc., was found, it was possible to evaluate that they had acquired the LPS workflow using ALOS images, and software operations from preparation of project files to evaluation of accuracy. On the other hand, there were differences between individuals in elementary areas such as familiarity with computer operations, which was seen as a difference in the level of proficiency. This is a problem that can be solved through the efforts of the individuals, and further training is expected.

Not only in aerial triangulation but in various cases those with more experience were the first to become proficient in the operations using the software, and it is necessary that more experience be accumulated in order to consolidate the technology acquired in the training.

For the pan sharpening process also it was confirmed that they were capable of carrying out the process on their own, although sometimes referring to the manual or memos. It is considered that this technology can be used for updating topographic maps by partial correction or in different operations.

3) Field identification/verification

In the technology transfer for photo interpretation and field identification, it was confirmed that the field identification capability of all the survey members was improved by lectures and practice. Because this survey method was completely different from conventional field identification, in particular in photo interpretation, they became able to distinguish items that could be interpreted photographically and items that are difficult by becoming familiar with the images.

The evaluation results for each objective are as follows.

- Improvement in the degree of understanding of the field identification procedures

  Understanding of the series of procedures of field identification was encouraged by explanation in the office. Also by repeated operation on site, each of the participants became capable of effectively applying the methods. This was particularly seen in confirmation of photographs taken, display of survey position on the photos, and determination of survey routes.

- Acquisition of basic skills in image interpretation and topographic map reading

  Differences in degree of proficiency in image interpretation and topographic map reading were recognized initially among individuals. However, as a result of repeated lectures and discussion, a uniform understanding was obtained for the degree of understanding of the application of map symbol rules and accuracy of planar interpretation such as vegetation boundaries, etc.

- Acquisition of efficient and effective survey procedures

  In image interpretation, the participants became familiar with satellite images, and became capable of distinguishing between map symbol items that can be interpreted and map symbol items that are difficult to interpret. Also, each of the members have become capable of defining survey routes to enable improvement in image interpretation capacity and efficient and effective survey of many survey items, and plans for the scope of surveying.

- Improvement in methods of displaying and arranging field identification results

Field identification results are displayed on images as point, linear, or planar objects corresponding to survey item type codes. The fundamental parts of this method of displaying were understood and implemented. However further improvement in the method of display and expression is necessary. Also it is desirable that the display of each member is uniform, and that the display takes into consideration the survey results of adjacent members, such as by adjoining the sheets of adjacent members.

4-1) Digital plotting

The Study Team decided to put the focus on the understanding by the trainee of software operation in the first phase and to explain logical check of data and selection of data for the digital plotting in accordance with the scale to be used. The Study Team identified the following problems in the outputs which the counterparts created without assistance in phase 1 and in the self-practice after the completion of the first phase:

- The trainees made many line-connection errors.
- The trainees failed to perform edge matching between files. (Data of certain features were acquired twice.)
- The trainees did not acquire data in a way to facilitate the data structurization when they acquired the data.

The Study Team was informed that IGB had experience in creating 1/50,000 maps without outside assistance. It is inevitable to see problem ② as the work is carried out by different operators. Therefore, the Study Team had expected the trainees to ask questions based on their experience. However, the trainees did not ask such questions. The trainees might have been concentrating too much on getting used to the software that they practically used for the first time in the technology transfer to ask questions. Nonetheless, the team was disappointed with the absence of questions. With regard to this problem and problems ① and ③, the instructor explained the error detection function and a method to correct data manually and the trainees practiced data correction in the second phase of the technology transfer. Many errors were detected in the practice. However, as what is important in learning software operation are repeated practices and recognition of the reasons to perform certain operation (use certain tools), the team expects the trainees to make good use of the experience in this technology transfer in their work in future.

Although there were some cases where data had been acquired in too small pieces and acquired elevation data were not accurate in the planimetric mapping, the team saw no significant problem with regard to the capacity in photo interpretation of the trainees. The trainees seemed to have interpreted types of vegetation, even vegetation that we, the Japanese, are not familiar with, with common understanding, in general, though there was slight difference among their interpretations.

Interpretation of elevation is a prerequisite technology for not only contour plotting but also planimetric plotting. Since the errors in the interpretation of elevation found in the planimetric plotting in the technology transfer were too small to affect accuracy of 1/50,000 maps, the instructor only mentioned to the trainees that they had made errors. Meanwhile, the Study Team would like them to realize that the errors at the same level will be problematic when they perform large-scale plotting in future.

Since only one of the trainees in this training had experience in contour plotting implemented in the second and subsequent phases of the technology transfer (because the other IGB technicians with experience in the plotting were not able to participate in the training because they had to participate in the field verification), the Study Team was unable to provide sufficient training. This was because trainees with no experience in plotting had to acquire technical capacity to interpret elevation accurately with practice of measuring the elevation control points at first and this process alone required a considerable amount of time. In addition, the study area was inappropriate for the training on interpretation of elevation because of its extremely flat terrain. As the instructor explained how to use TopoMouse and configuration of the software to the trainees and these subjects are described in the manual, they are expected to have little problem in manipulating the TopoMouse and software. Since it requires more training to master drawing of contours than to master planimetric plotting, those trainees will have to continue their training under the instruction of IGB technicians with experience in plotting.

