

- (6) Classification between electrified and non-electrified sections of railroad shall be done referring to the collected source materials.

4-10 Supplementary Digital Map Symbolization

After field completion and supplementary digital plotting, supplementary digital map symbolization was performed in Japan. This is the process for correcting, adding and deleting topographic map features, map symbols, and all sorts of letterings such as geographic names and abbreviations on the draft symbolized maps. The works were performed according to the final DXF data obtained through the abovementioned supplementary digital plotting and to the results of field completion indicated on the final materials (map).

Both sides also agreed to the following solutions.

- (1) Symbol size, and letter font and size shall be corrected according to the specifications of the former Yugoslavia. But if the difference between the specifications and those in the symbolized maps prepared by the Team is not large, operators are not required to correct the size and font.
- (2) A former village where no houses are found should be lettered with the former name referring to the existing map.
- (3) A small railroad station shall be lettered with an abbreviation Z.st., while a large station shall be lettered with its name. For example, Z.st. Mostar.
- (4) National boundaries provided by the State Commission of Border BiH shall be presented. Map presenting shall cover as far as about two centimeters beyond the national boundary on the map. In case of a boundary section that is defined by a wide river (more than 15 meters in width ---- polygon river), map presentation shall cover the water surface as far as the opposite shoreline.
- (5) The BiH side shall provide the Team with sheet names and adjoining sheet names of the new maps unofficially in early December 2004. Official provision shall be made in January 2005.

Specifications of the map symbols and letters, which were added during the field completion, are shown in Figure 4-4.

A map sheet is named, in general, by selecting one geographical name from those found in the sheet, for example, city's name, town's name, and mountain's name. The sheets of the existing 1:25,000 topographic maps of the former Yugoslavia are named in this manner.

In this project, every map sheet needs its own sheet name on the top of the sheet, four (4) adjoining sheet names to be put on the four neat lines, and another four (4) adjoining sheet names to fill the index map on the bottom of the sheet.

The Team proposed that, if the name of an existing topographic map sheet is not in existence or

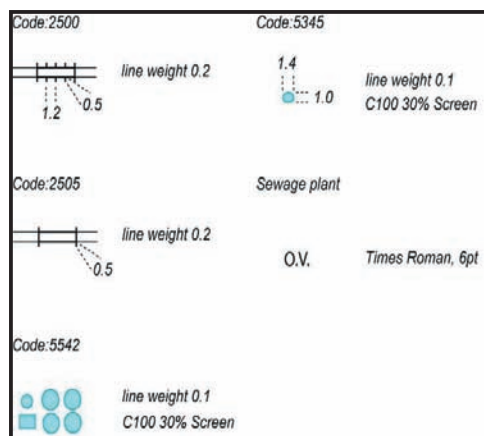


Figure 4 - 4 Specifications of the Added Map Symbols and Letters

belongs to the neighboring countries today, it should be renamed, and requested the BiH side to provide the renamed sheet names and adjoining sheet names. In response, however, the BiH side made a rule that the previous names should be kept even though the names are not in existence or they belong to neighboring countries, and a name of a neighboring country should be followed by an abbreviation of the country, for example, (SCG). According to the rule, the Team lettered the sheet name and the adjoining sheet names on each of the map sheet.

4-11 Preparation for GIS Data Creation from Existing Topographic Maps

4-11-1 Scanning of the existing maps

High precision scanning was conducted using a large flat bed scanner at 400 dpi resolution and RGB mode, for 426 sheets of the existing 1:25,000-scale topographic maps and 399 sheets of the existing contour version. These scanned images were prepared as the background of the map digitizing to create GIS data. Especially, it was thought that the scanned contour images were very useful to create vector data using Raster to Vector software. Moreover, the scanned topographic images were converted from RGB mode to CMYK mode for the future printing work, that is to say the preparation of the plate film for printing.

4-11-2 Geo-referencing

The scanned topographic map images were geo-referenced for GIS data digitizing. The used projection parameters are shown in 4-1. The used specifications of this work were below:

- 1) To select control points from the four corners of the existing topographic maps.
- 2) Total RMS error of each map image must be usually less than 1 pixel. But according to our advance experiment, it is a bit difficult to result the RMS error within 1 pixel on account of the bad condition of the existing topographic map and/or the scanned images. So RMS error within 2 pixels is accepted.

3) Geo-referenced scanned images as the final products are

Geo-tiff format or Tiff + World file

400 dpi (The resolution of the scanned images is 400 dpi. So, do not resample.)

None compression

The scanned contour images also were geo-referenced for digitizing. The used specifications were almost the same as the specifications for the topographic map images, but the following processing was needed, as the contour versions do not have map corner tics.

Step-1) Make the geo-referenced scanned images of the existing topographic maps.

