Integrated Geospatial Information for Sustainable Land Development in Tirana-Durres Area in Albania

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Key words: Capacity building, Cartography, Photogrammetry, INSPIRE, JICA

SUMMARY

Along with start of Albanian democratization in 1991, rural-urban migration resulted into rapid growth of urban population coupled with unplanned urbanization creating severe pressure on infrastructure and environment. In Balkan and Eastern Europe regions, the Government of Japan (GOJ) through Japan International Cooperation Agency (JICA) supported number of counties, including Albania, to improve their social infrastructure and environmental condition, in accordance with the UN Sustainable Development Goals (SDGs) 2030 (UN, 2015) and European Union (EU) standards, which may help them to achieve their ambition to join EU. JICA supported the Government of Albania (GOA) with ODA loan/grant for "Greater Tirana Sewerage System Improvement Project (2008-2014)" and Technical Assistance (TA) for "The Project for Tirana Thematic Urban Planning (2011-2012)" recognized as the substantial contribution in this direction, but continuation of unregulated urbanization created Tirana-Durres urban sprawl.

To address this issue, GOA created the National General Plan for Territory in 2016 with envision of sector-by-sector development plan, including land management registers preparation for implementing infrastructure. However, required basic large-scale (1/2,000) topographic maps had not been updated since the 1980s. In addition, recently established State Authority for Geospatial Information (ASIG) mandated to conduct geospatial information related services, needs to improve the capacity in terms of human resource, equipment and technology. Based on the technical cooperation request from GOA to GOJ, "Project on Geospatial Information for Sustainable Land Development in Tirana-Durres Area" consisting of digital topographic mapping and capacity building of ASIG for utilization, maintenance and updating ability, has been implemented since June 2017 and is planned to be completed by the end of June 2020. JICA Project Team (JPT), in close collaboration with ASIG, analyzed, defined and adapted all required, but plausible geospatial information specifications to meet the INSPIRE (Infrastructure for Spatial Information in Europe) standards, and Albanian standard of planar positional 40cm accuracy. Under the supervision of JPT, ASIG staff have been creating digital topographic maps of 20 km^2, out of 300km^2 of whole project area, as a part of capacity building, and remaining 280 km^2 is taken care by JPT. In addition, to introduce recent technologies, necessary training sessions have been conducted in both Albania and Japan. It is expected that ASIG will undertake similar mapping work to expand the coverage of the digital topographic map by themselves after the completion of the project.

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1. INTRODUCTION

Along with start of Albanian democratization in 1991, rural-urban migration resulted into rapid growth of population in the capital city Tirana metropolitan area. Prediction shows the population may grow up to four fold, reaching one million by 2025. Unplanned rapid urbanization is creating severe pressure on urban infrastructure and environment, particularly housing, transportation, water, wastewater and solid waste management. In order to achieve the UN Sustainable Development Goals (SDGs) 2030 (UN, 2015), besides others, for a sustainable and inclusive urban area development should be based on integrated Land and Water management. It requires ample provision of advance planning along with necessary data preparation, which explain the current status and future direction of the urban area growth.

In Balkan and Eastern Europe region, JICA supported number of counties, including Albania, to improve their social infrastructure and environmental condition, in accordance with SDGs-2030 goals and European Union (EU) standards, which may help Albania to achieve their ambition to join EU (JICA, 2019). JICA collaboration with the Government of Albania (GOA) , with ODA loan for "Greater Tirana Sewerage System Improvement Project" in 2008 and Technical Assistance (TA) on "The Project for Tirana Thematic Urban Planning" in 2011, completed in 2014 and 2012 respectively (JICA, 2008, JICA 2018, JICA 2019), were recognized as the substantial contribution in this direction. But continuation of unregulated and rapid urbanization connected Tirana with coastal area in Durres has become urban sprawl. To address this issue in a systematic way, GOA created the National General Plan for Territory in 2016 (cited in Qorri, & Fagu, 2017) and intended to start by taking Tirana-Durres area to promote infrastructure development based on the Plan.