Interpretation of elevation is a fundamental part in not only contour plotting but also plotting with photogrammetry and stereoscopy and an essential part requiring a certain period of training. The Study Team hopes that the IGB staff members who had the first experience in plotting with stereoscopy in the project will have opportunities to practice the plotting and expects them to continue repeated practice voluntarily as the equipment used in the plotting is always available to them.

The training in the technology transfer on digital plotting was implemented simultaneously with the field verification. The training began with some uncertainties as some of the map symbol items had been modified. Because of these reasons, the Study Team was unable to provide sufficient training to the trainees in the technology transfer. This is the issue that the Study Team has to reflect on. The attitude of the trainees to the training was serious and they always took notes in the training. They also showed willingness to learn technologies in one way or another. Despite these observations, they seemed to be passive in general in the training. There is more than one method to achieve a goal and one has to have flexibility to use different methods under different requirements or for different purposes. One cannot describe the skill required for such flexible use of methods in a manual. A help manual attached to the software explains ways to use individual tools. The team considers that an effort to read and understand the manual is an absolute necessity for the trainees to master the skill and that they can do so only if they continue the effort. Therefore, the team hopes that they will make this effort.

4-2) Digital compilation

The trainees recognized the importance of the specifications in the map symbol rules in the creation of 1/50,000 digital topographic maps and also acquired capacity to perform technical work in the digital compilation in accordance with the specifications without problems. The latest version of the software used in this technology transfer has a function for logical check of data. The trainees acquired the technical capacity to perform a certain level of quality control of data using this function in the technology transfer.

The Study Team recognized in the technology transfer that the counterparts were very much interested in new technologies. It will take a certain amount of time for them to understand and digest new technologies and use them in the practical work. Although the instructor of the Study Team urged them to digest transferred technologies with repeated practices, they seemed to be considering that it was sufficient if they understood the technologies in theory. They seemed content when the instructor lent them manuals. The team expects them to review the work procedures in the digital compilation and implement the digital compilation more efficiently using the latest version of the software provided in this project.

5) GIS data structurization

The Study Team determined whether the trainees had obtained the level of technical capacity required for structuring digital data with ArcGIS without assistance or not on the basis of the outputs of a pilot project of creating GIS data from a DGN file of topographic map data.

The technical contents of the pilot project were conversion of data in the commonly-used file formats, such as DGN, DWG, DXF and Shape, into future classes, data processing, construction of topology, detection and correction of errors, creation of layers and creation of map documents. The team confirmed that the trainees had learned these technologies on the basis of the results of the evaluation of the output of the pilot project which they implemented repeatedly. On the basis of this confirmation, the Study Team concludes that staff of IGB is able to create GIS data by structuring data with ArcGIS without assistance.

The Study Team confirmed that IGB had had a certain level of experience in using ArcGIS in the work before this project. However, the team also confirmed, at the stage of the practice of basic operation, that they had been using it mainly for a specific purpose of data creation operation (data digitization) without taking advantage of the features of ArcGIS. On the basis of the confirmation, the instructor taught the theories and methods to use tools of ArcGIS effectively and ways to improve efficiency of the work with the use of the tools. The implementation of this technology transfer reinforced trainees' understanding of structuring digital data with ArcGIS.

The trainees attended the technology transfer with a positive attitude and voluntarily asked questions on the points that they had failed to understand. The Study Team acknowledges that IGB selected ideal persons as the trainees of the transfer of GIS technologies.

It is regrettable that only a number smaller than expected of trainees participated in the technology transfer because some of the staff members supposed to participate in it had to take part in the survey of place names. However, those trainees who participated in the technology transfer improved their level of knowledge markedly in the technology transfer. The team expects improvement of the GIS capability of IGB as a whole from the training provided by the trainees to other IGB staff members.

6) Map Symbolization

The Study Team determined whether the trainee had obtained the level of capacity required for the implementation of the map symbolization with Illustrator without assistance or not by observing her work in the process from the import of the actual data created in the digital compilation into Illustrator to the map symbolization.

The contents of the map symbolization implemented by the trainee for the evaluation were how to use Eyedropper Tool, patterns, symbols and brushes in Illustrator. The Study Team confirmed that the trainee improved her technical capacity and learned the technology while the trainee repeatedly practiced the task.

The instructor spent sufficient time to teach the trainee how to create symbols, patterns and brushes which are used as basic tools for the map symbolization. The Study Team evaluated the technical capacity of the trainee on this subject by giving her a test. In practice, the Study Team asked her to create certain symbols, patterns and brushes for the evaluation.

On the basis of the results of the evaluation processes mentioned above, the Study Team concludes that the trainee of IGB has acquired technical capacity to implement the map symbolization with Illustrator.

