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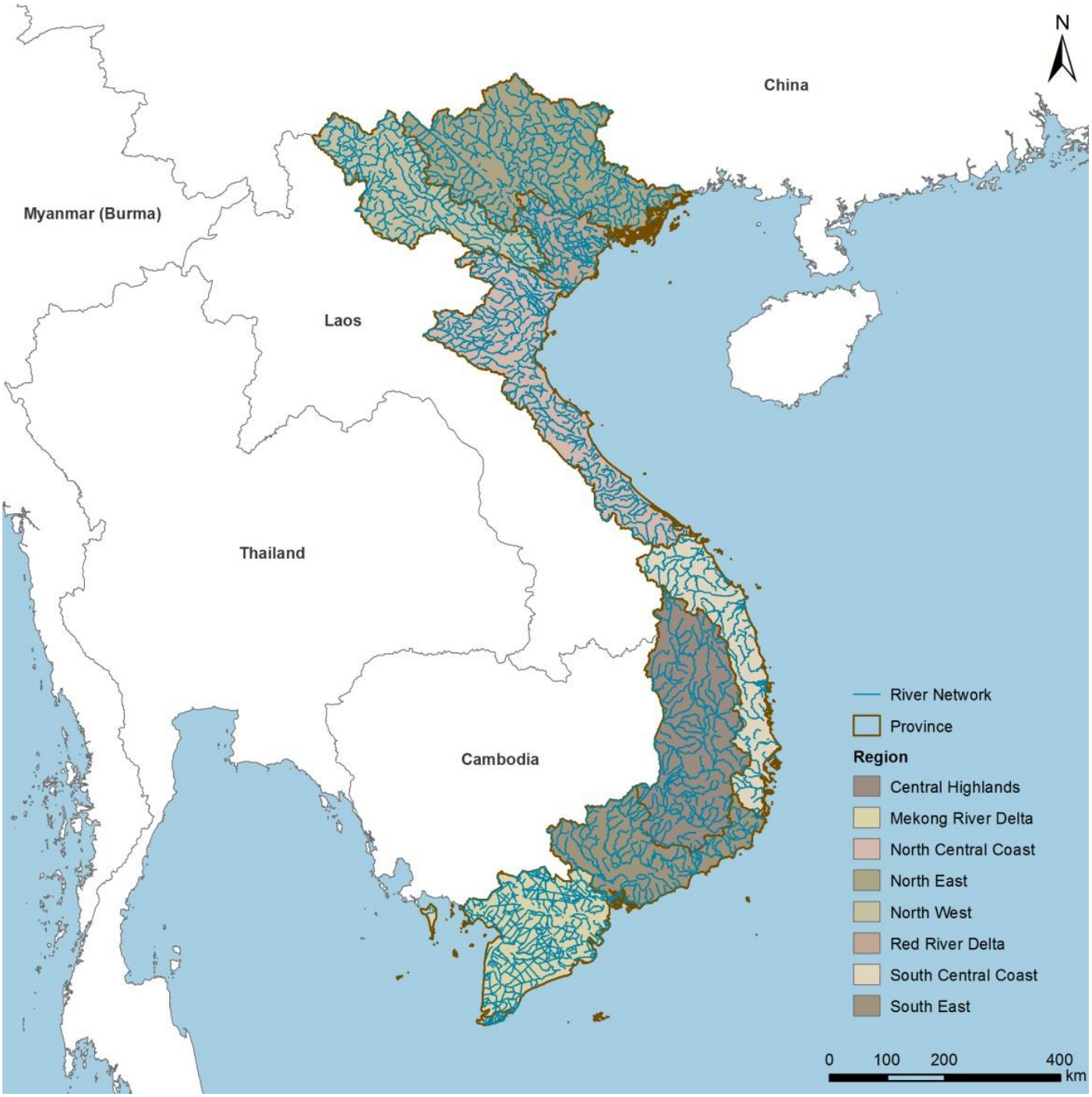
WORLD BANK GROUP

ESMAP
Energy Sector Management Assistance Program

Small Hydro Resource Mapping in Vietnam

INCEPTION REPORT

December 2014



This report was prepared by Gesto Energy Consulting, http://www.gestoenergy.com/, under contract to the World Bank Group (WBG).

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This document is an **interim output** from the above-mentioned project. Users are strongly advised to exercise caution when utilizing the information and data contained, as this has not been subject to full peer review. The final, validated, peer reviewed output from this project will be a Vietnam Small Hydro Atlas, which will be made available once the project is completed.

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Gesto

ENERGY CONSULTING

SMALL HYDROPOWER MAPPING AND PLANNING

VIETNAM

PROJECT ID: P145513

INCEPTION REPORT

December 2014

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
COTS	Common-Of-The-Shelf
DB	Data Base
DEM	Digital Elevation Model
DOIT	Department of Industry and Trade
DPI	Department of Planning and Investment
EIA	Environmental Impact Assessment
ESA	European Space Agency
ESMAP	Energy Sector Management Assistance Program
ESRI	Environmental Systems Research Institute
EVN	Electricity of Vietnam
FAO	Food and Agriculture Organization
FS	Feasibility Study
GADM	Global Administrative Areas
GDE	General Directorate of Energy
GIS	Geographic Information System
GNS	Geonet Names Server
HPP	Hydro Power Plant
ICOLD	International Commission On Large Dams
IHR	Institute for Hydropower and Renewable Energy
IM	Inception Mission
IUCN	International Union for Conservation of Nature
JETRO	Japan External Trade Organization
LHP	Large Hydropower
MARD	Ministry of Agriculture and Rural Development
MHP	Medium Hydropower
MIS	Management of Information System
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MPI	Ministry of Planning and Investment
MRC	Mekong River Commission
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
NGO	Non-Governmental Organization
NHMS	National Hydro-Meteorological Service
NHP	National Hydropower Plan
O&M	Operation and Maintenance
PDP	Power Development Master Plan
PMB	Power Management Board
PPC	Provincial People's Committee
PSP	Pumped-Storage Projects
Q&A	Questions and Answers

QGIS	Quantum GIS
RDBMS	Relational Database Management Systems
REDP	Renewable Energy Development Project
RES	Renewable Energy Sources
SHP	Small Hydropower Plant
SQL	Structure Query Language
SRTM	Shuttle Radar Topography Mission
TOR	Terms Of Reference
UNEP	United Nations Environment Programme
USGS	United States Geological Survey
UTM	Universal Transversal Mercator
VAWR	Vietnam Academy of Water Resources
WBG	World Bank Group
WCMC	World Conservation Monitoring Centre
WCPA	World Commission on Protected Areas
WDPA	World Database of Protected Areas
WGS	World Geodetic System
WMO	World Meteorological Organization

1 PROJECT SYNOPSIS

Project title: Small Hydropower Mapping and Planning in Vietnam

Project Number: Selection No. 1125339

Country: Vietnam

Project objectives: Advisory services to Ministry of Industry and Trade (MOIT), the Client, on building up geographical databases for Small Hydropower Plants (SHP), and on developing guidelines for geospatial planning of SHP, thus having an overall objective to strengthen MOIT's capacity for planning SHP. Such planning should be developed consistently with planning of other Renewable Energy Sources (RES), such as wind and solar, in Vietnam and in close cooperation with a National Consultant hired by MOIT, within the scope of the implementation of the database.

Expected results:

1) Digitizing and creation of a geographic information system (GIS) database of existing small and large hydropower in Vietnam
2) Building up of complementary Geographic Data, initially focusing on globally available data
3) Creation of GIS capacity with the Hydropower Division of MOIT to host, operate, maintain, and extend the geographical database for planning of SHP
4) Develop guidelines and build capacity of MOIT in improved planning of SHP, focusing on optimized hydro development from both economic, environmental and safety perspectives.

Contract signing date: June 17, 2014

Project duration after final methodology approval: 12 months

2 INTRODUCTION

2.1 ESMAP

The Energy Sector Management Assistance Program (ESMAP) is a global knowledge and technical assistance program administered by The World Bank Group (WBG) and supported by 11 bilateral donors. ESMAP's efforts focuses on energy security, energy access, and climate change, and take into account three core services: i) analytical work, ii) knowledge clearinghouse, and iii) operational support to The World Bank regions for technical assistance work at the country level.

Carrying out RES mapping and geospatial analysis at country level helps to scale up the deployment of biomass, SHP, solar and wind electricity generation, particularly in countries where one or more of these sources of power are underdeveloped. This is because such mapping is a crucial step to developing a policy framework to guide investment in RES electricity generation which, along with publicly-available data, helps reduce transaction costs and speeds up deployment by providing commercial developers with:

- Increased certainty that projects are likely to be approved or permitted with minimal bureaucracy and delay
- Data transparency and a level playing field, thereby reducing barriers to the entry and limiting the scope of corruption
- A baseline of reliable data that can help guide prospecting activities and can be used for data verification purposes
- A better informed off taker or purchasing authority, thereby improving the price negotiation process

In response, ESMAP has launched a new initiative to support country-driven efforts to improve RES awareness, put in place appropriate policy frameworks for RES development, and provide "open access" to resource and geospatial mapping data. One of the key elements of this ESMAP initiative was to select consulting firms and establish framework agreements for the procurement of resource data and mapping services. For the renewable energy mapping based on hydropower, the WBG hired qualified consulting firms with demonstrated capabilities in providing Small Hydro Power resource mapping and related services and an Indefinite Delivery Contract commenced on May 28, 2013, and is expected to end by 2017.

The tender for *Small Hydropower Mapping and Planning in Vietnam* was released under this contract in early 2014. For this particular tender, an International Consultant's Association (CONSULTANT) led by Gesto Energy Consulting (GESTO)and including GAF AG and GeoViet Consulting (GeoViet) as local partner was formed.

After the tenders' evaluation in mid-2014, the World Bank informed the CONSULTANT that it was chosen to carry out the Project. After a period of negotiation the Contract was signed in June 17 2014.

2.2 THE CONSULTANT

GESTO, the leading partner, is an international consultant specialized in energy and in evaluation of renewable resources. GESTO has know-how and experience in assistance to the implementation of renewable energy policies as well as master plans and support in all phases of RES projects development.

With a wide scope of expertise, including but not limited to hydro resource study and evaluation, project analysis and prioritization, and support for projects development, GESTO track record includes, not only, resource mapping – more than 15 resource maps in the last 4 years – but also, the development of Hydro Atlas and projects identification for Cape Verde, East Timor, Mozambique and Angola, and a 5 MW Solar plant development in Cape Verde (Santiago Island) - the largest built in Africa at that time.

Currently, GESTO presents a worldwide portfolio of concluded and on-going projects: Renewable Energy Roadmap to 2020 (Cape Verde), Concentrated Solar Power (CSP) Plant Pre-Feasibility Study (Namibia), Mozambique Renewable Energy Atlas, Angola Energy Vision to 2025, Renewable Electrification Plan of East Timor, Project Development for Renewable Auctions in South Africa and Small Hydropower Mapping and Improved Geospatial Electrification Planning in Indonesia.

With a team of 183 experts GAF AG offers comprehensive consulting services and turnkey solutions in the fields of e.g. environmental surveillance and spatial monitoring of land information along with above ground biomass estimation, land cover mapping, cartography and information systems development.

GAF AG is equipped with powerful, leading-edge information technology and a high-performance computer network. On the hardware side, GAF AG operates a heterogeneous server infrastructure with 25 different servers as well as more than 220 workstations/desktop computers and additionally 30 notebooks for mobile computing. Regarding software, GAF AG routinely uses standard professional software products from ESRI, ERDAS, ORACLE, PCI Geomatica, ER Mapper, Definiens and ENVI for EO-data based production tasks. Additional software tools for dedicated tasks are utilized on demand.

GAF AG allocates substantial resources to the design and development of cutting edge software for the processing of geo-information. A number of tailor-made software packages have been developed in form of stand-alone applications as well as customized applications for dedicated remote sensing production tasks. In addition, dedicated software packages and tools based on COTS platforms and proprietary solutions are developed, used in GAF AG projects, and distributed to clients. GAF AG has developer agreements with leading manufacturers and the necessary experience, to offer a wide range of product customizations. All software developments are fully integrated with the quality management system of the company.