Step-2) Make the geo-referenced scanned images of the contour version extracting control points from the above geo-referenced topographic map images. In this processing, do not use the map corners as control points, because usually differences of those corner points between the images of the topographic maps and the contour versions can not be ignored. Use control points, the locations of which can be easily determined by the figures of the contour Lines. Select four or more control points with well-balanced distribution. See Figure 4-5.



Figure 4 - 5 Geo-referenced Topographic Map Images to Scanned Images of Contour Version

4-12 GIS Data Creation

4-12-1 General

The GIS data were created as the coverage format of ArcInfo software for the following three areas, namely, area A: the new mapping areas for the Principal 21 Cities, area B: the new mapping areas added for the JICA Eco-tourism Study, and area C: the rest of territory except the areas covered the existing 1:25,000-scale topographic map sheets that include the above areas A.

What the users need to know is the used projection parameters and the extracted features for the GIS data. Although the country has the three zones of Transverse Mercator, it is better for GIS data to use only one zone. Therefore, TM zone 6 was selected. An ellipsoid and a false easting of the GIS data are Bessel and 500,000 meters, respectively for reasonable data creation and simple data use, of course, these parameters can be changed semi-automatically and easily by ArcGIS software. About the extracted features, 95 codes were defined considering application of the GIS data. Details are explained later. The main processes are the following:

1) To define the coverage schemas and layer structure.

- 2) To digitize manually the contour lines and the other topographic features for the area C from the geo-referenced scanned topographic map images. For the contour lines, the geo-referenced contour version images also were used to extract them automatically utilizing Raster to Vector conversion software or auto-tracing function.
- 3) To create the coverage data putting topology information.

Note: The process 2) in the areas A and B is different from the above process. Digitizing process is not needed because the extracted CAD data by the digital plotting can be used.

4-12-2 Contour Lines

Specifications of ArcInfo coverages of the contour lines are below:

- 1) Contour coverages must be created by ArcInfo v.7 or the newer version. Pre-Version 7 coverage data are not accepted.
- 2) Precision of the contour coverages must be double precision.
- 3) Coverage name must be CONTOUR and the coverage must be created per map sheet. Workspace name must come from the existing 1:25,000-scale topographic map sheet number. For example, the contour coverage of the topographic map sheet 051-3-1 must exist in the workspace 051_3_1. Do not use hyphen (-) for the work-space name.
- 4) The four tics of each contour coverage must be taken on the four corners of a corresponding existing topographic map as Figure 4-6.

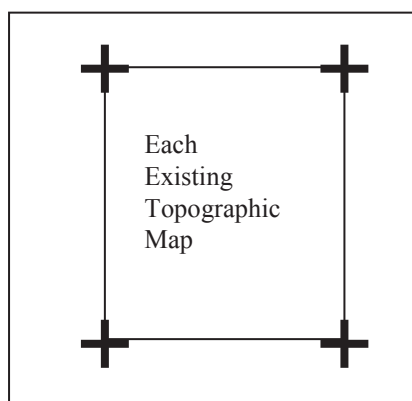


Figure 4 - 6 The Four Tic Placement on Each Existing Topographic Maps







- 5) The contour coverage must have the following projection parameters. Use PROJECTDEFINE command of ArcInfo.

Projection: TM (Gauss-Kruger)
 Unit = meter
 Scale factor = 0.9999
 Central meridian = 18:00:00 E
 Latitude of origin = 00:00:00 N
 False easting = 500000
 False northing = 0

Ellipsoid: Bessel




6) INFO file schema should be Table 4-24.

Table 4 - 24 INFO File Schema

Map symbol	Code	Description
 50	7110	Index contour Lines 50 m interval
	7120	Intermediate contour Lines 10 m interval
	7130	Supplementary contour Lines 5 m interval
	7140	Auxiliary contour Lines 2.5 m interval
	7150	ShoreLines (Input 0 m) Except rivers and lakes
	7160	Isobaths (depth contour Lines)

7) Code and D_flag description

Table 4 - 25 D_flag Description

Map symbol	D_flag	Description
	1	Contour Lines with small hill symbol
	0	Normal contour Lines
	-1	Contour Lines with depression symbol

Note: Input 0 into all D_flags. D_Flag will be used in the future.

- 1) Do not digitize the contour lines in the outside of the country border. You can use the provided country border coverage but it is better to digitize contour Lines up to the distance of 6 cm (actual distance: 1,500 m) outside of the border on the existing 1:25,000-scale topographic maps, because the country border coverage is not accurate enough to define the country border of the 1:25,000-scale topographic maps.
- 2) To digitize the contour Lines smoothly displaying at the scale of about 1:2,500 on a monitor of PC. This means resolution of contour lines.
- 3) To ignore the smallest depression symbol (See below). Do not digitize this type of symbol.