Because the trainee of the technology transfer on map symbolization had never used Illustrator, a vector graphics editor, before the transfer and it was fundamentally different from the CAD software, MicroStation, which she learned in the preceding technology transfer, she had difficulty in learning how to operate the software. Therefore, the instructor gave her a task of creating objects which were relatively easy to create, such as the logo of IGB, as a means for her to master basic operation of Illustrator before the transfer of the technologies used in the map symbolization.

The trainee participated in the technology transfer with a positive attitude, which was revealed in the fact that she always asked questions and took notes during the technology transfer. The selection of a woman as the trainee of the technology transfer on map symbolization is considered appropriate because map symbolization is a process to give appropriate appearance to topographic maps which requires meticulous attention of operators.

The fact that she was the only trainee seems to have resulted in turn in the implementation of detailed and content-rich technology transfer. The team expects that she will be able to improve her technical capacity further by teaching map symbolization to other IGB staff members.

Chapter 5 Reports

5.1 (2) Preparation of Inception Report (Work in Japan)

Based on the existing documents and collected documents, a preliminary study of the basic policies associated with implementing the work, work methods (including methods of technology transfer), details of work items, implementation system, schedule, etc., was carried out, and summarized in the Inception Report, which was approved by JICA.

5.2 (3) Explanation and discussion of Inception Report (Work in Burkina Faso)

The Inception Report (draft) that was already approved by JICA was submitted to the Government of Burkina Faso, and the study details and implementation methods were explained to them. Also, details of the discussion were summarized in the minutes of meeting which was approved.

5.3 (12) Preparation of Interim Report (Work in Japan)

The Study Team prepared an Interim Report which described the work implemented by the end of November 2012, assessment of the outputs and strategies and schedule for the work to be implemented.

5.4 (13) Explanation and Discussions of Interim Report (Work in Burkina Faso)

"Explanation and Discussion of Interim Report" was held at the conference room of IGB in May 2013 as an occasion for the Study Team to explain to and discuss with the IGB side the details of the progress of the work up to the end of March 2013. Three senior officials of IGB, Mr. Tapsoba, the Director General, Mr. Compaore, the Project Manager, and Mr. Belem, the Director of Technical Department, and three members of the team, including an interpreter, participated in the explanation/discussion. The Study Team members used the Interim Report to explain progress of the work by the end of March 2013 by work stage, interim results of the study, results of the assessment of the interim results and strategies and schedule for the work to be implemented.

5.5 (20)Preparation and Explanation/Discussion of Draft Final Report (Work in Japan/Burkina Faso)

The Study Team prepared the Draft Final Report which described the progress of the entire project and its outputs. The team also compiled various work manuals to be used by IGB for development, maintenance and administration of various (geospatial information) data by themselves in future.

After having incorporated views of member experts expressed in the discussion meetings on the report held in Japan, the Study Team explained and held discussion on the Draft Final Report in Burkina Faso.

5.6 (21) Preparation of Final Report (Work in Japan)

The Study Team prepared the Final Report by revising the Draft Final Report in accordance with the outcome of the discussion on it with the counterparts and adding the description of the work implemented after the discussion on the Draft Final Report (*e.g.* printing of topographic maps, technology transfer on website construction and promotion of data utilization).

Chapter 6 Other Work Implemented

6.1 Procurement of equipment (Implemented by Study Team)

In the beginning of May equipment that was procured by the Study Team was delivered. This was used in the analysis of ground control point survey data, and confirmation of its operation has been completed. This equipment also includes items (UPS, large scale plotter) that are used in combination with the equipment delivered through an equipment tender organized by the JICA Burkina Faso Office. The following photographs show the equipment that was supplied.

Photo 6-1 Large format printer

Photo 6-2 Cartridges, paper rolls

Photo 6-3 Digital levels DNA10

Photo 6-4 UPS

Table 6-1 List of equipment supplied by the Study Team

No.	Item name	Quantity	Unit
1	Uninterruptible power supply	6	sets
2	A3 printer	2	sets
3	Printer cartridges	12	sets
		12	sets
		12	sets
		12	sets
4	Large format printer	1	set

5	Waterproof paper rolls	2	rolls
6	Paper rolls	5	rolls
7	Bond paper	5	rolls
8	Printer heads	6	sets
		6	sets
		6	sets
		6	sets
9	Maintenance cartridge	1	set
10	Printer cartridges	6	sets
		6	sets
		6	sets
		6	sets
		6	sets
		6	sets
11	LEICA digital levels	2	sets
12	Staffs	2	sets
13	Staff rods	2	sets
14	LGO analysis software	2	sets
15	LGO_CAD export MDL	2	sets
16	LGO_leveling results MDL	2	sets
17	LGO3DMDL	2	sets
18	LGO bundled communication programs	2	sets
19	OS for notebook PC	6	sets
20	Antivirus software	6	sets
21	Notebook PC	2	sets
22	Training program	1	set

6.2 Procurement of equipment (Implemented by JICA)

Equipment procured by JICA was delivered in the middle of September, and the equipment underwent inspection for acceptance. The following is a list of the equipment procured.