GeoViet is an inter-disciplinary consulting company providing services in research, consultancy and training in the areas of geospatial information technology, urban/regional development and planning, environmental studies and natural resources planning and management as well as in management support of development projects/programs and business analytics for sustainable development. Established in 2006, GeoViet has been delivering dynamic, creative, cost effective solutions and practical

tools for national and local governments, private sector and communities to address critical environmental and development problems and establish rational views for timely and informed decision making. GeoViet has extensive practical experiences in design and development of geospatial databases, as well as capacity building and technology transfer.

2.3 OBJECTIVES

After the September 2013 Scoping Mission where representatives from the WBG met with key Client counterparts it was concluded that SHP plays an essential role in clean power generation in Vietnam, and that there was interest from both public and private investors to develop SHP, but that there lacks coordinated planning of SHP development. Hence the ESMAP current contribution for SHP in Vietnam – *Small Hydropower Mapping and Planning in Vietnam* – has an overall objective to strengthen MOIT's capacity for planning of SHP. Such planning should be developed consistently with planning of other RES, such as wind and solar, in Vietnam.

More precisely the consultancy services have the ensuing specific purposes:

- Digitize and create a GIS database of existing small and large hydropower in Vietnam
- Buildup complementary Geographic Database, initially focusing on globally available data
- Create GIS capacity with the Hydropower Division of MOIT to host, operate, maintain, and extend the geographical database for planning of SHP
- Develop guidelines and build capacity of MOIT in improved planning of SHP, focusing on optimized hydro development from both economic, environmental and safety perspectives.

Moreover, the consultancy services will be done in parallel on one contract for local Vietnamese consultants (National Consultant) aiming for data compilation and building up the GIS system for SHP, as well as other RES, within MOIT. For sustainability purposes this contract is proposed to be funded through the WBG supported Renewable Energy Development Project (REDP), in which MOIT will procure the National Consultant as part of the capacity building component. The CONSULTANT is requested to closely coordinate the scope of work between the two contracts.

2.4 THE CONSULTANT'S TECHNICAL PROPOSAL

The Terms of Reference requested the work to be grouped into two main activities:

- Activity 1 – Advisory services for building up a GIS national database for small hydro
- Activity 2 – Developing guidelines for improved planning of small hydro

The objectives of Activity 1 are:

- To carry out an Inception Phase and draft an Inception Report (the current document)
- To design a GIS database for national information on SHP development
- To produce the working report on the design of the SHP GIS database

- Advisory services for compilation of data, digitizing and population of GIS database, in coordination with the parallel contract

The objectives of Activity 2 are:

- To develop guidelines for review and planning of SHP
- To test and fine-tune guidelines and capacity building of MOIT
- To produce the Final Report and promote the Final Workshop for the Client and relevant stakeholders

For the development of these activities, the CONSULTANT proposed a methodological approach during the selection period. The original methodology and schedule for the development of the tasks are reviewed in this report.

2.5 CONTENT OF THE REPORT

After carrying an Inception Mission the CONSULTANT reviewed the compiled information, including feedback from meetings, and refined the focus of the study to finalize the detailed methodology.

The findings of this pre-diagnostic exercise are summarized in this Inception Report, which will require approval by the Client and the WBG team for the continuation of the services.

Chapters 1 and **2** are the introduction to the project.

Chapter 3 describes the Inception Mission. In **chapter 4** a preliminary compilation of globally available data is presented.

Chapter 5 consists on the revision of the implementation plan and the final methodology proposal. In this chapter key challenges in the project implementation are acknowledged, which lead to some modifications in the preliminary methodology. Finally, the proposal for the final methodology, milestones and work plan is presented.

In **chapter 6** the main conclusions from the Inception Report are exposed.

3 INCEPTION MISSION

3.1 OBJECTIVES

The Inception Mission (IM) occurred between October 13 and 24 in Hanoi and Son La province, Vietnam, with the general purpose of presenting the CONSULTANT and Client teams, getting the CONSULTANT acquainted with local conditions and fine-tune the proposed implementation plan. The specific objectives of the IM were to:

- promote meetings with the Client;
- promote meetings with the National Consultant[1];
- identify and promote meetings with relevant stakeholders;
- make an assessment of available information;
- compile relevant information and data;
- make an institutional assessment of MOIT's capacity on GIS;
- evaluate major challenges in the project.

Apart from the work-in-progress task of compiling relevant information and data, all objectives were fulfilled during the IM.

3.2 MEETINGS AND WORK SESSIONS

The CONSULTANT had several meetings with the WBG and Client, as well as agencies and institutions currently developing work related to hydropower in Vietnam. All meetings were documented in meeting reports. The work schedule and the meeting reports from the IM are presented in **Annex I**.

3.3 RELEVANT STAKEHOLDERS

MOIT is not only the main beneficiary of this project but also the most relevant stakeholder when it comes to SHP planning and licensing. Small scale hydro (below 30 MW) is planned on province level by the local Departments of Industry and Trade (DOIT), and sub-sequent approval of the Provincial People's Committee (PPC), and nationally by MOIT.

Other relevant stakeholders on planning and licensing are MARD, MONRE and EVN. The current legal framework on SHP planning foresees mandatory consultation to MARD and MONRE during specific stages

[1] During the IM, the National Consultant had been appointed but not yet formally hired

of the approval process related to land-use, protected areas and environmental matters, and to EVN primarily regarding grid connection issues.

Regarding SHP project development, it is mostly done by private investors or joint-stock companies. EVN, on its turn, besides being part of the planning process has created internal high capacity on hydropower development, from the development of more than 11 GW of hydro, even though most of them are large schemes.

The following diagram shows the approval process and major stakeholders' relationship for SHP projects in Vietnam (**Figure 3.1**).

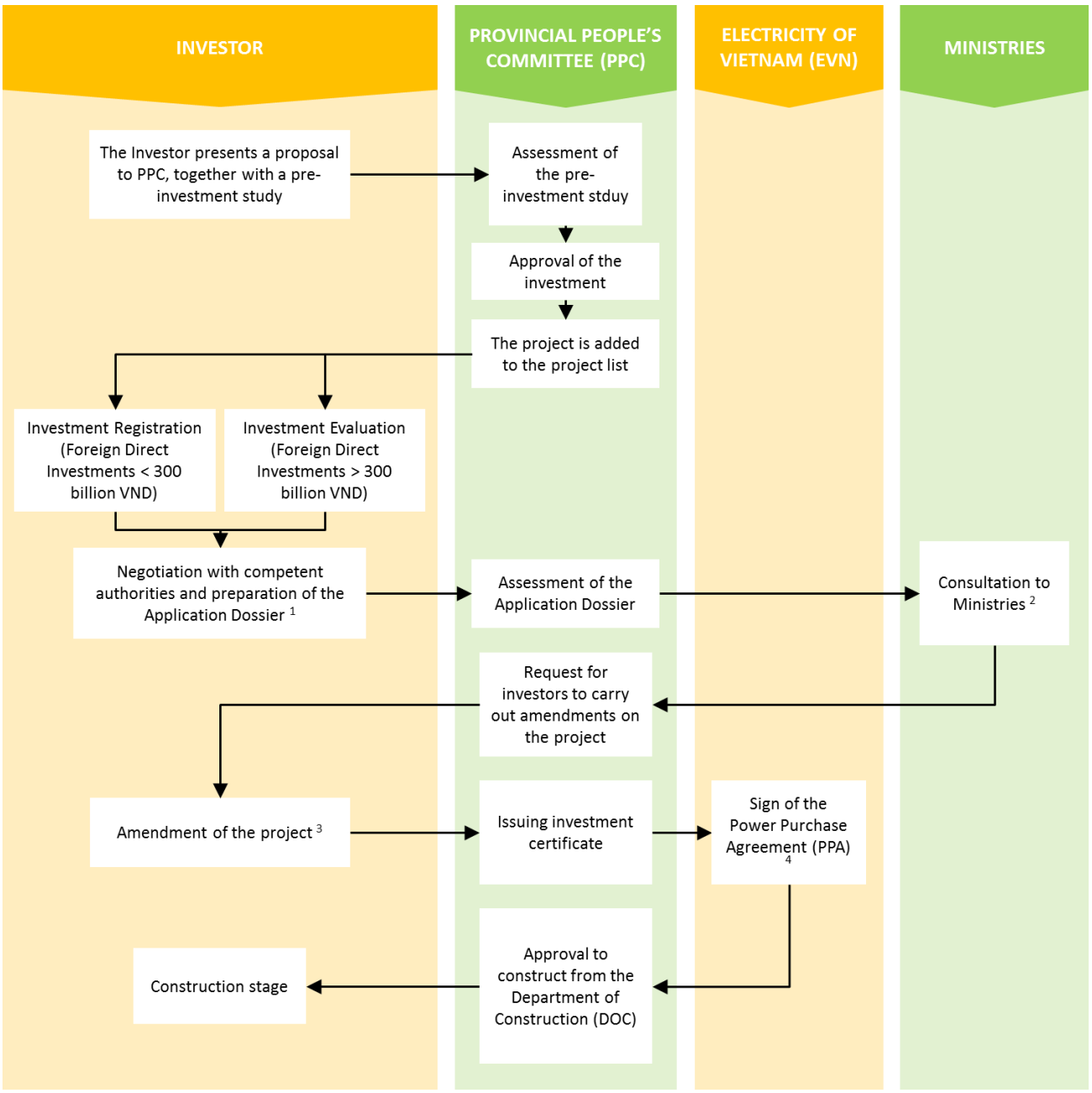


Figure 3.1 – Approval process and major stakeholders' relationship for SHP.

Following the initial step of presenting a proposal to PPC, together with a pre-investment study, and negotiating with DOIT, the Department of Planning and Investment (DPI) and EVN, the investor shall prepare an Application Dossier (1). The Application Dossier includes documents verifying the legal status of the investor, a report on the financial standing of the investor, an eco-technical explanatory statement (only in case of an Investment Evaluation) and the initial contract. Next, DOIT may seek for advice from ministries, such as the Ministry of Planning and Investment (MPI), MOIT, MONRE and MARD (2), which may result in the request for investors to carry out amendments on the project. In the affirmative, the investor must finish the amendments on the project contract within 10 days (3). Afterwards, the investment certificate is issued and the conditions for selling power to EVN are discussed (4). Finally, the construction approval must be obtained.

Worth mentioning too in terms of relevant stakeholders is the IHR, part of the Vietnam Academy of Water Resources (VAWR), an omnipresent institution providing technical support for the development of SHP.

The feedback obtained from the stakeholders, including relevant info on their possession and ways of cooperation is presented in the minutes from the meetings held assembled in **Annex I**.

3.4 DATA COLLECTION

During the IM, the CONSULTANT focused on getting an overview of the existing data that could later be helpful when designing the database, in terms of format, size and quality, and on making an assessment of available information and previous studies on the subject (for a better understanding of the sector and to avoid duplication of work). The bulk of the collection of data on this initiative will be the National Consultant's responsibility, however it should be mentioned that during the IM, the National Consultant had already been appointed but was still waiting for official contract and thus wasn't able to perform an in-depth data collection activity. Notwithstanding, at this stage the CONSULTANT identified and requested some basic information such as:

- National Hydropower Plan (NHP) from 2007 – and any existing update;
- SHP Development Plans requested to the Provinces by MOIT in 2005 – and any existing update;
- Current licensing and approval process for SHP;
- List of existing/planned hydropower projects;
- Existing maps and GIS layers;
- Other info that might be relevant.

The NHP and the plans requested to the Provinces by MOIT in 2005 are important since they should constitute the baseline for small and large hydropower development in Vietnam and, presumably, contain lists and main features of existing and planned hydropower projects. An updated description of the current licensing and approval process for SHP is also relevant considering the identification of relevant stakeholders in the process and the development of guidelines for improved strategic planning of small hydro. A rough list of existing/planned hydropower projects and existing maps and GIS layers helps to estimate the preliminary features of the database in terms of size, complexity and storage requirements.