Figure 4 - 7 The Smallest Depression Symbol

- 4) To ignore small closed contour Lines, each diameter of which is less than 1 mm on the existing 1:25,000-scale topographic maps.
- 5) To digitize by continuous Lines in case of the following conditions:

- 6) Contour Lines described by broken Line
- 7) Spaces for the elevation values of contour Lines
- 8) Do not connect contour Lines if main roads, wide rivers and so forth on the existing 1:25,000-scale topographic maps separate the contour Lines.
- 9) Do not digitize any neat Lines.
- 10) To match between contour Line edges of the neighboring map sheets. This is a process of the so-called edge matching.

(2) About the Map Features Except the Contour Lines

Specifications of ArcInfo coverages of the map features except the contour Lines are almost the same as one of the contour Lines. Proper specifications of the created ArcInfo coverages are described below:

ROAD:

- 1) To digitize only center Lines.
- 2) The code 2195 (street) is used for the new mapping areas only.

TRNS_LIN:

- 3) To create tunnels or galleries data, copy road (or rail) Line segments for them from ROAD (or RAIL) coverage. The tunnels and galleries coverage should be just on ROAD (or RAIL) coverage.

TRNS_POL:

- 4) For railroad stations, digitize the outlines of the station sites. Buildings inside of the station sites should be digitized as BLDG_PNT or BLDG_POL coverage.
- 5) Airport areas are usually surrounded with fences. So, digitize the fences as airport polygons. Do not digitize airport symbols.

BLDG_POL:

- 1) Maybe polygons of church, mosque, synagogue, etc. do not exist on the existing maps. These are prepared for the new mapping areas.
- 2) If there are space (blank area/s) inside of building polygons, digitize the outlines of the space and enter code 0 (zero) into the space polygon/s.

OBJ_LIN:

- 1) To copy road (or rail) Line segments for bridge data (except map symbol No. 169) from ROAD (or RAIL) coverage. This type of the bridge data should be just on ROAD (or RAIL) coverage. Map symbol No. 169 is for bridges, on which there is water flow. So, to create this type of

bridge data, copy river Line segments for them from HYDR_LIN coverage. This type of bridge data should be just on HYDR_LIN coverage.

HYDR_LIN:

- 1) In case there is a road on a dam, copy a road Line segment on the dam from ROAD coverage and create the dam Line. This type of dam data should be just on HYDR_LIN coverage.

HYDR_POL:

- 1) For wide rivers, digitize shorelines and close the polygons at the mouth of each river. Also digitize the outlines of sand banks in the wide rivers as polygons, and enter code 0 (zero) into these polygons.
- 2) For the peat bogs, do not digitize each symbol of the peat bogs. Digitize them as an aggregate.
- 3) For sea polygons, use the shorelines of CONTOUR (code 7150), the Line segments of mouths of wide rivers and the neat Lines of the map sheets.

CONTROL:

- 1) In case triangulation points are at churches, mosques, synagogues, weather stations or radio wave towers, at first digitize the churches and so on, and copy them to CONTROL coverage. This type of the triangulation points should be just on the points of the churches and so on.

4-12-3 GIS Data Creation for the newly mapped areas

The final GIS data of the new mapping areas were created from the DXF data corrected according to the results of the field completion. The processes of the data creation are the following:

- (1) Cleaning of DXF data
- (2) Conversion DXF data into Coverages by ArcGIS
- (3) Check and correction of the Coverages

4-12 DTM Generation

The data of DTM (Digital Terrain Model) with a grid distance of 25 meters were generated from the contour line dataset of GIS by ArcInfo Topogrid command, that is to say, as ArcInfo Grid format. In this project there are two types of the contour line dataset. One type is the dataset created digitizing the 1:25,000-scale existing topographic maps and the other is the dataset created from the new plotting data. The DTMs were generated using both types of the contour line dataset, respectively. The image of the DTMs is shown in Figure 4-8.