Table 6-2 List of equipment procured by JICA

No.	Item name	Quantity	Unit
1	LPS CORE software for photogrammetry	3	Licenses
2	LPS STEREO software for stereoscopic viewing	3	Licenses
3	ORIMA/DP-TE/GPS software for aerial triangulation	1	Licenses
4	LPS Pro600 software for digital plotting	3	Licenses
5	LPS ATE software for preparation of DEMs	1	License
6	LPS TE DEM editing software	1	License
7	MicroStation V8i digital editing software	6	Licenses
8	Bentley Map V8i digital editing software	3	Licenses
9	Adobe Illustrator symbolization software	2	Licenses
10	ArcGIS Desktop GIS software	1	License
11	ArcGIS Desktop Extension Spatial Analyst GIS utilization software	1	License
12	ArcGIS Desktop Extension 3D Analyst ArcGIS GIS utilization software	1	License
13	ArcGIS Desktop Extension Network Analyst ArcGIS GIS utilization software	1	License
14	USB TopoMouse digital plotting mouse	3	Units
15	Planar SD2620 3D monitor for digital plotting	3	Units
16	Nvidia Quadro FX4800 graphics card for 3D monitor	3	Units
17	Adobe Photoshop image processing software	2	Licenses
18	Dell S2410w monitor	6	Units
19	Dell Precision T5500 desktop computer	6	Units

Chapter 7 Outputs

The reports submitted at each stage of the work are as follows.

7.1 Study reports

Table 7-1 Study reports

No.	Report name	Volume in Japanese	Volume in English	Volume in French	Government of Burkina Faso	
					Volume in English	Volume in French
a	Inception Report	10	15	15	10	10
	Content	Plan for implementation of the project, such as basic policy of the project, methods, work schedule, personnel plan, implementation system, technology transfer plan, etc.				
	Time of submission	At the start of the project				
b	Interim Report	10	15	15	10	10
	Content	Survey results up to field identification, progress of technology transfer, subsequent plan				
	Time of submission	11 months after start of project				
c	Draft Final Report/main	—	15	15	10	10
	Summary	—	15	15	10	10
	Japanese summary	10	—	—	—	—
	Content	Total outputs of the project, technology transfer outputs, work manuals, quality management report, rules, etc.				
	Time of submission	22 months after start of project				
d	Final Report/main	—	15	15	10	10
	Summary	—	15	15	10	10
	Japanese summary	10	—	—	—	—
	Content	Total outputs of the project, technology transfer outputs, work manuals, quality management report, rules, etc. (final version)				
	Time of submission	Within 1 month of receiving the comments from the Burkina Faso side on the Draft Final Report				

7.2 Outputs to be delivered

The following outputs will be submitted to JICA. The numbers submitted are also as follows.

Table 7-2 Outputs

No.	Outputs	Unit	Quantity	Notes
a	Orthophotos	Set	1	1 set for the Government of Burkina Faso
b	Aerial photograph contact prints	Set	2	1 set for the Government of Burkina Faso
c	Site surveying results	Set	1	1 set for the Government of Burkina Faso
d	Aerial triangulation results	Set	1	1 set for the Government of Burkina Faso
e	Digital data files			
i)	1/50,000 topographic map data	Set	2	1 set for the Government of Burkina Faso
ii)	1/50,000 GIS basic data	Set	2	1 set for the Government of Burkina Faso
iii)	Final Report	Set	1	1 set for the Government of Burkina Faso
f	Output maps	Set	200	200 sets for the Government of Burkina Faso
g	Booklet	Set	100	A3 size (100 sets for the Government of Burkina Faso)
		Set	5	Master drawing size (3 sets for the Government of Burkina Faso)
h	Quality management report	Set	1	Instead of a review of the topographic map production process, a report on quality control by the contractor for this project will be submitted.
i	Technical specifications	Set	1	1 set for the Government of Burkina Faso

Chapter 8 Utilization of Digital Topographic Map Data in Burkina Faso and Recommendations

8.1 Utilization of Digital Topographic Map Data

8.1.1 Importance of Topographic Maps

Topographic maps contain various objectives, whose (1) distances, (2) areas, (3) directions and (4) topology are correctly represented in an easy-to-understand way. When a nation has emerged as a result of social development, topographic maps become an essential administrative tool for such activities as development of farmland and construction of irrigation channels. The central and local governments and private companies which intend to implement development projects need topographic maps which describe the latest conditions of project sites as indispensable basic materials, because it is difficult for them to prepare appropriate national land development plans without accurate topographic maps.