As for other info that might be relevant, in the sequence of the meetings held with other relevant stakeholders such as MARD, EVN and MONRE, additional information on hydropower, dams or the licensing processes was considered to be useful and requested at said meetings, even though from the feedback obtained (**Annex I**), an official request by letter is compulsory.

From the above list, the CONSULTANT has so far obtained information on existing maps and GIS layers (**Annex II**) and a preliminary list of existing/planned hydropower projects (**Annex III**).

Considering the latter, current and future energy situations were assessed from analyzing this data. The different types of hydropower projects per province were assessed, along with the total generation capacity in each region. For this purpose, the following definition is considered:

- Small Hydropower Plant (SHP) – under 30 MW;
- Medium Hydropower Plant (MHP) – under 100 MW;
- Large Hydropower Plant (LHP) – above 100 MW;
- Pumped-Storage Plant (PSP) – any capacity.

This definition was also considered due to the type of information gathered. While the LHP and PSP list contains the installed capacity and the status of the development per project (*in operation, under construction* or *planned*), the MHP list only contains the projects in *preparing for construction* status, and the SHP list only contains the number of projects and total installed capacity per status (*in operation, under construction, FS preparing* or *Planned with no developer*) and per province, without any specific information about the projects. The information processed by the CONSULTANT on LHP, MHP and PSP is presented in **Table 3.1**, while information regarding SHP is presented in **Table 3.2**.

Table 3.1 – LHP, MHP and PS gathered information.

Name of project	Install capacity (MW)	Type	Prov. Eng	Status
Hòa Bình	1920	LHP	Hoa Binh	In Operation
Thác Bà	108	LHP	Yen Bai	In Operation
Yali	720	LHP	Gia Lai	In Operation
Đa Nhim	160	LHP	Lam Dong	In Operation
Hàm Thuận	300	LHP	Lam Dong	In Operation
Đa Mi	175	LHP	Lam Dong	In Operation
Thác Mơ	150	LHP	Binh Phuoc	In Operation
Trị An	400	LHP	Dong Nai	In Operation
Tuyên Quang	342	LHP	Tuyen Quang	In Operation
Bản Chát	220	LHP	Lai Chau	In Operation
Huội Quảng	520	LHP	Son La	In Operation
Sơn La	2400	LHP	Son La	In Operation
Bản Vẽ	300	LHP	Nghe an	In Operation
A Vương	210	LHP	Quang Nam	In Operation
Kanak-An Khê	173	LHP	Gia Lai	In Operation
Sông Tranh 2	190	LHP	Quang Nam	In Operation
Sông Ba Hạ	220	LHP	Phu Yen	In Operation
Đại Ninh	300	LHP	Lam Dong	In Operation
Plei Krông	110	LHP	Kon Tum	In Operation
Sêsan 3	260	LHP	Gia Lai	In Operation
Sêsan 4	330	LHP	Gia Lai	In Operation

Name of project	Install capacity (MW)	Type	Prov. Eng	Status
Srêpok 3	220	LHP	Dac Lac	In Operation
Buôn Kuôp	280	LHP	Dac Lac	In Operation
Đồng Nai 3	240	LHP	Lam Dong	In Operation
Đồng Nai 4	270	LHP	Lam Dong	In Operation
Nam Chien 1	210	LHP	Son La	In Operation
Khe Bố	100	LHP	Nghe an	In Operation
Hủa Na	180	LHP	Nghe an	In Operation
Nho Quế 3	135	LHP	Ha Giang	Under Construction
Lai Châu	1200	LHP	Lai Chau	Under Construction
Trung Sơn	250	LHP	Thanh Hoa	Under Construction
A Sap	150	LHP	Thura Thien Hue	Under Construction
Sông Bùng 2	100	LHP	Quang Nam	Under Construction
Sông Bùng 4	145	LHP	Quang Nam	Under Construction
Đakmi 1	200	LHP	Quang Nam	Under Construction
Đakmi 4	140	LHP	Quang Nam	Under Construction
Thượng Kontum	260	LHP	Kontum	Under Construction
Đông Phù Yên (storage)	1200	PSP	Son La	Planned
Bác Ái (storage)	1050	PSP	Ninh Thuan	Planned
Long Tao	42	MHP	Dien Bien	Planned
Nam Pan 5	34,5	MHP	Son La	Planned
Song Lo 6	44	MHP	Ha Giang	Planned
Chi Khe	41	MHP	Nghe An	Planned
Son Tra 1	42	MHP	Quang Ngai	Planned
Bao Lam (1+2+3)	116	MHP	Cao Bang	Planned
Yen Son	70	MHP	Tuyen Quang	Planned
Cam Thuy 2	38	MHP	Thanh Hoa	Planned
Nam Mo 1	95	MHP	Nghe An	Planned
Vinh Son 2	80	MHP	Binh Dinh	Planned
Pa Ma	80	MHP	Dien Bien	Planned
Phu Tan 2	60	MHP	Dong Nai	Planned
Thanh Son	40	MHP	Dong Nai	Planned

Table 3.2 – SHP gathered information.

Province	In Operation		Under construction		FS preparing		Planning	
	Nr.	MW	Nr.	MW	Nr.	MW	Nr.	MW
Ba Ria - VTau|Ba Ria-Vung Tau	0	0,0	1	2,50	0	0,0	0	0,0
Bac Kan|Bac Can	3	10,1	1	5,00	1	4,5	23	26,4
Binh Thuan	1	6,6	6	64,50	6	43,7	0	0,0
Binh Dinh	0	0,0	0	0,00	2	17,5	0	0,0
Binh Duong	2	6,4	3	27,20	3	16,0	10	28,1
Binh Phuoc	1	33,0	2	22,00	4	28,0	2	9,0
Cao Bang	10	32,4	6	50,90	10	68,5	10	24,4
Da Nang City|Da Nang	0	0,0	4	50,20	2	5,2	2	6,7
Dak Lak|Dac Lac	11	57,1	2	10,00	5	26,2	3	12,2
Dac Nong	8	59,3	3	36,00	13	75,7	1	1,9
Dien Bien	7	20,5	3	67,50	12	216,4	22	127,8
Gia Lai	28	168,9	11	71,75	7	35,0	2	12,5
Ha Giang	15	193,0	7	93,70	16	176,9	6	35,3
Ha Tinh	2	36,0	0	0,00	5	63,1	1	1,0
Hoa Binh	5	13,6	4	15,30	0	0,0	0	0,0
Khanh Hoa	1	28,0	3	56,00	1	7,0	0	0,0
Kon Tum	7	82,2	15	97,30	20	149,3	2	11,5

Province	In Operation		Under construction		FS preparing		Planning	
	Nr.	MW	Nr.	MW	Nr.	MW	Nr.	MW
Lai Chau	4	20,5	8	70,30	22	242,9	9	76,6
Lam Dong	9	84,5	7	77,90	14	92,2	4	21,6
Lang Son	1	4,5	5	54,40	1	2,0	7	12,5
Lao Cai	27	281,6	20	409,10	28	216,8	2	10,0
Nghe An	4	38,5	11	174,40	6	93,0	1	2,0
Ninh Thuan	2	15,6	1	10,50	2	14,8	0	0,0
Phu Tho	0	0,0	1	2,60	1	4,0	0	0,0
Phu Yen	0	0,0	3	31,00	1	4,8	1	1,6
Quang Binh	1	13,5	1	22,00	3	38,5	21	68,8
Quang Nam	11	88,0	4	189,00	19	166,8	1	4,2
Quang Ngai	4	33,1	1	1,80	13	240,7	3	14,5
Quang Ninh	1	3,6	1	3,60	3	28,4	0	0,0
Quang Tri	2	9,4	6	71,50	0	0,0	3	8,0
Son La	20	251,1	18	221,20	13	131,6	9	65,0
Tay Ninh	1	1,5	1	1,50	0	0,0	0	0,0
Thai Nguyen	1	1,9	0	0,00	0	0,0	0	0,0
Thanh Hoa	2	3,0	3	30,60	0	0,0	1	6,0
Thua Thien - Hue	0	0,0	3	55,20	5	52,0	2	8,0
Tuyen Quang	0	0,0	1	8,00	1	9,5	0	0,0
Yen Bai	15	68,425	13	255,90	10	56,8	7	43,6
Total	**206**	**1665,6**	**179**	**2360,4**	**249**	**2327,7**	**155**	**639,2**
To be commissioned until 2015				***4025,9***	***MW***			

Considering this, the CONSULTANT proceeded to digitize the above information and depict the current and future hydropower-based generation situation per province in Vietnam in the next figures.