In future, sector-by-sector plans and land management registers must be created for implementing infrastructure development based on the plan. However, the large scale (1/2,000) digital topographic maps on which they will be based, have not been updated since the 1980s. In addition, recently established State Authority for Geospatial Information (ASIG), mandated to conduct large scale mapping and provide geospatial information related services, is having difficulties in creating digital topographic maps. In order to develop digital topographic maps of the Tirana -Durres Region and build capacity of ASIG for maintenance and updating ability, the "Project on Geospatial Information for Sustainable Land Development in Tirana-Durres Area" is being implemented (June 2017 – June 2020) by JICA Project Team (JPT) in close collaboration with ASIG, financed by the Government of Japan (GOJ) based on the request from GOA.

The project procured and installed all required Hardware and Software, and under the supervision of JPT, ASIG staff, with the necessary support from sub-contractors, prepared digital topographic map of 20km^2 out of 300km^2 as a part of capacity building while JPT

prepared the remaining 280km^2. In addition, to enhance the knowledge and introduce the recent technology, necessary training sessions have been conducted both in Albania and Japan.

2. PROJECT AREA

Tirana and Durres cities became default financial and economic hub of Albania due to (a) their strategic geographic location, (b) high population and (c) transportation infrastructures in and passing through cities, creating east-west and north-south connectivity of Albania as well as inland eastern European Balkan countries (PwC, 2017). Considering their importance and immediate need, GOA and JICA decided to take them as a pilot project area with two folds of strategy and objectives, namely (a) produce quickly large scale topographic map for proper urban planning to tackle the unplanned urban-sprawl growth in the area and (b) build capacity of ASIG so that they could ultimately cover the whole country with large scale mapping by themselves to diversify and bring economic activities and development for the entire country. The location of the project area is depicted in the Figure 1.

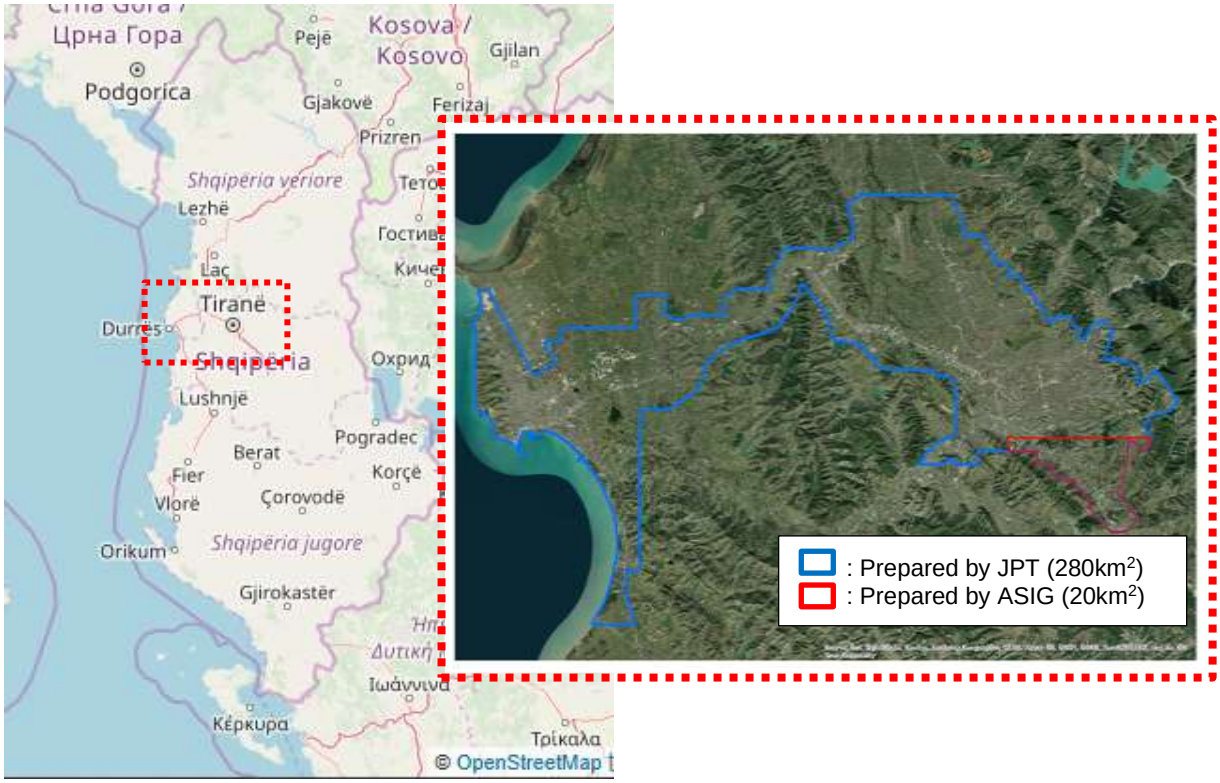

Figure 1: Location of the Project Area
(Source of the Project Area: JPT, Source of the backbround: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community)

3. KEY TECHNOLOGY

The following technologies have been applied through this project along with all available latest mapping infrastructure and newly procured Hardware and Software.