Unavailability of accurate topographic maps and delay in creation of topographic maps have been often cited as obstacles to development in developing countries in Africa and other areas. Topographic maps have contributed to development of nations in many areas, including development of infrastructure, agriculture, health and education sectors, reconstruction after disasters and forest and natural resource management, as basic reference materials.
For example, the topographic maps created with assistance from JICA have been utilized as foundation of national development on many occasions, including maintenance and management of urban infrastructure, urban planning and projects in the areas of food security and health. One of the more visible examples is that GIS based on topographic map data is constructed for the selection of sites for construction of schools and hospitals, and drilling sites of boreholes before the implementation of those construction projects.

In the area of people's life, the residential maps of Zenrin and Google Maps are widely used in many occasions in daily life in Japan. Google Maps and other similar applications are widely used largely because they are available on smartphones. In fact, these applications not only have a large number of users, but also are indispensable tools for users' daily lives. In this area, utilization of such applications is expanded by good public relations (advertising) activities, understanding needs in the everyday life of ordinary people.

8.1.2 Characteristics of the Recent Topographic Maps and Future of Topographic Maps

Transition from topographic maps on paper to digital topographic maps began in the 1990's. At present, all the maps found in everyday life are digital maps. All JICA's assistance has also been on topographic mapping in digital format since the latter half of the 1990's. This transition from paper to digital maps has created a large potential for utilization of topographic maps. In the era of paper

maps, creation and utilization of maps are mutually independent processes. Digitization of topographic maps has resulted in acceleration of the integration of creation and utilization of topographic map data, which is generally referred to as' provision of solution' with inclusion of solution in the area of positioning.
A wide variety of solutions utilizing topographic map data have already been on the market, including not only those for personal use such as automobile navigation systems and shop information search systems, but also those for the transport industry for the improvement of efficiency of physical distribution, locating airplanes and vessels, management of vehicles and facilities, etc.
Automatic sowing and fertilizer application systems with agricultural machinery equipped with GPS devices are widely used in the world. Some foreign companies offer services to track stolen vehicles with GPS devices. Remote-controlled operation of bulldozers equipped with GPS devices is widely used in civil works in Japan.

As above, extended use of positional information via topographic maps is continuously expected in a wide variety of areas including transport, robotics, agriculture, forestry and fisheries and disaster prevention. For example, use of GPS and positional information systems in forestry will enable collection of accurate forest information in the field and improve the efficiency of creating maps required for forest management. Use of radio-controlled helicopters equipped with GPS devices will enable quick and low-cost aerial photography of disaster-stricken areas.

Three-dimensional display of geospatial data created by combining digital topographic map data and elevation data and building data obtained from aerial photographs and satellite images is expected to become general in future. Excellent graphic representation of the 3D display is expected to extend the use geospatial data to a wide variety of areas including simulation of disasters such as landslides and floods and creation of 3D tourist information maps. In addition, full scale projects for creation and utilization of 3D geospatial information, such as trials of creating "highly-accurate 3D geospatial information" with mobile mapping systems (MMSs) using vehicles equipped with laser measuring apparatus have already been launched.

It is evident from the observations mentioned above that the area of utilization of geospatial information (topographic maps) with high-precision positional information will expand further and that such geospatial information will become part of social infrastructure both in developed and developing countries. Unfortunately, the general public is not much aware of the importance of such topographic map data. Since creation of topographic maps is expected to remain an important mission of a nation, creators of the digital topographic map data will have to meet the standards of accountability to the people fully. From this viewpoint, "activities to promote utilization of topographic map data" for the general public are an important and indispensable action.

8.1.3 Utilization and Promotion of Digital Topographic Map Data

In response to the importance of awareness creation activities mentioned above, the Study Team took the measures mentioned below on the utilization of and the creation of awareness to the digital topographic map data.

- Explanation on “A Story of Maps” and “Geospatial Information (Topographic Maps) in Future”

The Study Team held a meeting to explain “A Story of Maps,” “Introduction to the Project” and “Geospatial Information (Topographic Maps) in Future” to approx. ten Japanese working in Burkina Faso, including the secretary in charge of mapping at the Embassy of Japan in Burkina Faso and the staff members concerned with the Mapping Project of JICA Burkina Faso Office (including the representatives in charge of the project including the Chief Representative, experts (in agriculture and fisheries), JOCV coordinators and JOCV members) as a measure to create awareness to geospatial information and promote its utilization in the activities of the Japanese working in Burkina Faso. (See (3) Holding of Meeting about Maps on page 67)

The Study Team had the impression that the participants of the meeting had understood the importance and usefulness of the geospatial information in the meeting. Therefore, the team expects extension of the awareness creation and the utilization in Burkina Faso by the Japanese through Burkinabés involved in Japanese technical cooperation.

- Implementation of user meeting

The Study Team held a user meeting for relevant organizations and people in Burkina Faso that are utilizing the data of IGB (mainly analog 1/50,000 topographic maps) in their official duties and notified them of the usefulness of the project outputs (digital topographic map data).

In addition, the team studied the current states of data utilization and specifications of digital data of user organizations by conducting questionnaire surveys and interview surveys and used the results of the surveys in the development of a system to provide output data on the website.