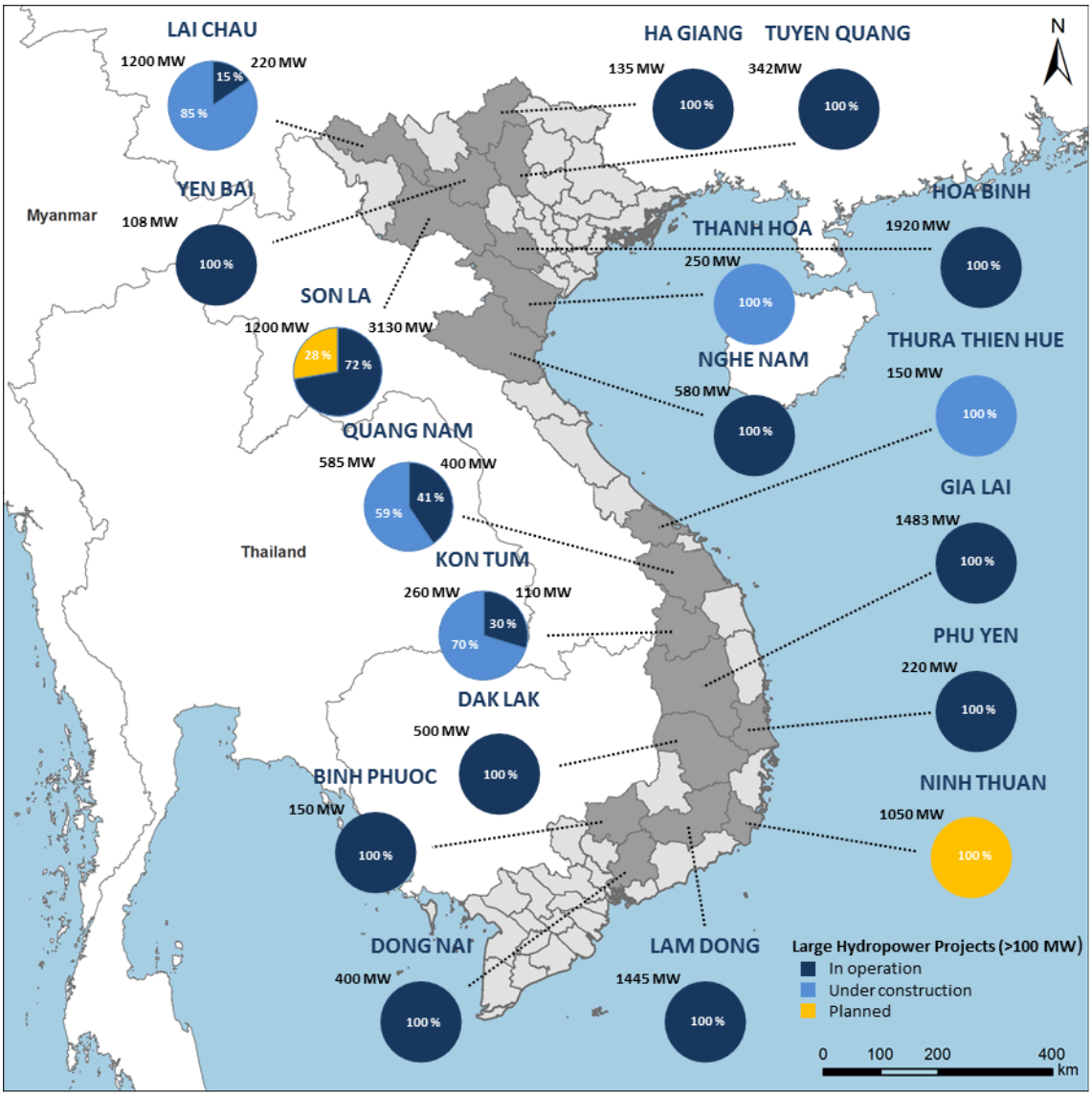
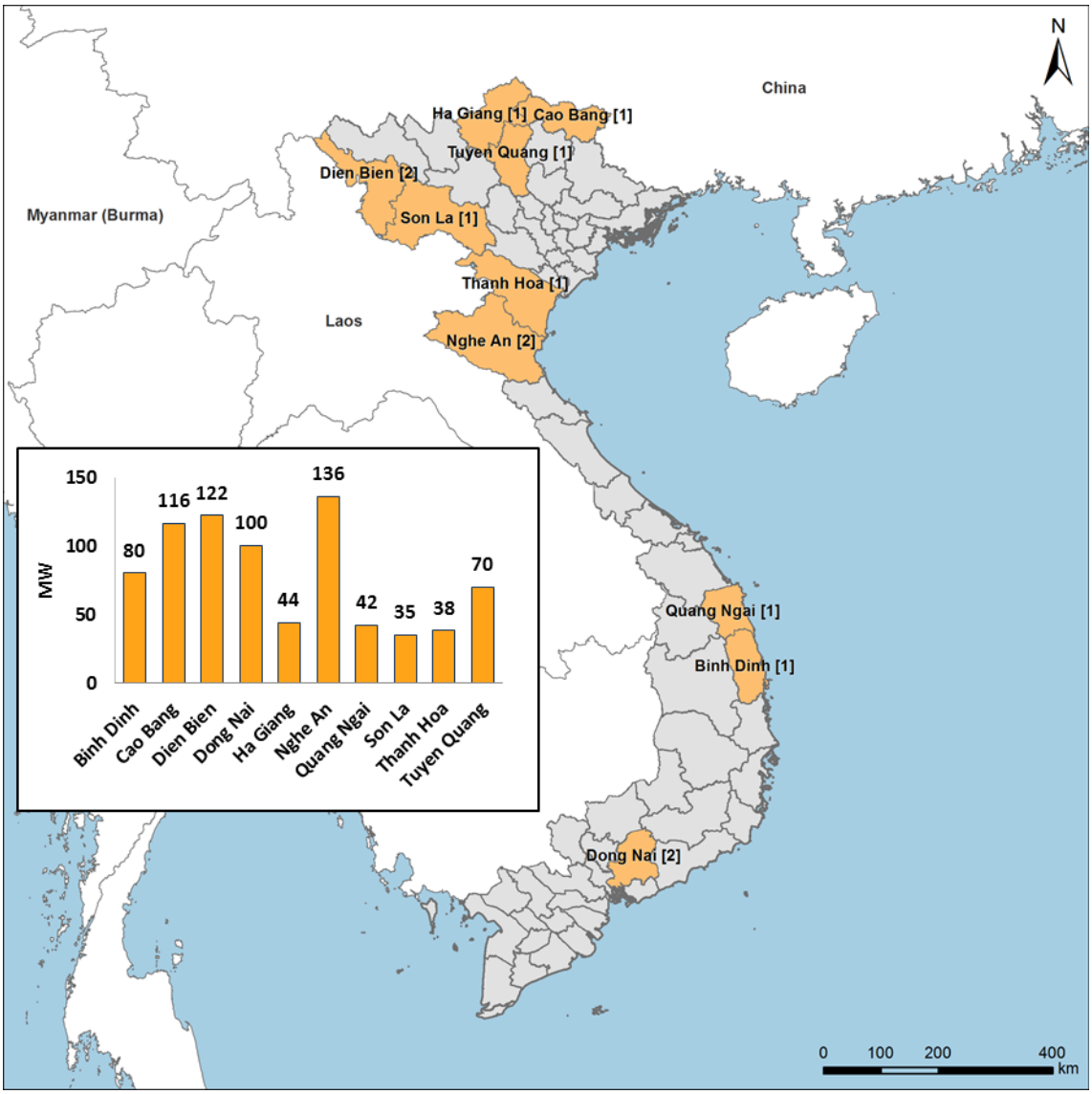


Figure 3.2 – Current and future situation for LHP (CONSULTANT's processing).



[#] – Number of sites per province

Figure 3.3 – MHP *preparing for construction* status (CONSULTANT's processing).

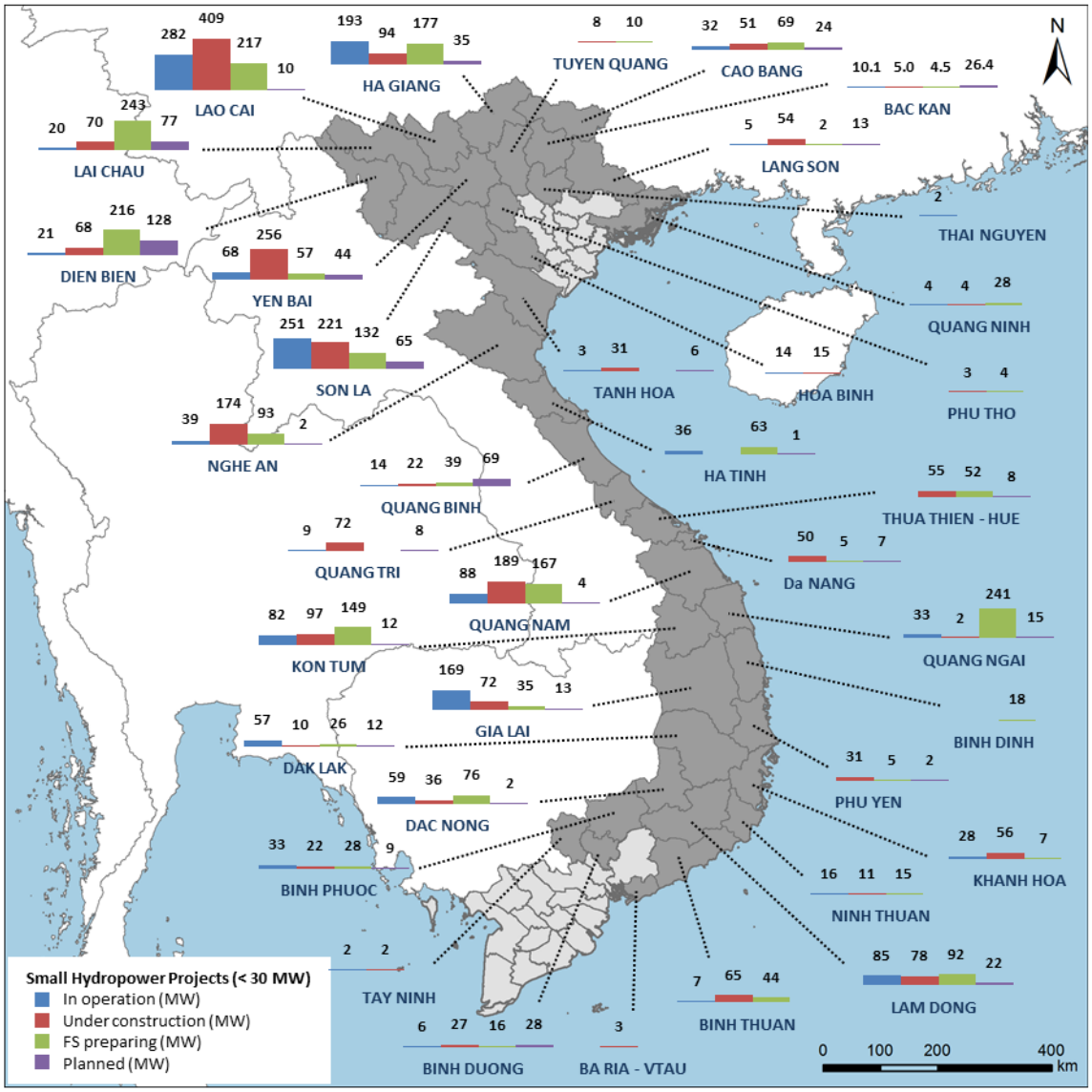


Figure 3.4 – Current and future situation for SHP (CONSULTANT's processing).

Since no coordinates were available in the information provided, the CONSULTANT used the *Vietnam Energy Map* from Japan External Trade Organization (JETRO), which is based on the National Power Development Master Plan VI (PDP VI), in order to geo-reference the data collected, while adding some additional projects. Likewise, the transmission network, pipelines and other source based power plants were digitized into GIS layers, being represented in **Figure 3.5**.

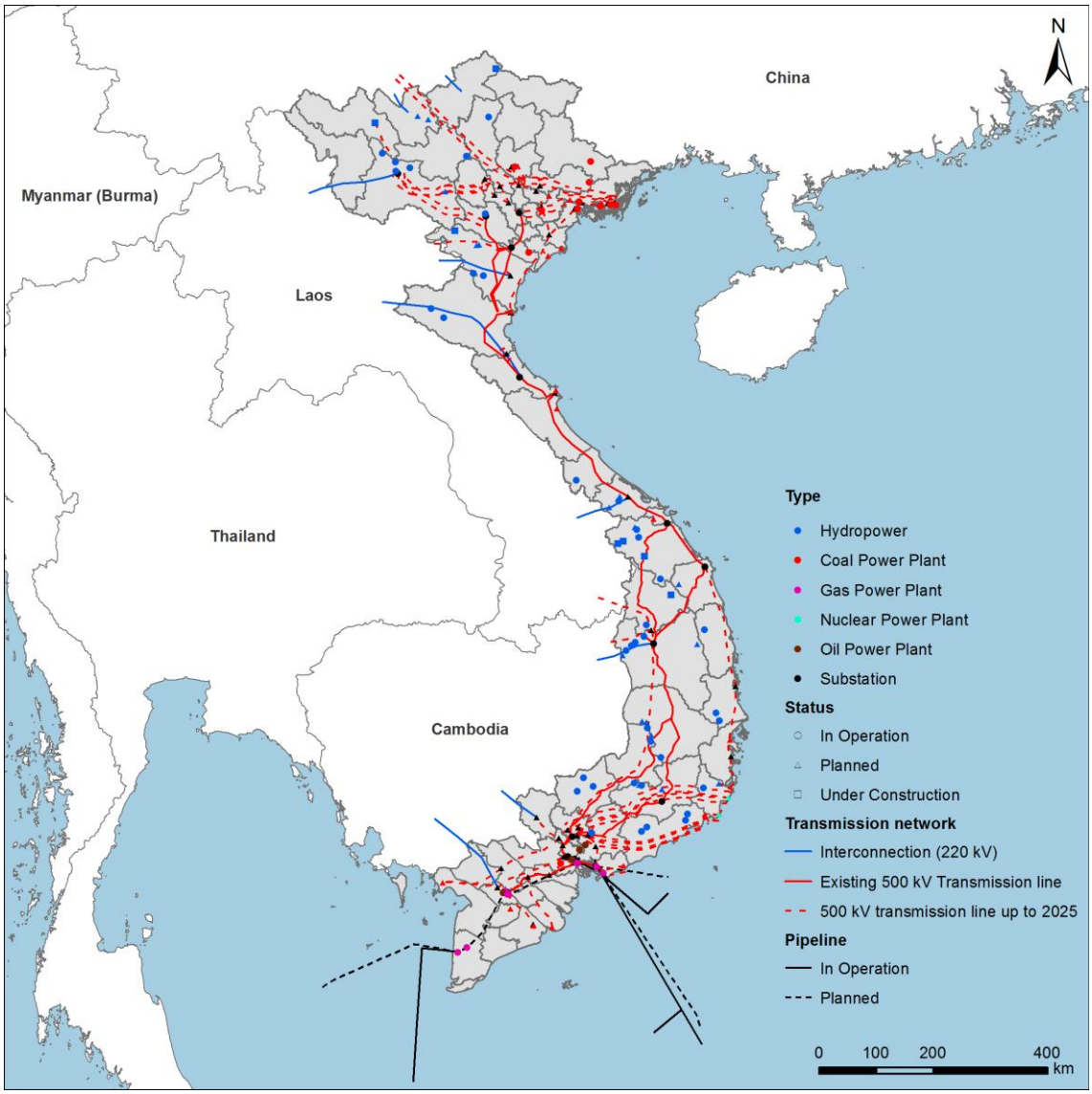


Figure 3.5 – Vietnam Energy Map (CONSULTANT's processing).