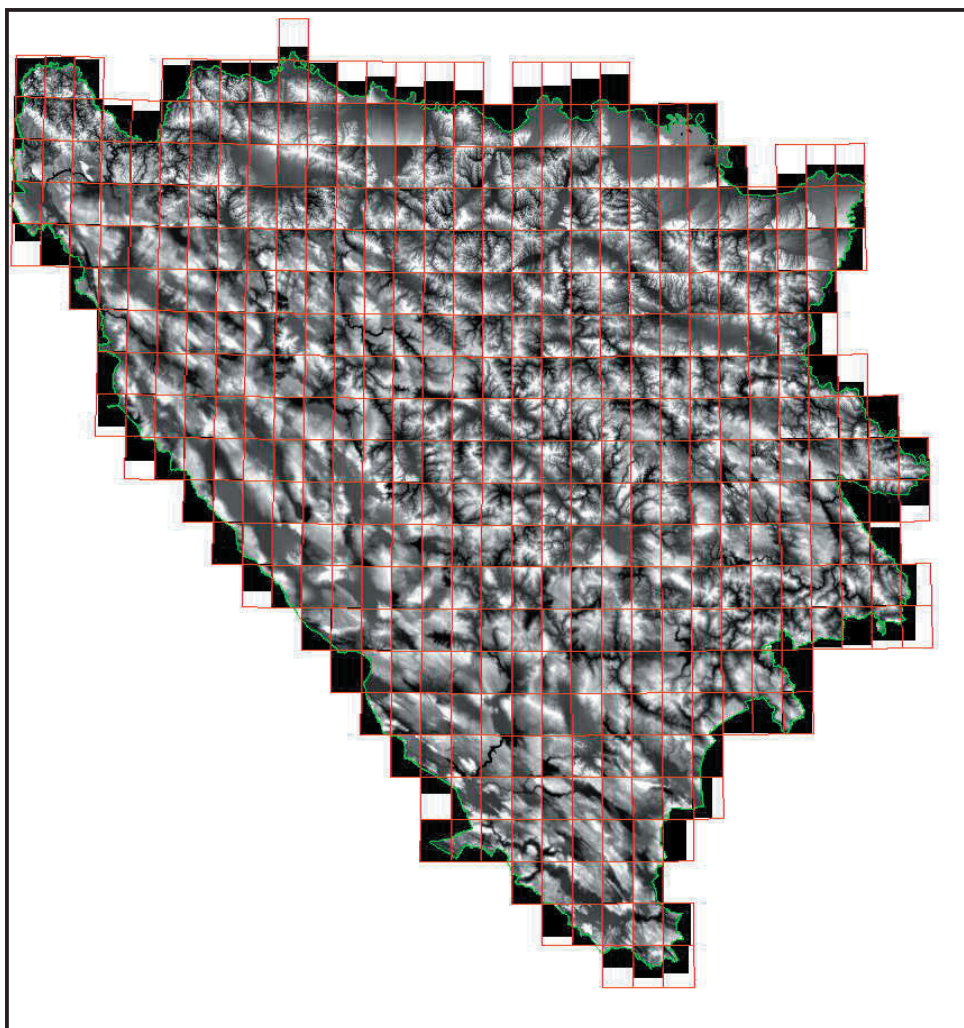


Figure 4 - 8 DTM

4-14 Reproduction

A total of 57 sheets of the new 1:25,000 scale topographic map were offset-printed at the end of the project. All the symbolized data of the new mapping (68 map sheets) were copied into media in order to deliver to the BiH Government. These processes are described below.

(1) Plate Film Making

In the process of printing, trapping needs to be performed in order to prevent color gap by registration mistake. Overprinting was chosen as the method of trapping in this project. Also, for spot colors, CMYK decomposition or gray scale substitution needs to be checked.

Symbolized data (AI data) were converted to Encapsulated Post Script (EPS) format for the 57 map sheets to be printed. From these converted data, plate films were prepared at the resolution of 3,000 dpi with high precision plotter. According to the four colors (green, blue, brown and black), four plate films were prepared for each map sheet. The plate films totaled 228.

(2) Map Printing

With the plate films, 100 copies for each map sheet were printed using offset-printer. Therefore, the printed sheets of paper totaled 5,700.

The paper is 9 g/m² in weight, low in elasticity and resistant to folding, stretching, breaking and tearing. The printed colors are similar to those of the existing maps and the size of map sheet (sheet format) is 68.5cm by 48.5cm.

5 RECOMMENDATIONS

The JICA Study Team presents the BiH Government the following recommendations on the state topographic mapping.

5-1 Administration

5-1-1 Early Revision of Old Maps

The BiH Government should revise the existing 1:25,000 scale topographic maps published in the 1970s, using modern technologies including those transferred through the Study project before the photos are outdated.

Through this project, 68 sheets were revised. Based on the revised data, new GIS data were prepared and 57 sheets among them were printed as analogue paper map with offset printer. The rest (11 sheets), which are partially compiled, have not been printed. To complete these sheets, the mapping agency needs to fill up the unfinished parts with the new aerial photos taken in 2003 with the method used in this project.

The rest of the existing map sheets (358 sheets without revision) were digitized to prepare GIS data. In order to complete a thorough coverage of new data for these sheets, the agency should revise them with the specifications used in this project by 2008 or sooner, before the photos will have become outdated. Based on the revision, the Government should replace the old GIS data with the new ones.

Modern technologies, reducing the laborious jobs of conventional methods, highly raise the efficiency in mapping works. In that respect, it is judged that the BiH staffs have attained to a satisfactory level in applying these modern technologies to map revision and GIS data updating.

Efficient performance is needed for urgent map revision. Therefore, the Team recommends the mapping agency to consider the following technical improvement.

(1) Improvement in control point survey method

In the beginning of the project, the Team proposed that GPS observation and pricking should be performed as the main part of control point survey. But in response to the BiH's strong request, the Team used the conventional method that is to set aerial signals at the existing control points.