- Holding of a lecture tour

The Study Team conducted a lecture tour for pupils in the upper grades (fifth and sixth grade pupils) of elementary schools to draw their interest to topographic maps.

The team considers that drawing attention of pupils and students to surveying and topographic maps at the place of education will be a significant factor contributing to construction of sustainable geospatial information.

- Establishment of Rules on Utilization of Topographic Map Data

It is important to promote effective use of the data by promoting secondary use of the data among the general public. It is also important to establish rules (legal restrictions) on the secondary use of distributed data for data management including prevention of data falsification, because digital data are particularly vulnerable to falsification. Therefore, the Study Team explained the importance of legal management of the secondary use to the senior staff members of IGB and recommended them to establish such rules urgently.

8.1.4 Recommendations on Activities to Promote Data Utilization

Based on the results of the project, the Study Team recommends the following practical awareness creation activities for the further promotion of data utilization:

1) To place importance on awareness creation activities in the plan for a national survey project which will be a guideline for the mapping organization
2) To prepare a short movie (on DVD) which explains roles of topographic maps in infrastructure development projects, characteristics of topographic maps, outline of the process of map creation and how to read topographic maps
3) To distribute copies of the created DVD to various public and educational institutions and collect information on the needs for the maps from them after the distribution
4) To promote development of an environment enabling users to obtain data easily and quickly (data provision through the website)
5) To improve people's awareness of topographic maps by offering the general public opportunities to see inside the mapping organization

8.2 Problems in and Recommendations for Technology Transfer

The purpose of the technology transfer was to equip the counterparts with capacity to create topographic maps unassisted in future. The Study Team set the target at the level of Japanese topographic maps for this technology transfer. Problems recognized by the Study Team during the technology transfer and recommendations for improvement in future are as follows:

8.2.1 Problems in Technology Transfer

《Technical capacity》

- Lack of basic technical capacity and knowledge

  The counterparts did not have sufficient knowledge of the work rules for the creation of 1/50,000 topographic maps. They seemed to consider creation of all different kinds of topographic maps as a single type of work and applied the specifications which should be applied to 1/5,000 and 1/10,000 topographic maps to 1/50,000 topographic maps. Lessons on plotting and compilation work had been provided to them before they had grasped basic knowledge required to understand the lessons. They seemed to have mistakenly believed that they had understood plotting and compilation work in its entirety by just mastering operation of software. The Study Team assumed that the counterparts had certain levels of knowledge and technical experience in GIS and website creation when they prepared the original plan for the technology transfer in this study. However, in reality, the team had to begin the technology transfer from the introductory level.

《Organizational structure and system》

- <u>The proportion of engineers who continue to work at the NGOs is low</u>
  There have been cases where highly educated young technicians have found new jobs elsewhere after having participated in OJT for the technology transfer and, thus, the efforts made to transfer technology to them have been wasted. Motivation to take up a new job for those technicians is always simple, expectation for higher salaries in a short period of time.

- <u>Information is not shared within the organizations</u>
  It seems that technicians who have had training in foreign countries do not share the technologies that they have learned in the training with other technicians in IGB. This conduct is against the principle of information sharing and there is a risk that such conduct may degrade the technical capacity of IGB.
  - ➢ The following are the reasons for the lack of information sharing:
    - Staff members of IGB are not so interested in sharing information which could lead to improvement of technical capacity with colleges and subordinates in the work place.
    - Since knowledge of a person is considered as a personal asset, those who have participated in Training in Japan do not extend the technical knowledge they have acquired in Japan to their colleagues or the colleagues do not ask for sharing of the knowledge.
    - The senior officials of IGB are not well aware of the importance of the information sharing.
  - ➢ The following are the measures against the lack of the information sharing:
    - Those who have participated in Training in Japan are made sure to hold reporting meetings after returning home.
      If a Japanese expert is in an NMO, he could make sure that such a meeting is held. However, it will be difficult to make sure that such a meeting is held in NMOs where there is no Japanese expert.
    - The importance of the technology sharing shall be emphasized in Training in Japan.
      Those who have participated in Training in Japan are made sure to present action plans after returning home. They require monitoring and support for such an activity.

- <u>There is no mechanism to transfer and improve technical capacity</u>
  The Study Team assumes that presentation of practical benefits of newly-acquired technology through establishment and operation of a system to present, review and evaluate the new technologies and their outputs leads to technology succession. Therefore, it is necessary to swiftly establish such a system in IGB.

《Work ethics》

- Necessity of awareness to the improvement of working environment is low

  In developed and newly developed countries, the 4S (*seiri, seiton, seisou and seiketsu,* the Japanese words for orderliness, tidiness, cleaning and cleanliness, respectively) activities are practiced in workplaces for organizational reform and improvement of productivity. Some countries and organizations further advanced the activities to 5S (adding *shitsuke* (discipline) to the previous four) activities.