3.1. Compliance with EU INSPIRE directive and Albanian standard for Geographic Information

Albania has been putting effort into establishment of national mapping standards compliant with EU INSPIRE for a decade. There are 10 out of 34 EU INSPIRE data specifications which have been adopted (October, 2017). Specifications of the digital topographic map was defined by utilizing a newly prepared specification named "albatopo2000" which are partly interoperable with EU INSPIRE data specifications and adding a theme named "AS (ASIG)" which was originally defined by ASIG for the purpose of adopting the specification to local needs (ASIG and JICA, 2018). National Spatial Data Infrastructure (NSDI) in compliance with EU INSPRE directive has been rapidly developed in the western Balkan region. However, large scale topographic maps have not yet been created in many countries. In fact, Albania is the first country in the region to create 1/2,000 topographic map being compliance with INSPIRE. Albanian standard of planar positional 40cm accuracy (Standard Deviation) was applied for this project.

3.2. Utilization of CORS for Establishing GCPs

For large scale topographic mapping, precise and high accuracy Ground Control Points (GCPs) are crucial input for aerial photographs acquisition, processing and orthophoto production. As base network for processing of GCPs coordinates, six (6) Continuously Operating Reference Stations (CORS) from the existing network of Albanian Satellite Positioning System (ALBPOS) which comprises 16 permanent CORSs, have been utilized to ensure and meet the defined accuracy and precision of GCPs. In total 40 GCPs were installed for aerial photography, where some of GCPs were used for check points, specifically for the verification of aerial triangulation result.

3.3. Efficient Geospatial Information Management and Sharing Mechanism

This project will deliver the digital topographic map in a relational database format, in particular ESRI's "Geodatabse (GDB)" as well as with vector tile format, which will contribute for ASIG in future to develop efficient data management and sharing mechanisms through national geoportal (EGAR, 2017). Orthophotos acquired under this project are already published on ASIG's Gerportal.

4. WORKING FRAMEWORK

Based on well defined standards and norms of topographic mapping frameworks, this project has been implemented as illustrated in the project workflow (Figure 2) and described in

subsections below hereafter to create the large scale topographic maps and building necessary capacity of ASIG.

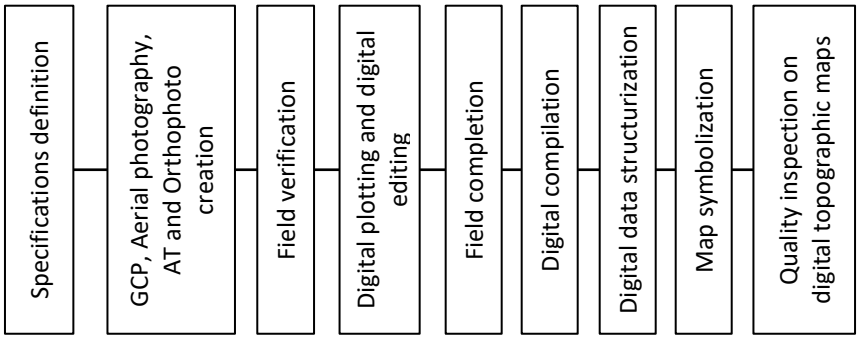

Figure 2: Project Workflow (Source: JPT)

4.1. Specifications Definition

albtopo2000 focuses on providing geospatial foundation in large scale as of national geospatial infrastructure. Features of the digital topographic map was defined based on 13 themes of albtopo2000 which are created as excerpts of the original INSPIRE data specification plus a theme "AS (ASIG)" originally defined by ASIG for the purpose of adopting the specification to local needs. "AS (ASIG)" includes "Religious Feature", "Transport Feature", "Fence Feature" and so on.