3.5 INSTITUTIONAL ASSESSMENT OF MOIT'S CAPACITY ON GIS

The IM included an institutional assessment to identify factors that will be essential for the project's implementation and sustainability of its results, with emphasis given to MOIT's institutional capacity for GIS database development, operation and maintenance.

This was a straightforward task since from the meeting held with the Client at October 15, 2014 (**Annex I**) there is currently no GIS knowledge nor GIS or Applied Database software licenses within GDE. The current Operating System is Microsoft Windows and there is manifest lack of storage capacity.

3.6 CHALLENGES IN THE PROJECT

On a primary level the major challenge identified during the IM for this project will be the seamless coordination between National and International Consultants.

On a secondary level other major challenges will be the language barrier for the International Consultant, the comprehensive data collection activity for the National Consultant and the decision between types of software to use.

These subjects will be addressed in **subchapter 5.1**.

4 COMPILATION OF GLOBALLY AVAILABLE DATA

4.1 CONTEXT

As stated previously, all local datasets shall be gathered by the National Consultant. Data coming from a local (usually official) source should always be preferable when compared with data from other sources, such as globally available data.

Nonetheless, the CONSULTANT is expected to conduct a complementary compilation of readily available (global) geographic data for Vietnam and use it in the event that any of the data is not locally available.

Given the CONSULTANT's experience, the types and sources of globally available datasets with relevance to the project might be:

- Meteorological Data - Rainfall, Temperature, Evaporation (e.g. from WorldClim);
- Digital Terrain Models, River Network, Catchment areas (e.g. from NASA's Shuttle Radar Topography Mission - SRTM);
- List of large dams (e.g. from ICOLD);
- Rails, roads, water bodies, rivers (e.g. from Digital Chart of the World);
- Administrative boundaries (e.g. from GADM);
- Administrative layers (city points, districts, localities, civil divisions, neighborhoods), geographic features (parks, forests, lakes, islands), points of interest (schools, markets, hospitals, temples, etc.), and roads and rails (e.g. from Google Map Maker);
- The coastline, highways, key locations, natural areas, points of interest, water bodies (e.g. from Open Street Map - crowd-sourced and updated frequently);
- Settlements and population (e.g. from Open Street Map)
- Protected lands (e.g. from Protected Planet);
- Land cover map (e.g. from ESA GlobCover);

This compilation was planned to be developed after the Inception Phase but the CONSULTANT decided to anticipate it. The preliminary results of the globally available data ready to be used in the development of the SHP database are presented in the next subchapters.

4.2 HYDROLOGICAL AND METEOROLOGICAL DATA

Hydrological and meteorological info are amongst the most important type of data for SHP, and should preferably be collected locally. However, in the event that no detailed hydro or meteo data is available for the development of the study, an alternative might be the use of global data sources such as the WorldClim project, the Tropical Rainfall Measuring Mission or the NCEP/NCAR reanalysis [1].

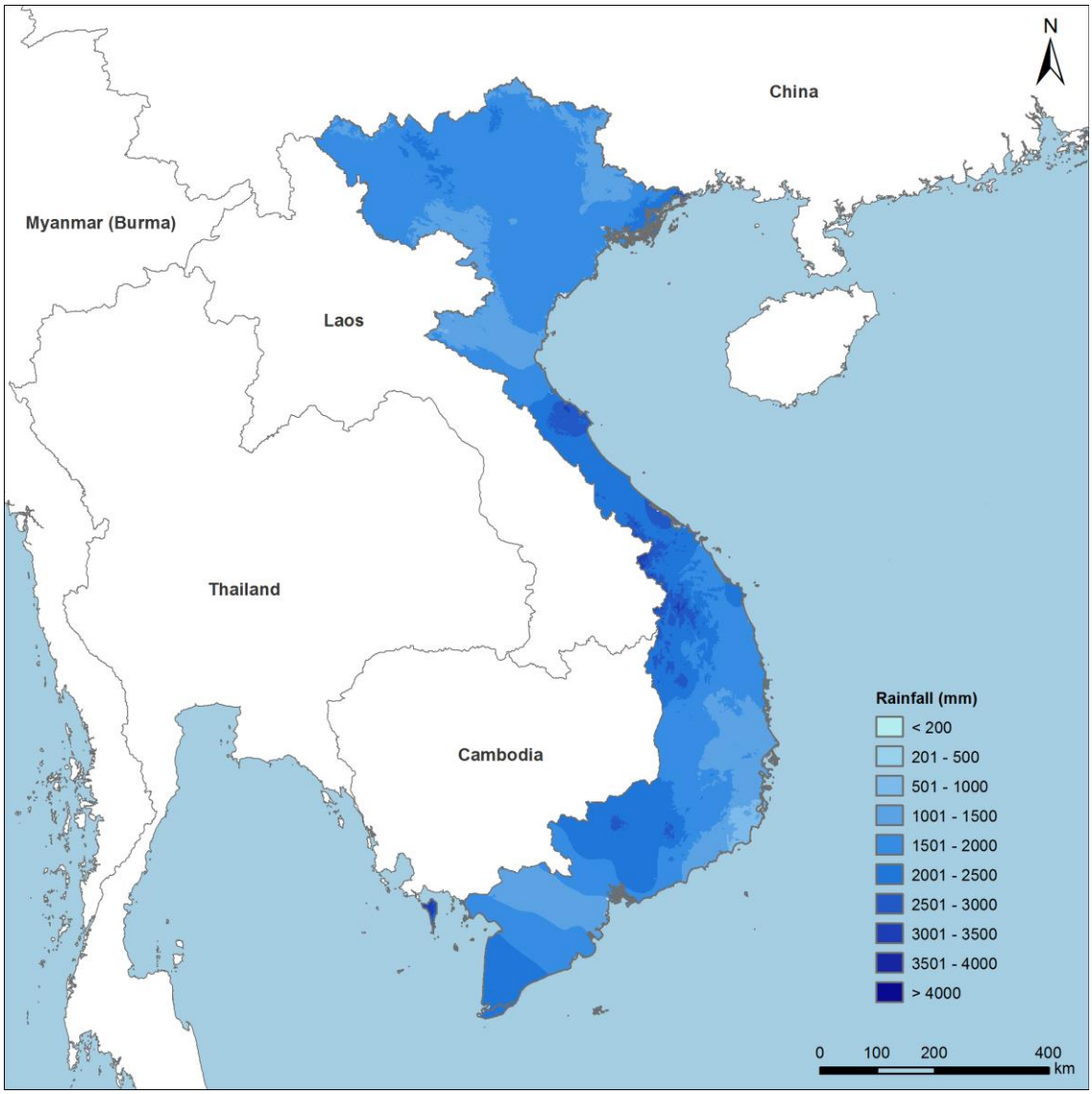


Figure 4.1 – Mean annual rainfall in Vietnam (WorldClim data, CONSULTANT's processing).

These global data sources allow an estimation of the rainfall and temperature, even though it is advisable to have at least some good quality ground stations to assess the global data sources level of accuracy. As an example, **Figure 4.1** and **Figure 4.2** respectively present the mean annual rainfall and temperature for Vietnam, obtained from data from the WorldClim project.

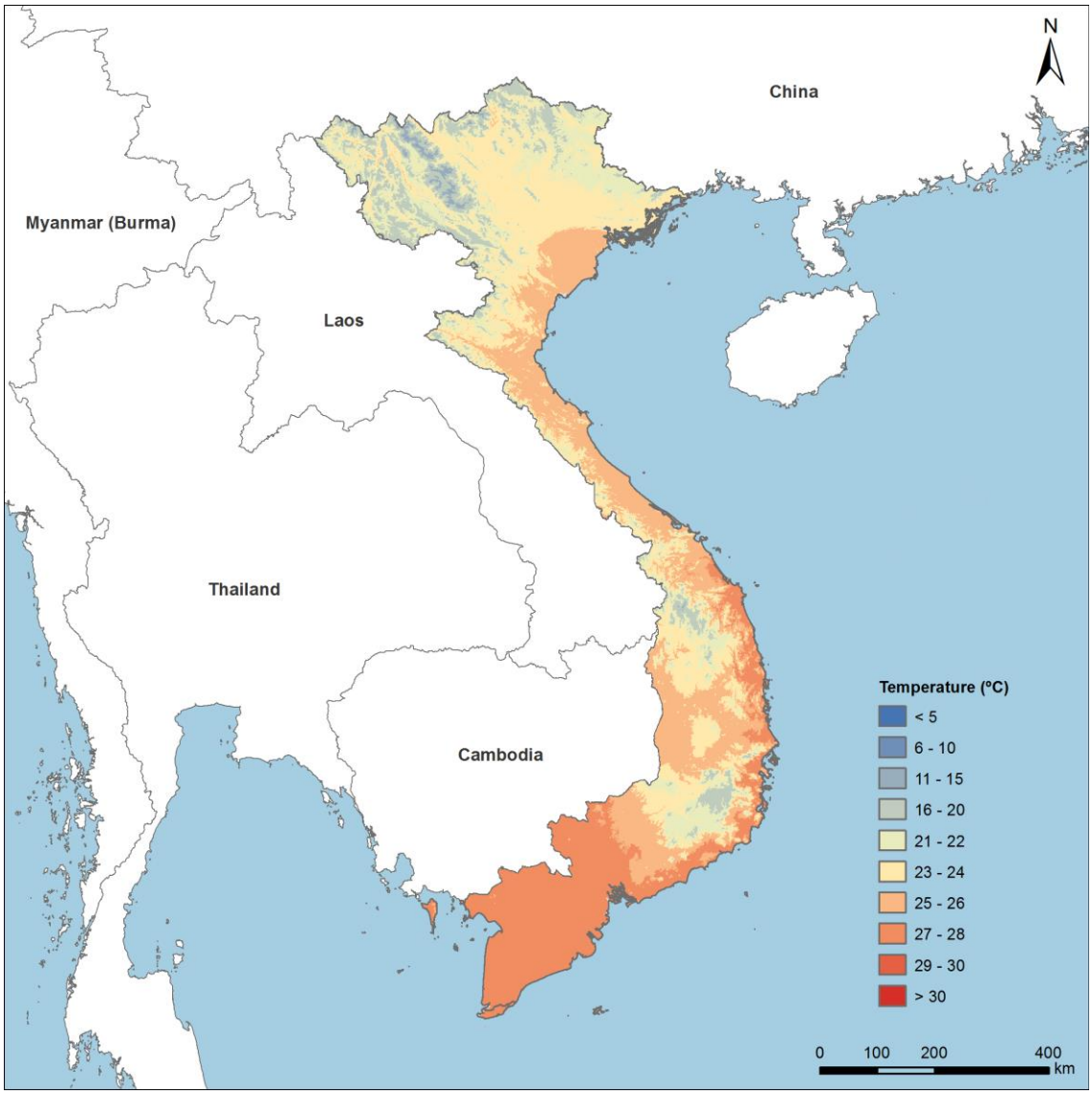


Figure 4.2 – Mean annual temperature in Vietnam (WorldClim data, CONSULTANT's processing).

4.3 PROTECTED AREAS

Protected areas are also one of the most important factors in the assessment of a potential site for a hydropower plant and energy planning in general. The environmental impact can be a decisive factor and should be initially evaluated on a desktop level to avoid any possible conflicts. This information should be from official source to guarantee its authenticity.