  Meanwhile, the IGB technicians do not seem able to maintain orderliness and tidiness of their workplaces very much. For example, a Study Team member found a tripod for ground survey just lay on the floor of the room where maps were to be created with precision equipment. Team members often found the counterparts unable to locate their observation field books when they were required for the GNSS analysis calculation. Even after a Study Team member had taught the counterparts a basic filing method (filing data in a chronological order) by practicing it, they were unable to implement it.

- Planning and punctuality

  While working together, the Study Team found that counterpart engineers tend to be negligent of time, promises and plans. Work plans prepared by them tend to be unrealistic and work implemented with such plans often produces outputs quite different from those assumed in the plans. Therefore, they seem to waste time and money on reconciling this difference. On the basis of this observation, the Study Team considers that "observance of rules" is a very important precondition for the development of IGB. Capacity of the counterparts in preparation of plans seems to be necessary.

《Project implementation and management》

- Replacement of trainees occurs frequently

  Illness, childbirth and job changes were among the reasons cited for the change of trainees. Frequent change of trainees in the technology transfer delayed the progress of the work. It is important to take all possible measures to implement technology transfer with the fewest possible changes of trainees in order to maintain their motivation to participate in the topographic map data creation and to prevent loss of transferred technologies.

8.2.2 Recommendations on Technology Transfer

《Technical capacity》

- Implementation of a technical cooperation project

  The lack of basic technical capacity and knowledge of the staff of IGB was revealed in this study. Therefore, implementation of a technical cooperation project focused on the technology transfer similar to the one implemented in this study will be required for them to create and maintain topographic maps independently. The implementation of such a project will be important for a wider area because of its contribution to the strengthening of organizational capacity of the national mapping organizations (NMOs) in West Africa where many cooperation projects in topographic mapping have been implemented in recent years.

It has been mentioned in this report that Technical Seminar for Wide-Area Collaboration was held in Burkina Faso for the purpose of establishing collaboration among West African nations led by IGB for continuous and sustainable creation of geospatial information by IGB and in West Africa where Burkina Faso is located. This seminar was held in Burkina Faso because IGB was the leading institution in the area with regard to technologies to create topographic maps. Representatives of the member countries of UEMOA (West African Economic and Monetary Union) and NMO (National Mapping Organization) of Guinea were invited to attend the seminar held in Ouagadougou. They were expected to share problems in their organizations and measures taken against them in the seminar. This was because the UEMOA member countries which face many problems are believed to easily find solutions to problems by developing countermeasures against those problems jointly, instead of tackling them independently.

Therefore, provision of technical cooperation to IGB is expected to contribute to the improvement of technical and organizational capacity of NMO's in West Africa, among which IGB is regarded as a leading organization. In addition, further significance may be added to the assistance provided so far in West Africa by JICA, with implementation of technical cooperation with such a wide-area perspective.

The Study Team recommends technology transfer as the form of a technical cooperation project in future. Unfortunately, the team has concluded that the technical capacity of IGB has not reached the level at which it can carry out topographic mapping from the planning stage independently, as mentioned elsewhere in this report. Therefore, the following are recommended as contents of the project of technology transfer in a wide sense, which is intended for complete mastery of the technology for topographic map data creation by counterparts:

- As one of the programs in the project, a long-term expert shall be dispatched (as a supervisory advisor) to Burkina Faso intermittently for a period of two years.
- Engineers for the technology transfer shall be dispatched to Burkina Faso (as short-term experts) intermittently with each dispatched for a period of two months in a period of two years.
- The counterpart engineers of IGB shall be trained so that they shall have the technical capacity to serve as instructors of Training in Third Country for engineers of the NMOs of the other UEMOA member countries at the completion of the project.

The project shall include content related to the UEMOA seminars (inclusion of a seminar or workshop intended as a follow-up to the two seminars so far conducted in the technical cooperation project) for identification of a new project (which may be a pilot project).

《Organizational structure and system》

- Improvement in proportion of technicians who continue to work at IGB

i) Improvement of motivation

IGB shall prepare programs which can improve the motivation of its technicians. For example, IGB has to make its technicians recognize again that the data in the national base maps created by IGB can be a basis of infrastructure development in Burkina Faso. The Study Team has observed that IGB has not recognized this fact.

ii) Effective reassignment of personnel

Many technicians have worked at the same departments for a long period of time. IGB should take measures to improve motivation of technicians such as opportunity to acquire other technical skills by exchanging technicians, for example, between the Survey Division and Geospatial Information Division.

iii) Review of remunerations

Although the Study Team has no right to comment on working conditions of public service personnel in Burkina Faso, the team considers it necessary to increase salaries of IGB employees even by small amounts under certain circumstances.

iv) Participation in training of choice

Opportunities for technicians to participate in technical training in developed countries such as Nigeria, the Netherlands, France and Japan, shall be increased.