But the photos that were left unused for the topographic mapping lack aerial signals. Therefore, when these photos are used for mapping from now, pricking is an indispensable work for preparing ground control points.

The Team recommends that the surveyors should perform GPS observation and prick at new points that are accessible and easily recognizable on the photos, for example, an intersection of roads and a corner of a house, etc. This method can reduce time and cost, and avoid mine risk as well. Moreover, there is an advantage in the aerial photos taken in 2003, because the principal point of each photo is positioned by differential GPS. The records are helpful for reducing the number of

new control points to prick.

(2) Usage of ortho-photos for provisional mapping

The Team suggests that, if provisional new topographic data are required urgently for some specific areas, ortho-photos should be utilized as substitute.

The BiH staffs have learned the processing of ortho-photo making with DTM. So they can prepare an ortho-photo from the aerial photos taken in 2003. Overlaying it on the existing GIS data, they can find basic features like new roads, buildings, land use and some other infrastructures. And they can replace the existing data with new ones.

(3) Prioritization of GIS Data Preparation

GIS data preparation shall be prioritized when updating of the rest of the country cannot be conducted in a timely fashion. The Team suggests that the agency should make decision to complete GIS data first and leave analogue maps until later.

5-1-2 Standardization of Digital Topographic Data

Digital topographic data to be published and maintained at the state level should be kept standardized.

The items (layers of topographic map features and DTM) of the digital and analogue information that appeared through this project were standardized by the BiH side through discussions with the Team so that the items are uniform in all sheets of the 1:25,000 scale topographic maps of BiH.

When new items become necessary in the future, partial adoption of new items for specific areas should be avoided. The data coverage under the new standard should be completed as soon as possible for the whole country without blank areas.

5-1-3 Periodical Data Updating

Topographic information should be updated periodically with appropriate time intervals, as the size and rate of land use changes are being taken into account.

To provide topographic information as current as possible, the Government should update the data at a reasonable interval. Desirable time intervals are, for example, every year for the principal cities, every three years for urban areas and flat areas, and every five to ten years for hilly or mountainous areas. Updating data on specific features need to be conducted at locations where some new infrastructures such as motorways, railways, harbors, canals and reservoirs are under construction and/or opened.

5-1-4 Archives

All the old topographic data and maps should be kept in archives and they should be available upon requests.

Often old maps are necessary to analyze comparative land use changes over time. Every time map

revision or data updating is done, the former data should be sent to archives and maintained. The archives should be organized to enable efficient retrieval for users.

5-1-5 Utilization of Scanned Maps

The scanned maps shall be utilized as additional supply to the existing stock.

In the process of preparing GIS data of the existing 1:25,000 scale topographic maps in this project, all the map sheets covering the country (426 sheets) were scanned. These scanned data are not itemized as the final products in the Scope of Work of the project, but the Team delivered these data to BiH. The high resolution, 400 dpi, makes it possible for the data to be utilized as maps in paper media when the data are plotted from an ink-jet printer. If the existing maps run out of stock before revision, these data would be able to supply the sheets which satisfy users.

5-1-6 Reorganizing Mapping Agencies

The BiH Government should reorganize a specified agency responsible for state topographic mapping.

A topographic map and its digital data at the scale of around 1:25,000 provide the most basic geographic information of the state territory. Therefore, in any country, topographic mapping should be one of the important state undertakings as well as cadastre in the sector of surveying and mapping. In BiH, for the same reason, topographic mapping should be exclusively undertaken by a governmental agency and the results should be published under the supervision of the Ministry of Civil Affairs BiH that is responsible for geodetic affairs in the country.

At present, there are two public agencies having technical potential to perform topographic mapping and updating, because they have been surveying and mapping in the field of cadastre since the end of the war. One is JP Geodetski Zavod in Sarajevo and the other is the Republic Administration for Geodetic and Real Property Affairs, Banja Luka.

But it is undoubtedly inefficient that the agencies would individually try to improve the performance and carry out these mapping jobs. Therefore, the Team recommends the Government to reorganize the two agencies united into one body that performs revision of the existing 1:25,000 scale topographic maps for the whole country. The Study Team supports the recent movement to discuss reorganization of the existing agencies.

For the moment until the unification, the staffs of the two agencies should collaborate in completing one or a few map sheets from the viewpoint of quick improvement of performance. After then, the agencies should carry out the jobs sharing the map sheets according to each entity's territory under the coordination of the Coordinating Committee chaired by the Ministry of Civil Affairs, in the same manner taken for this Study project.

For this reason, the Team recommends that, after the Study project ends, the BiH Government should hold the existing Coordinating Committee for planning and managing the topographic mapping from a state viewpoint until the agencies are united. The Ministry of Civil Affairs and Communications and the JICA Preparatory Study Team supported this perspective in the Minutes of

Meetings of October 23, 2002.