Table 1: Features of the Digital Topographic Map

№	**Basic dataset name (Theme)**
1-03	GN (Geographical names)
1-04	AU (Administrative units)
1-07	TN (Transport networks)
1-08	HY (Hydrography)
1-09	PS (Protected sites)
2-01	EL (Elevation)
2-02	LC (Land cover)
2-04	GE (Geology)
3-02	BU (Buildings)
3-06	US (Utility and governmental services)
3-08	PF (Production and industrial facilities)
3-09	AF (Agricultural and aquaculture facilities)
4	AS (ASIG) *Cartographic features defined in addition
Source: albatopo2000 (ASIG and JICA, 2018)	

4.2. GCP, Aerial Photography, AT and Orthophoto Creation

Ground control point survey, aerial photography, aerial triangulation, and orthophoto creation were carried out by a sub-contracted company under supervision of JPT. Aerial photos (8cm.

GSD) were taken on 26 and 27 of May 2018, and orthophotos are published through ASIG's Geoportal (https://geoportal.asig.gov.al/en) to comply its open data policy.

Figure 3: The Orthophoto Displayed on ASIG's Geoportal (Source: ASIG)

4.3. Field Verification

The data of the topographic features to be expressed on the maps according to the defined specification was acquired using QField software installed on tablet PCs. Laser rangefinders were also used so that surveyors measured precise distance and drew conditions of sites under trees and others. 280km^2 out of 300km^2 was carried out by an Albanian sub-contractor under supervision of JPT and remaining 20km^2 was carried out by ASIG as a part of on the Job Training. Inspection survey was conducted in 2% area of the 300km^2 (6km^2 in total) to check completeness (data deficiency and excess), positional accuracy (positioning error) and thematic accuracy (code and annotation error).

Figure 4: Output of Field Verification (Source: JPT)

4.4. Stereo Plotting and Digital Editing

Based on the defined specification, topographic features were plotted using the aerial photos and field verification result. This work was carried out by using work environment with a centralized database where data can be edited concurrently by multiple operators, which makes data management as well as work progress monitoring efficient.

4.5. Map Symbolization

ASIG and JPT are paying close attention to create and apply map symbols which are easy to understand so that the map will be useful not only for professionals but for everyone. For example, buildings are expressed by different colors by building types (e.g. "Administrative Building", "Educational Building", "Service Building", "Religious Social/ Cultural Building" etc.), which may not be very common for a large scale topographic map but important for the map of this project.

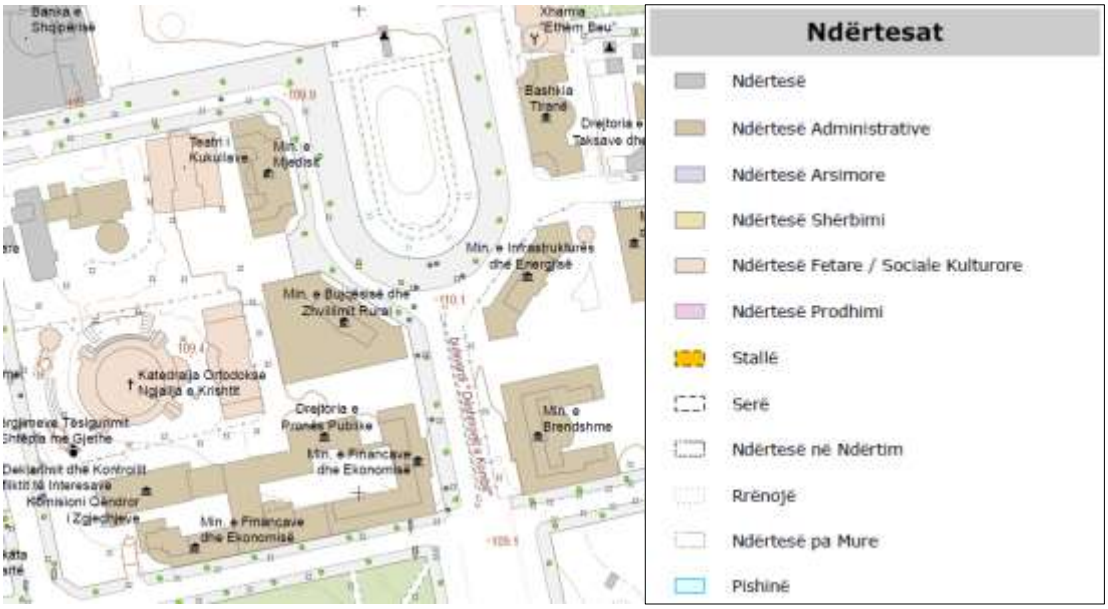

Figure 5 (a): An Example of Symbolized Map, (b): Legend of "Building" (Source: JPT)