- Information sharing shall be facilitated for transfer and improvement of technical capacity

i) Equal opportunities to participate in technical training

IGB employees shall have equal opportunities to participate in technical training with regard to what has been mentioned above. (No employee shall have more training opportunities than other employees.)

ii) Frequent in-house reporting meetings with presentations by those who have completed training courses

Since new technologies acquired by certain technicians of IGB should be considered as properties of the entire IGB, it is essential to have such meetings frequently.

iii) Establishment of a permanent project implementation structure

IGB has to change the attitude from waiting for assistance from donor countries and organizations to attempting to implement projects with self-help effort. For this attitude change, IGB must prepare plans for projects to be implemented immediately and in future.

iv) Establishment of a closely-connected information network with countries in the area

IGB has to implement projects while sharing the information on problems and measures taken against them identified and discussed in the Technical Seminar for Wide-Area Collaboration with countries in the area.

《Work ethics》

- Awareness to comfortable working environment shall be enhanced
  Training courses conducted in Japan should include an opportunity for participants to learn 4S or similar activities. Those who have participated in such courses are expected to be able to behave somewhat differently from the way they used to on all matters, though it may take a long period for them to do so. This behavioral change is expected to contribute significantly to improvement of the quality of products and productivity. However, the Study Team considers that long-term, five-year or 10-year-long, training is required for such improvement (change in attitudes).

- Observance of rules
  The Study Team recognizes a need to introduce a time-card system and recommends it as a means to enhance planning capacities and awareness of punctuality. The team expects IGB to self-improve discipline by nurturing the culture of punctuality and efficient time management.

《Project implementation and management》

- Creation of good environment at places of work
  An advantage of the French scheme is that a wide variety of material assistance enhances motivation of participants of the project. However, it seems that this advantage does not necessarily help Burkina Faso, as an independent country, achieve its goal of self-reliant topographic map creation (by IGB). Meanwhile, the team considers that the Japanese scheme should allow inclusion of a certain level of assistance to improve work environment, such as provision of desks and chairs appropriate for operation of computers to be provided, in technical cooperation in order to motivate counterpart technicians.

- Fixed trainees
  The Study Team recommends that the number of trainees should be decided in proportion to the number of copies of software and that of pieces of hardware. The technology transfer on some subjects had only one trainee in this project. It might be possible for trainees who benefited from such content-rich technology transfer implemented in sufficient time to teach the technologies learned in the technology transfer to other trainees.

- Firm decision-making
  The Study Team recommends that managerial personnel should be trained to assume

responsibilities attached to their positions. They should learn that progress of work will be delayed significantly if they change orders frequently. IGB should train them to fulfill their responsibilities.

8.2.3 Remarks on Technology Transfer

Quality of outputs of the technology transfer was good while experts in the Study Team are in Burkina Faso, for obvious reason. However, the Study Team members have learned from their experience that the counterpart technicians will not be able to do anything against unexpected technical problems which occur while they are using the transferred technologies by themselves after the scheduled technology transfer program has been completed and the Japanese experts have gone back to Japan. The time allocated to the technology transfer in this project was too short to expect the counterparts to master the transferred technologies. People usually master technologies by practicing them repeatedly for a long period of time. They are likely to encounter various obstacles and problems during the course of mastering technologies. The Study Team consider that "transfer of technologies should be considered completed" only after the counterparts have encountered all those obstacles and problems and solved them by themselves.

At present, the Study Team considers it impossible to raise the technical capacity of the counterparts to the target level in such short technology transfer. The technology transfer in this project should be considered as the first step in the process of raising the level of technology transfer to the target level. Therefore, what is important in this stage is to search appropriate ways to transfer technologies and let the counterparts master the technologies transferred so far.

To ensure that the counterparts to attain the target level, the Study Team considers two aspects of the technology transfer, namely, in a narrow sense and in a wide sense.

The team considers that technology transfer in the narrow sense implies technology transfer focused on technologies used in specific stages of the work, *e.g.* GNSS observation, analysis of GNSS observation data, compilation of the analysis results, field identification, plotting with satellite images, map compilation and printing.

Technology transfer in the wide sense implies not only transfer of practical technologies, but also technology transfer in a much wider perspective including technology transfer on maintenance of equipment, necessity for work planning and maintenance of planning and work environments and what can be referred to as creation of a foundation enabling technology transfer which includes changes in attitudes and long-held traditional behaviors based on local environments.

It is thought that it takes at least two years to make counterparts master technologies to their full potential even in the case of the technology transfer in the narrow sense. It is considered that dispatch of experts for a long period of time, at least 10 years and probably longer, will be required for the technology transfer in the wide sense. Of course, the Study Team has experience in implementing technology transfer in other countries where it did not take such a long period of time to complete it. Nonetheless, the Study Team considers long-term continuous technical cooperation necessary for African countries, regards topographic maps as infrastructure for infrastructure development and believes that they are indispensable in national development as basic information/tools.

With recognition of the need for measures to develop technology transfer into the one in the wide sense at an opportune moment in the technology transfer with improvement of work environment and dissemination of knowledge in lectures, the Study Team earnestly requests continuation of the technology transfer in future.