Alternative information is available in the World Database of Protected Areas (WDPA), such as the one presented in **Figure 4.3** [2]. The WDPA is a joint venture between the United Nations Environment Programme's World Conservation Monitoring Centre (UNEP – WCMC) and the International Union for Conservation of Nature's World Commission on Protected Areas (IUCN – WCPA). It is the largest database both on terrestrial and marine protected areas, collected from the international convention secretariats, governments and NGO's.

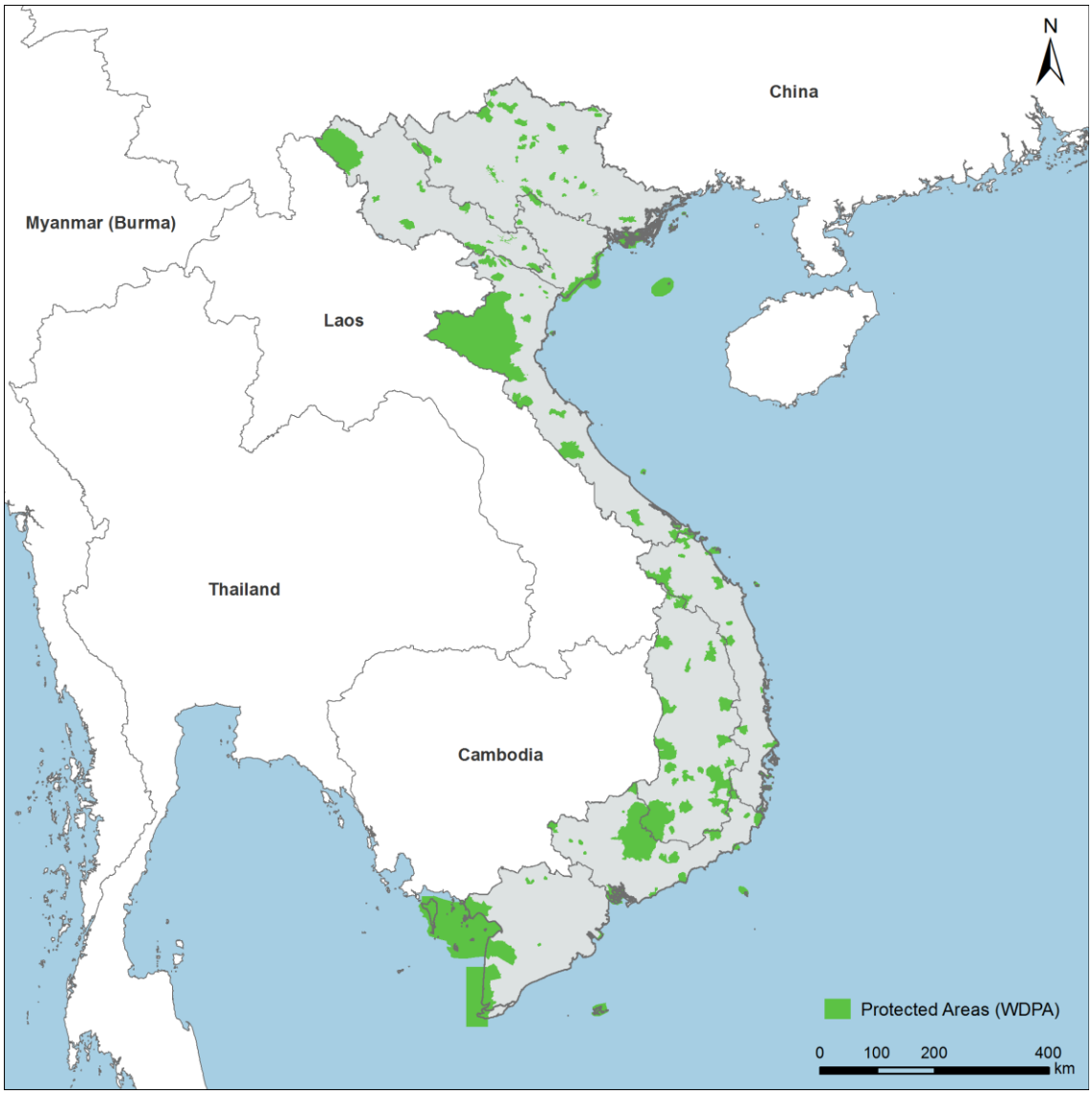


Figure 4.3 – Protected areas (WPDA data, CONSULTANT's processing).

4.4 LAND COVER

Land cover may be a decisive factor when assessing a SHP site, and if it is not possible to obtain this data locally, it is possible to obtain it from global datasets, such as *GlobCover* from the European Space Agency (ESA). The most recent version of the *GlobCover* land cover dates is from 2010 and is presented in **Figure 4.4** [3].

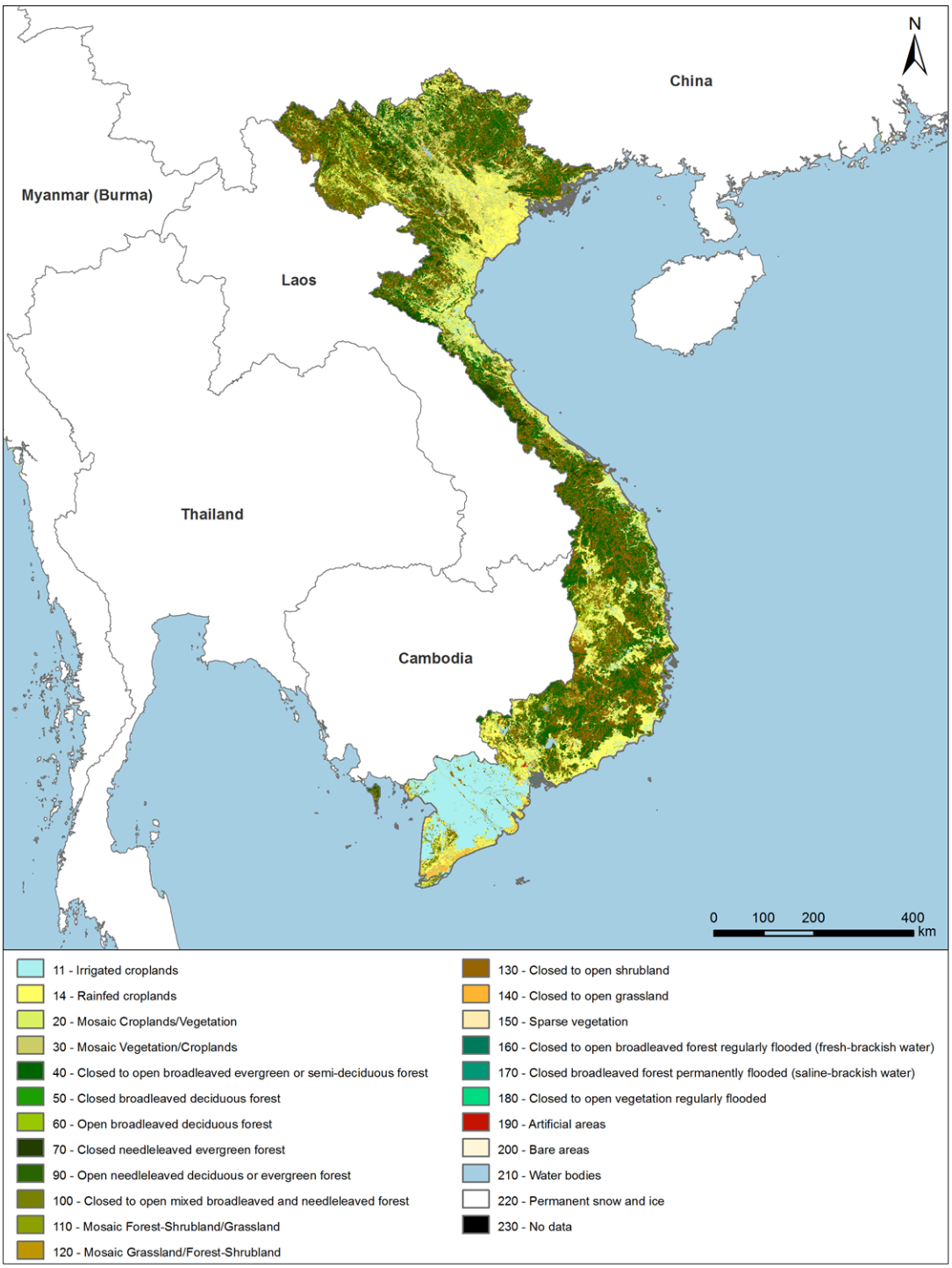


Figure 4.4 – Land Cover (*GlobCover* 2010 data, CONSULTANT's processing).

4.5 LAND USE

Such as protected areas and land cover, land use is also very important for the environmental impact assessment, especially when specific areas may prevent the development of hydropower projects. Once again, if it's not possible to obtain this data locally, it is possible to obtain it from global datasets, such as *GeoNetwork*, as presented in **Figure 4.5** [4]. This open-source global database, belongs to Food and

Agriculture Organization of the United Nations (FAO), and allows easily sharing geographically referenced thematic information between different organizations.

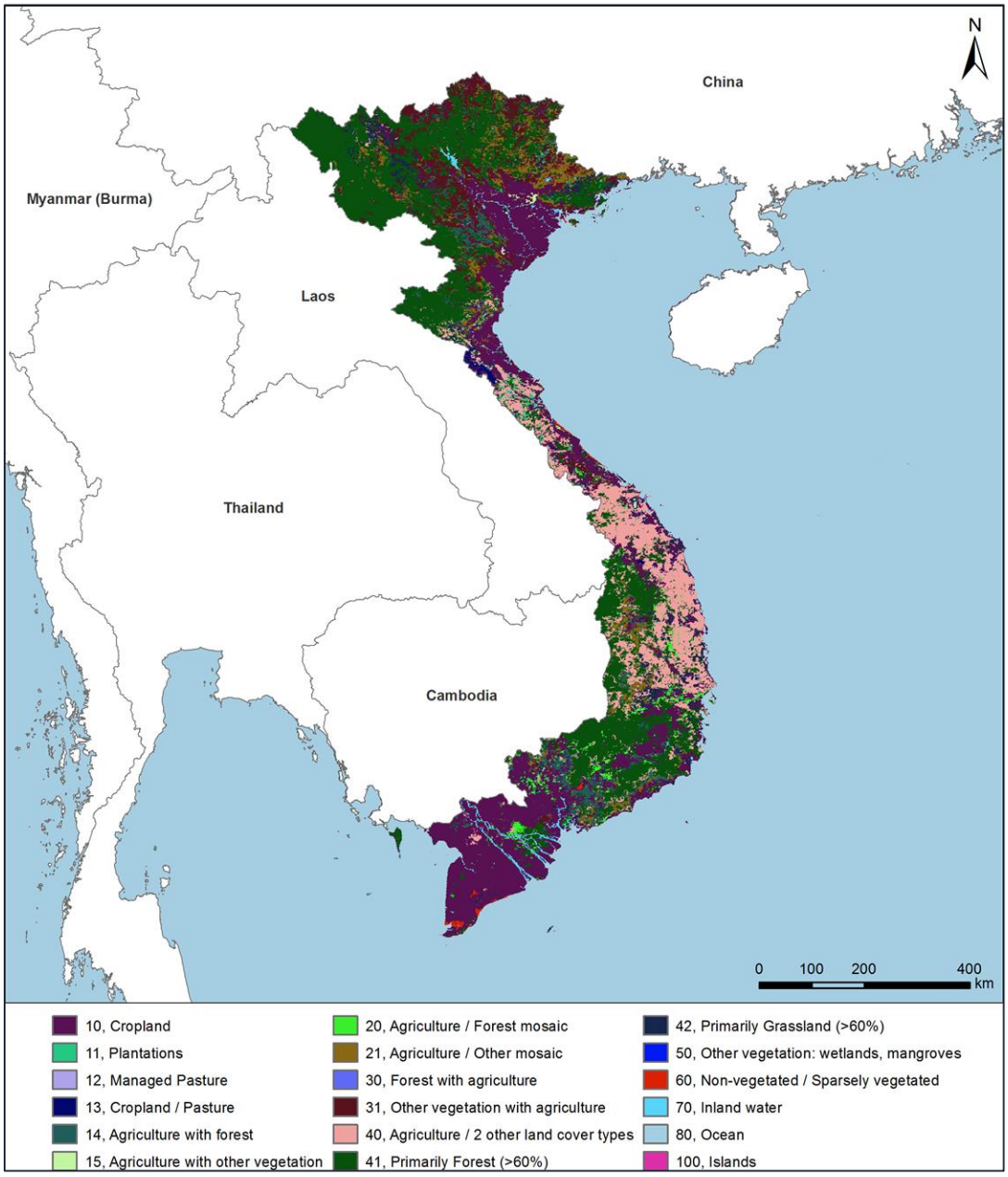


Figure 4.5 – Land Use (*GeoNetwork*, CONSULTANT's processing).