5-2 Finance and Marketing

5-2-1 Higher Accessibility of Existing and New Maps to the Public

All the topographic information including the old maps inherited from the former Yugoslavia and new maps prepared by the BiH Government should be open to the public. In order to realize the open publicity, the Government should renew the former Yugoslavian law as soon as possible.

At present, the authorities control map distribution, requiring one who wants the maps to make an application for permission, because the former Yugoslavian law still remains in force, where the topographic information has been confidential because it was compiled for military use.

Topographic information published or maintained by the Government must be the public property. Everyone should be allowed to use it without procedure for permission. For improving the present status of publicity with not only old maps but also new maps, it is necessary to renew the existing law. The Team supports the recent movement in this country to discuss cancellation of the procedures prescribed in the existing law.

At present, users make application for topographic maps and other survey and real estate data to the Federal Administration for Geodetic and Real Property Affairs in Sarajevo or Republic Administration for Geodetic and Real Property Affairs in Banja Luka and its regional branches. It is suggestible that the authorities should increase the number of places to handle these materials for the customers' convenience. In the future, topographic maps among others should be retailed at private shops in highly populated areas.

5-2-2 Publicity and Promotion on Digital Maps

The Government should make every effort to publicize the existence of topographic maps in analogue form and digital form to general public.

The topographic information should be utilized by anyone who wants to use, because the information especially in digital form provides usefulness that only users can find and develop.

In particular, on the occasion of releasing new data or maps, the authority should announce the existence of the materials to general public through official gazettes, media of information and so on.

It is also suggestible that the authority should show some good examples of digital data usage through the media from a viewpoint of promoting data usage.

Following the model of the existing topographic maps of the former Yugoslavia (old maps), the new maps printed in this project do not include the legend of map symbols in the marginal information mainly due to space limitation. Separate printed materials of legend for user's convenience accompany the former Yugoslavian maps. For the same reason, the agency concerned with the new

maps should be required to prepare a similar printed material.

5-2-3 Standardization of Map Prices

Prices of the topographic maps published and maintained by the Government should be standardized.

Amount of payment for usage of survey and real estate data including topographic maps is prescribed in the law of each entity. Comparing the price lists of both entities, the Team finds that the price of topographic maps differs largely from each other. It is unreasonable that the price of the same maps published by the Government is different by place, because the maps are standardized materials for the whole country. Therefore, the Team recommends the Government to standardize the price. In the future, however, when retailers sell these maps, they should be allowed to determine their own price.

5-2-4 Product Development

The agency shall develop mapping products to promote uses of digital topographic maps and to generate revenue from sales of new products.

As shown in the very first figure the counterparts produced, the agency is already capable of developing thematic maps of their own needs. With the new digital data it is possible to develop other map products such as street maps and tourism information maps.

5-3 Technical Training

The Government should build up a standard program of technical training in order to secure a necessary number of technical staffs for topographic mapping and data updating.

It is essential for the Government to build up a standard program for systematic training. The standard program should be formed for each process from control point survey to GIS data creation, where each process has beginner's course and advanced course aiming for trainee's voluntary development. It should be also proposed that a technical staff would learn not only one process but also the processes before and after it.

As for the teaching staffs, it is suggestible that a trainee who has mastered a process should be appointed to instruct the process to other staffs.

It is suggestible that the agencies should bring up management staffs that can check and control the total job with knowledge of the thorough process flow from control point surveying to GIS data compilation and map symbolization.

5-4 Application of the Study Outputs

The Government should use the study results for national and regional planning and development especially for demining, locating houses for refugees and internally displaced persons, and for private led economic development. The eco-tourism related application was a case of utilizing the Study result; the scheme should be used to other regions in BiH.

The digital topographic maps and GIS data produced in the Study have a high potential of application, since the scale 1:25,000 is the fundamental scale for national and regional planning and development. General applications of the Study outputs are summarized in the following table.

Table 5 - 1 General Application

No	Product	Use
1	Aerial Photographs	Information for topographic mapping, agriculture, forestry, archeology, water resource management, geology, soil, hazard mapping and other spatially oriented disciplines
2	Scanned Maps	Reserve stock for the existing topographic maps
3	GIS Data	General engineering for basic plans
4	Ortho-photo	Substitute for new topographic maps
5	Symbolized Maps	General purpose
6	DTM	Landform classification map; landform visualization ; telecommunication design; road planning

More specific application is targeted to urgent policy issues: demining; locating housing for refugees and internally displaced persons; and promoting private led economic growth. Also, since tourism is one of income generating industries in BiH, application to tourism shall not be neglected. The case study on eco-tourism is briefly introduced.

BHMAC is the state level agency for demining activities. The 1:25,000 scale is too small to record demining activities; the scale can only be used for planning and assessing progress of demining activities. Since mine fields are generally located along the borders of FBiH and RS, the new symbolized maps may not cover all the demining areas. When this is the case, ortho-photos can be used to view spatial information as of 2003. When necessary, the digital topographic maps can be placed on top of the ortho-photos to be used as simplified maps.