5. TECHNOLOGY TRANSFER

JPT devised "Technology Transfer Plan", which was approved by ASIG and JICA. Using this plan, JPT has been carrying out technology transfer at relevant stages of the project. The key features of the technology transfer are (a) two basic policies "Enhancement of Capabilities of 1/2,000 Scale Digital Topographic Map Production" and "Improvement of Capabilities of Management of Outsourcing Work", (b) procurement and installation of necessary HW/SW for large scale topographic mapping and (c) necessary training in Albania including OJT and training in Japan. Under OJT, ASIG staff created 20 km^2 of topographic map of the project area with the assistance from sub-contracted companies and under the supervision of JPT, which became very effective as it includes the operation of HW/SW and field work for each step of the map production starting from aerial photography to the final digital topographic maps. JPT systematically introduced ASIG staff, both in the class room and field, about how to conduct accuracy control and quality evaluation and manage the outsourcing work of each step of the map production.

6. OUTPUT AND PROMOTION OF UTILIZATION OF DIGITAL TOPOGRAPHIC MAP

6.1. Outputs

Outputs of this project are (a) Aerial photos and orthophotos, (b) digital topographic maps together with composed topographic map in PDF files, and (c) related documents including project reports and the manuals prepared for the technology transfer.

6.2. Promotion of Utilization of the Digital Topographic Map

Following activities have been proposed and under implementation for promoting utilization of the outputs achieved under this project.

- Collaboration with a university in pursuit of fostering of geospatial information engineers: A practical training to the future engineers in the field of geospatial information was organized. More than 10 students of Faculty of Geodesy of Polytechnic University of Tirana were invited, and JPT and ASIG jointly provided relevant lectures and exercises on digital topographic map creation and utilization.
- Delivery and disclosure of digital topographic maps during the implementation of the project: Digital topographic maps are planned to be delivered provisionally well before the project ends, followed by further technology transfer and utilization promotion activities using the maps. This will enable implementation of technical responses and troubleshooting in a way that fits the reality in actual use.
- Provision of GIS training for municipalities: By considering the strong desire of municipalities in and around project area, JPT is preparing to conduct training on how to use digital topographic map for specific purpose, such as city and infrastructure planning, by utilizing open source GIS software.
- Workshop for use of open source software: JPT is proposing to share some ideas and technologies how to use digital topographic maps and other geospatial information in practice by utilizing open source software in near future.
- Holding meeting and conferences: With support from APT and other relevant government institutions, JPT is organizing and planning to organize several meetings, such as West Balkan regional meeting for promoting use of geospatial information, and conferences by targeting potential users.
- Participation to regional conferences: As a series of public relation activities to the Project and information gathering, JPT is taking part in the conferences organized by the western Balkan countries, Euro Geographics, and UNGGIM Europe.

7. CONCLUSION

After the start of democratization of 1990s in Balkan and Eastern European regions, rural-urban migration resulted into rapid growth of urban population coupled with unplanned urbanization creating severe pressure on infrastructure and environment. Considering this issue, JICA supported number of counties, including Albania, to improve their social infrastructure and environmental condition, in accordance with SDGs-2030 goals and EU standards, which may help them to achieve their ambition to join EU. Under JICA grant ODA, the project on creating large scale topographic map and capacity building of ASIG has been implemented by JPT in coordination with ASIG. It is envisioned that the output from this project will help to regulate the ongoing unregulated urbanization and manage Tirana-Durres urban sprawl. In addition it will also be an important input for the proper urban and infrastructure planning.

ACKNOWLEDGEMENTS

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Current Affiliation: Principal Engineer, PASCO CORPORATION, Tokyo, Japan

Lorenc ÇALA: An engineer of Geodesy who studied at the Polytechnic University of Tirana, he is a highly experienced and certified professional and lecturer at the Polytechnic University of Tirana in the science of remote sensing, with more than 16 years in the Geoinformatic industry, with a comprehensive background in strategy and business development. Seasoned management experience, with extensive exposure to different geoinformatic domains, and directing cross-functional teams.
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