On a different note, land property is one of the issues that the National Consultant could evaluate along the project, with the purpose of a better understanding on how to grant/own land for the implementation of hydropower plants and how the ownership of land may impact on project delays or its feasibility. For this sake, the mapping of different types of ownership or concession of land would be useful, though the CONSULTANT is not aware if such information is available.

4.6 ROAD AND RAILROAD NETWORK

The road and railroad networks presented below in **Figure 4.6** were obtained from *Open Street Map*, a vector-based collection worldwide GIS data, with global coverage at public domains. This data may be used if no other local data can be obtained [5].

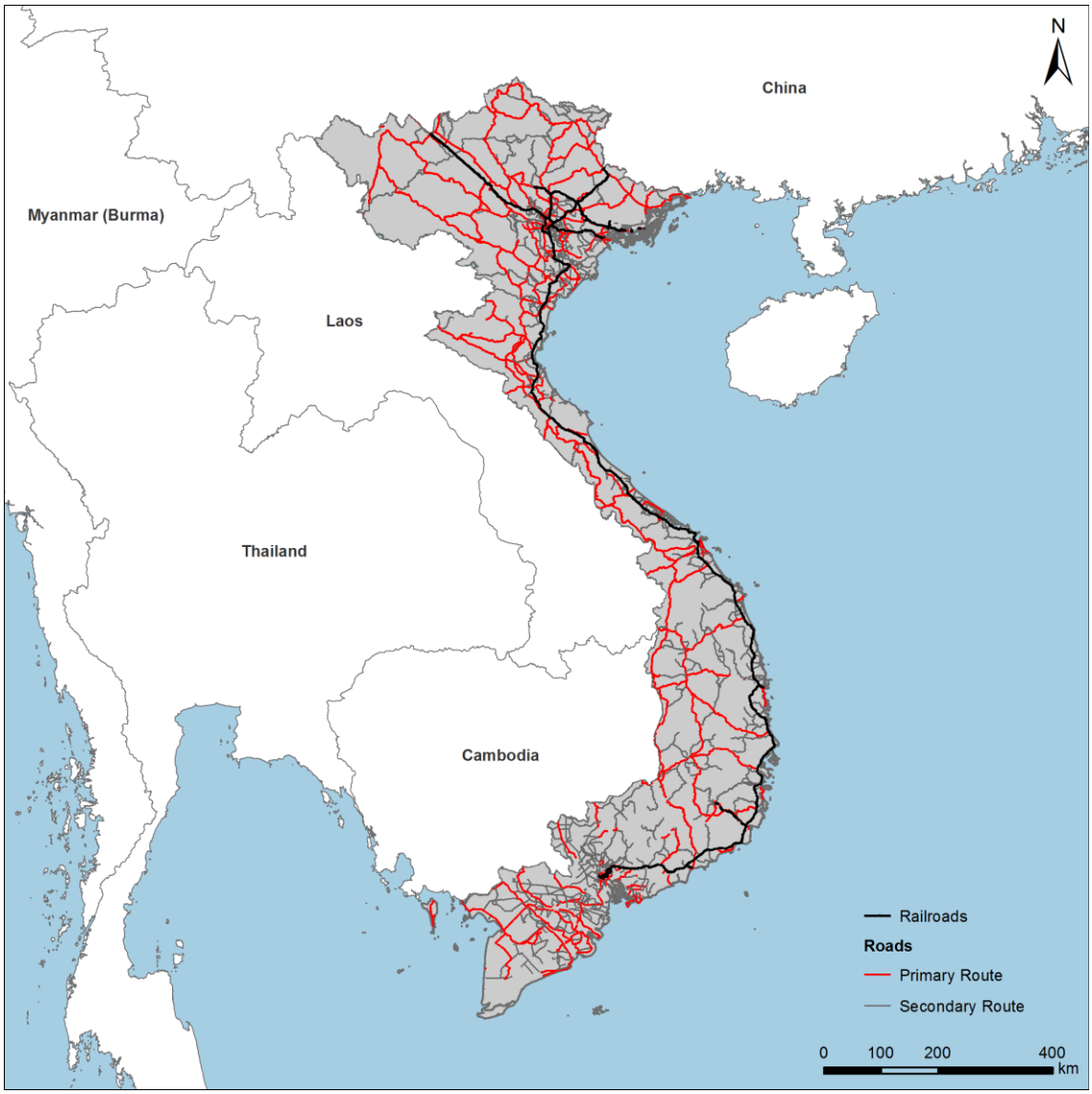


Figure 4.6 – Road and railroad network (*Open Street Map* data, CONSULTANT's processing).

4.7 MORPHOLOGICAL DATA

Contour data, as well as river and streams, may be derived from a Digital Elevation Model (DEM). Since the scope of work is SHP, the DEM resolution should be as refined as possible, and so, if a more detailed DEM exists locally, it should be obtained. An alternative dataset for this purpose is the larger scale universally used digital elevation dataset provided by the Shuttle Radar Topography Mission (SRTM), presented in **Figure 4.7** [6].

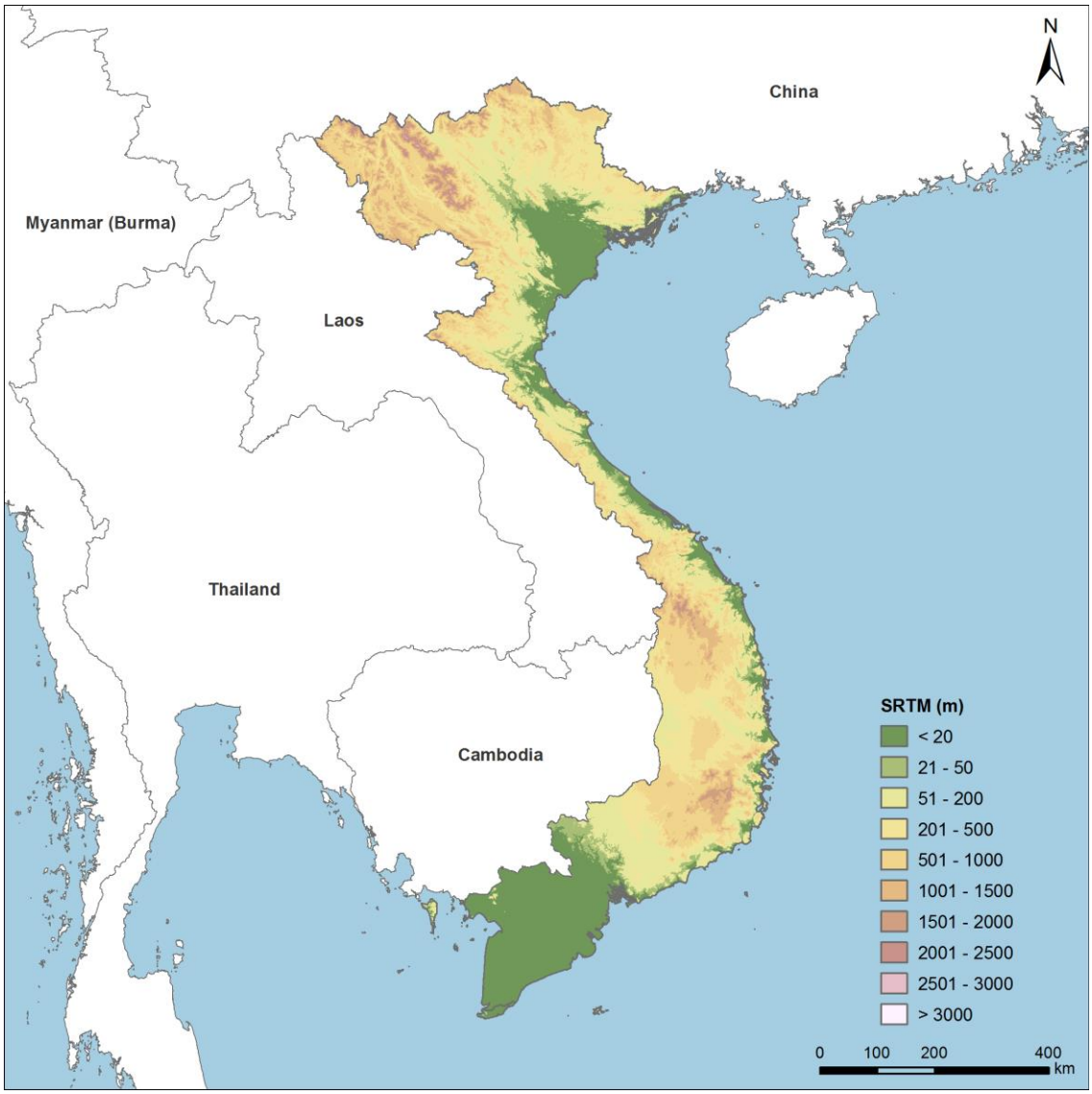


Figure 4.7 – Digital global elevation data (SRTM data, CONSULTANT's processing).

As mentioned, river and streams may be derived from a DEM. An example of this approach, using the SRTM, is presented in **Figure 4.8**.

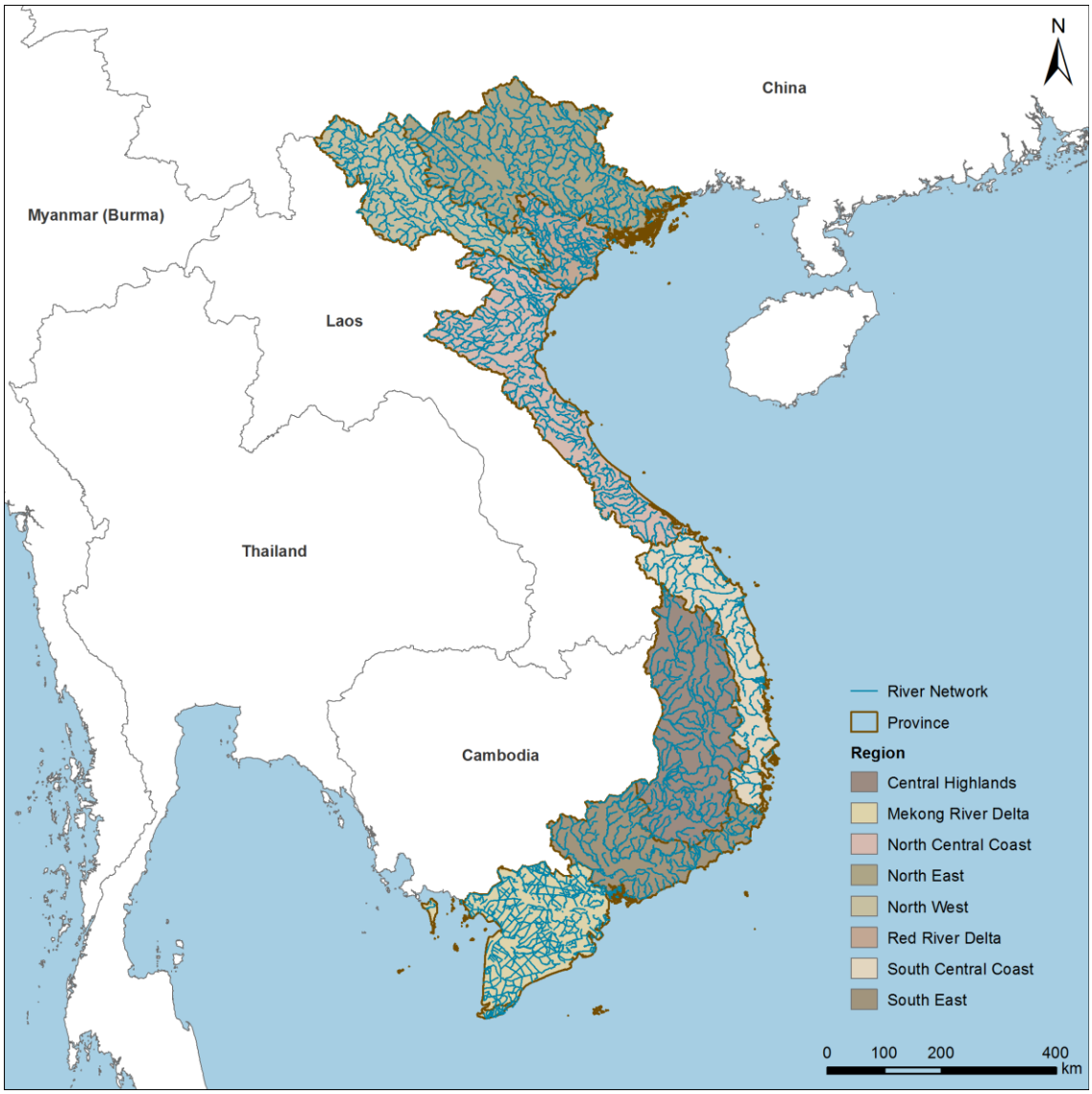


Figure 4.8 – River and Streams derived from a DEM (SRTM data, CONSULTANT's processing).