Locating housing for refugees and the internally displaced persons is a land use planning issue. It is urgent, but carefully planned in a comprehensive planning process in regional plans to be prepared in the Principal 21 Cities and surrounding areas. As in the demining situation, 1:25,000 scale is the scale of regional planning which includes conservation planning, actual facility planning needs to be conducted using larger scale maps. In areas where 1:2,500 or 1:5,000 scale topographic maps were created, site planning or facility planning would be possible.

For promoting private sector led economic growth, all geographic information needs to be easily accessible. As the BiH government as well as two entities promotes foreign investment, at least economic infrastructure information needs to be available for investors. When existing regional

plans are updated using new aerial photographs or topographic maps, potential locations to promote foreign investment can be identified. The site information with infrastructure information that can be prepared using the produced symbolized topographic maps or digital topographic maps facilitates promotion of foreign investment. The promotion information can be put into the web sites of BiH and the entities.

Types of application needed to be developed depend on the needs and availability of attribute data. When basic data on social and economic infrastructure such as school, hospital, road, water and sewer are organized into databases, development of GIS applications will be possible by linking the database to the GIS data.

The Study Team acquired intersections of roads as nodes in the GIS creation process so that transportation analysis would be possible. For transportation analysis, the nature of analysis becomes at a regional level, since the scale of the base map is 1:25,000. With current land use data and future land use data, a transportation planner can simulate volume of traffic and prepare transportation plans more efficiently with more support from citizens and stake holders. Also, maintenance information on roads and bridges can be put into the database; a road and bridge facility management system can be developed.

Eco-tourism is a type of tourism that promotes both development and conservation of tourism resources. As in the Eco-tourism Study conducted by the JICA, tourism resources, both natural and man-made, need to be managed. The GIS data created in the Study are useful in ecology zoning and tourism resource management. The scheme of eco-tourism resources and environmental protection can be facilitated with the GIS data and can be applied to other areas of BiH.



(<http://www.jica-ecotourism.ba/opsirnijemap.html?id=192&kategorija=4>)

Figure 5 - 1 The Study Areas for Eco-tourism

Case Study: Eco-tourism Study

The Study on Sustainable Development through Eco-Tourism in Bosnia and Herzegovina is a JICA study conducted by PADECO Co. Ltd in Association with Pacific Consultants International. The study period is from November 2003 to March 2005. It aimed to prepare eco-tourism master plans for two study areas.

In the process of plan formulation, the geographic information prepared by the Study Team was used. The most effective use of the GIS data were in the ecological zoning which classified land uses by intensity of use or level of preservation and conservation. Without the GIS data, the ecological zoning work must have taken months of manual labor. With the GIS data, tourism and environmental experts with

GIS expert's technological support were able to simulate zoning before they have come up with the final zoning plan. The thematic maps, visual aids, helped stake holders understand the zoning and plans much better than without. Figures 5-2, 3, 4, 5, 6, 7, 8 shows the examples of thematic maps created for the Eco-tourism Study using the GIS data created during this study. The sample shows only the Pliva Ecological zoning; for another study area, the Velez Ecological Zoning was prepared the same way. The major data source was the results of the Study; additional data sources were: 1:25,000 maps of the study area, Vojnogeografski institute, Republicka geodetska uprava, 1960~1980; CORINE Land Cover, EEA, 2000 ; Field surveys carried out by Eco-tourism Study, 2004; City planning, municipalities in the study area; Municipality boundaries, municipalities in the study area, and Institute of Urbanism, 2004; Mine distribution map, BHMAL, 2004; and Plan of National Parks, Former Yugoslavia, 1980.

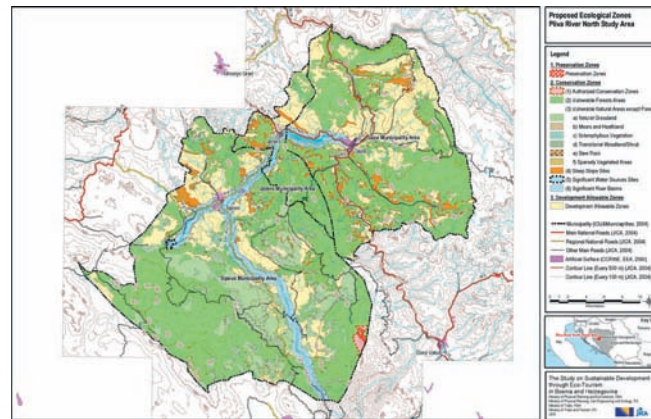


Figure 5 - 2 Pliva Ecological Zoning

Thematic Maps Prepared to Prepare Ecological Zoning

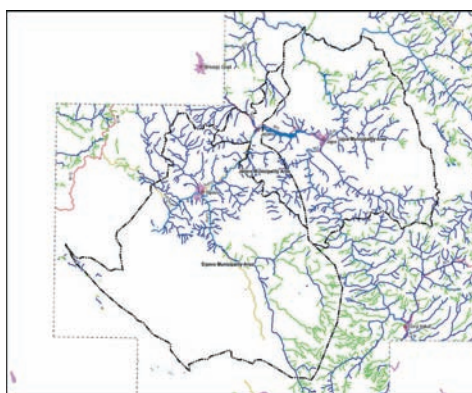


Figure 5 - 3 Water Body

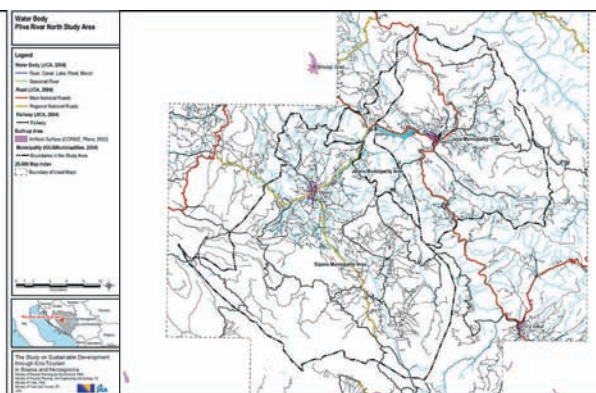


Figure 5 - 6 Road Network



Figure 5 - 7 Forest

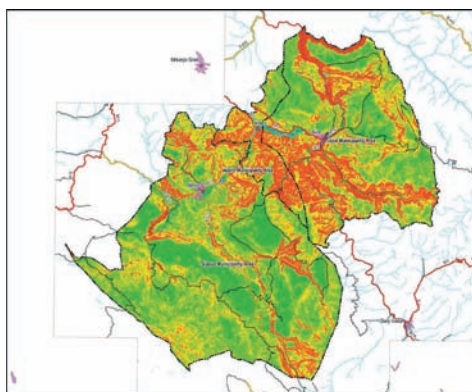


Figure 5 - 4 Slope Gradient

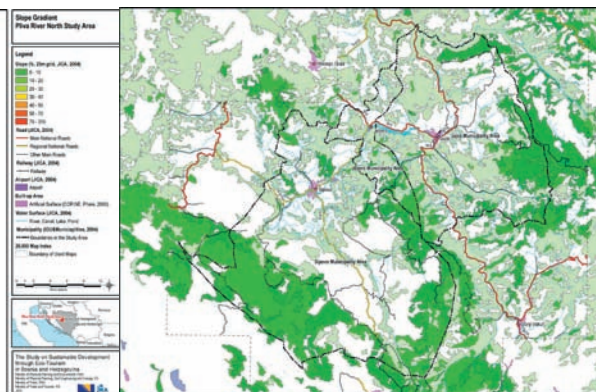


Figure 5 - 8 Elevation

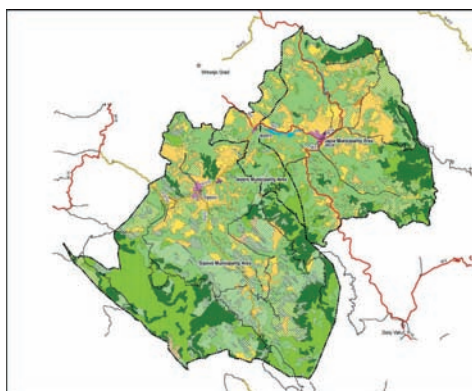


Figure 5 - 5 Land Cover



In the Eco-tourism Study, results of the tourism resource survey were stored into a database which was linked to graphic data. The following box, which is quoted from the web-site of the Eco-tourism Study, describes a method of using the GIS data created during this study.

Tourism Resource Survey

JICA Study Team carried out Tourism Resource Survey by subcontract basis.

The objectives of the Tourism Resource Survey are:

1. To make list of tourism resources in the Study areas

Resources that can be used for tourism development shall be listed, such as important natural environment (including those of good for sport tourism), cultural and historical heritages that are not well developed as tourism resources. Basic information of the resource items shall be collected and put into a directory of tourism resources. Geographic Information Systems (GIS) shall be used for this directory.

2. To collect data of tourism resources in surrounding areas and countries

Basic information concerning major tourism resources in the other area of BiH as well as in the surrounding countries (Central and South Europe) is collected, so that the Study team can examine the possibility of formulating regional tourism network that includes the Study areas. GIS shall be used for this directory.

3. To conduct preliminary evaluation of the resources in the lists

Preliminary evaluation of the resources listed shall be conducted with regard to uniqueness, fragileness and effectiveness as tourism resource. Appropriate criteria are to be formulated for this appraisal. The evaluation results are shown with GIS.

<http://www.jica-ecotourism.ba/opsirnijesurvey.html?id=248&kategorija=36> (2005/08/08)