A better resolution but less widespread alternative to the SRTM is the Advanced Spaceborne Thermal Emission and Reflection Radiometer[2] (ASTER). The comparison between these two source alternative datasets is presented in **Table 4.1**.

[2] ASTER GDEM is a product of METI and NASA.

Table 4.1 – Comparison between alternative DEM datasets.

	ASTERGDEM	SRTM
Data source	ASTER	Space shuttle radar
Generation and distribution	METI/NASA	NASA/USGS
Release year	V1 ~2011 V2	~2003 V1 ~2007 V4.1
Data acquisition period	2000 ~ ongoing	11 days (in 2000)
DEM resolution	30m	90m
DEM accuracy (stdev.)	7~14m	10m
DEM coverage	83 degrees north ~ 83 degrees south	60 degrees north ~ 56 degrees south
Area of missing data	Areas with no ASTER data due to constant cloud cover (supplied by other DEM)	Topographically steep area (due to radar characteristics)

The main problems with the use of large scale DEMs like SRTM or ASTER for SHP assessment may be summarized in two issues:

- The lower the resolution, the worst the hydraulic head and overall costs estimation;
- The stream network derived from flow accumulation procedures will present some deviations, sometimes getting the wrong path. This is more prone in larger scales.

4.8 ADMINISTRATIVE BOUNDARIES

Administrative boundaries are crucial to extract location information for the projects and to correctly identify the local entities to be consulted. This information should be officially provided, as it is likely to change periodically. If this is not the case, the Global Administrative Areas database[3] (GADM) may be used, as the ones presented nationwide in **Figure 4.9** and in higher detail in **Figure 4.10** [7]. The available administrative divisions available for Vietnam are: country, regions, provinces, districts and communes.

[3] Version 2.0, January 2012

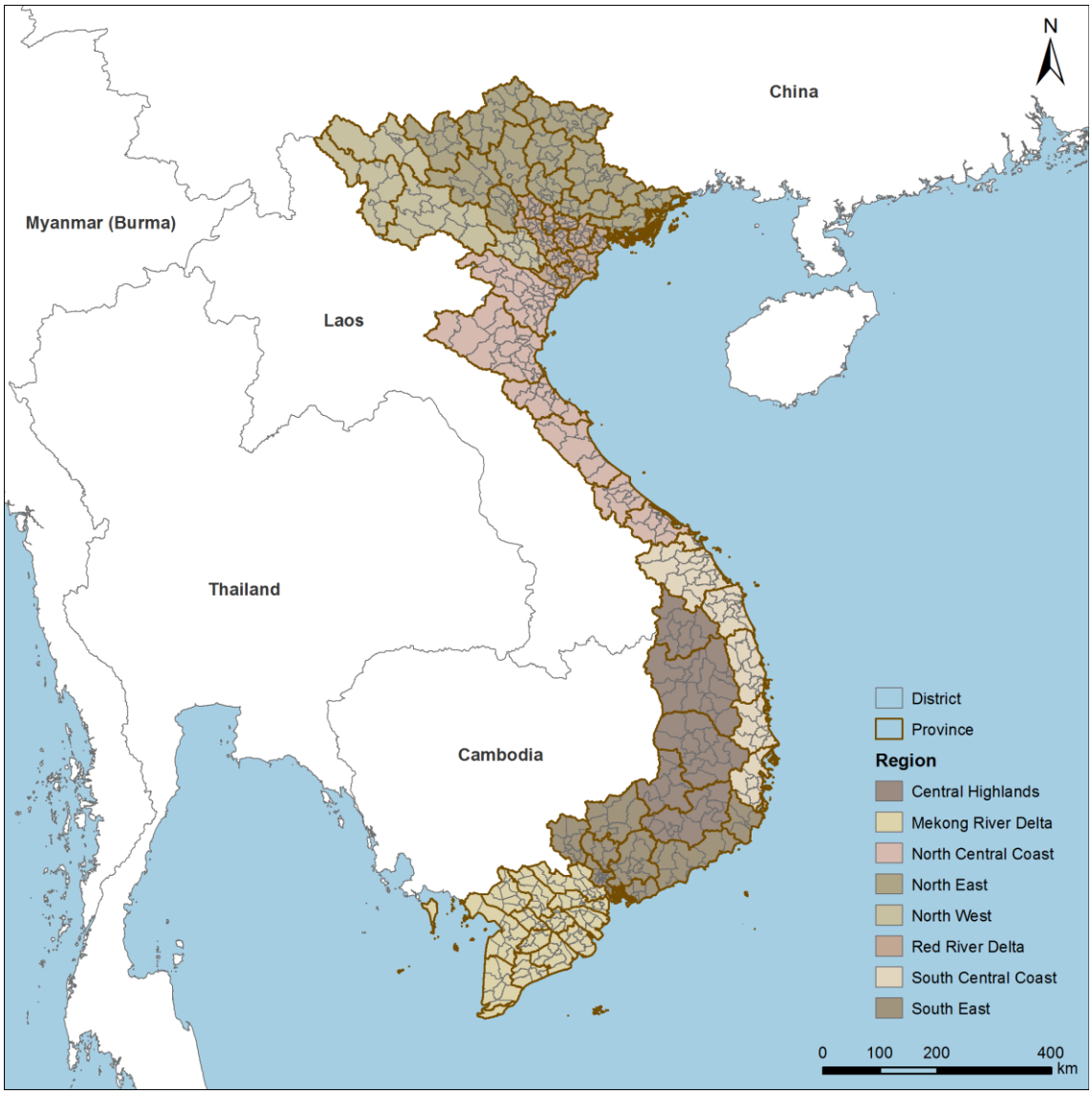


Figure 4.9 – Administrative divisions, district level (GADM data, CONSULTANT's processing).

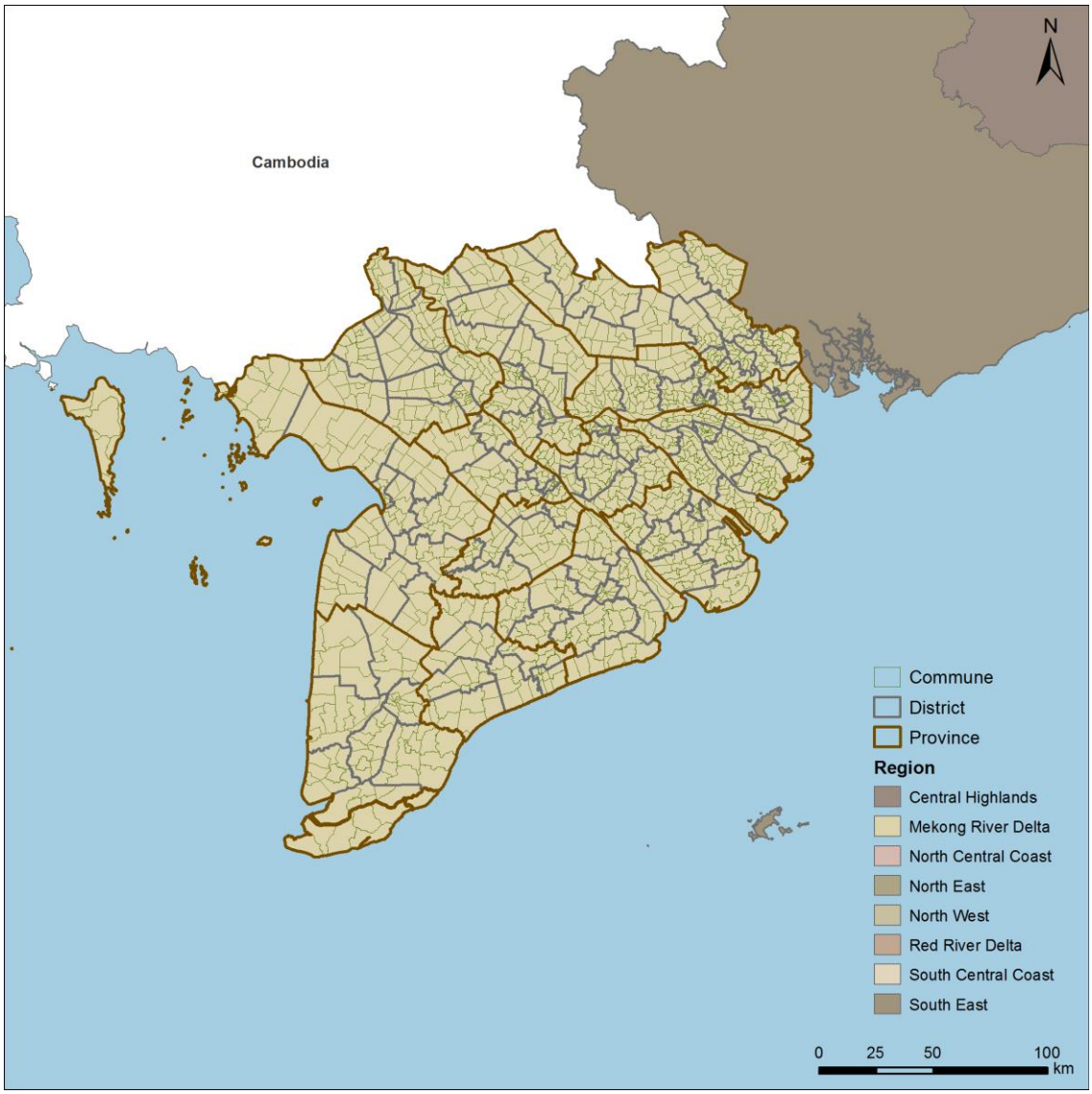


Figure 4.10 – Administrative divisions, detail at commune level (GADM data, CONSULTANT's processing).

4.9 SETTLEMENTS AND POPULATION

The information on settlements and population, respective loads, grid and mini-grids aggregation is crucial for the first design approach for the capacity of the hydropower projects.

The hydropower project levelized cost of energy is strongly dependent on its energy production, and consequently, its installed capacity. For the same site, all the capacities below the optimum balance between capacity and resource will result in higher generation costs. Nevertheless, the capacity is sometimes limited not by the resource but by the demand load side. For this reason, the population, expected loads and the aggregated load are essential information for adaptation of the hydropower potential to grid and population needs.

At this stage, available data was collected from these global data sources:

- Open Street Map;
- Geonet Names Server (GNS).

An example of information obtained from the GNS is displayed in **Figure 4.11**, where major settlements in each district are geo-referenced [8].

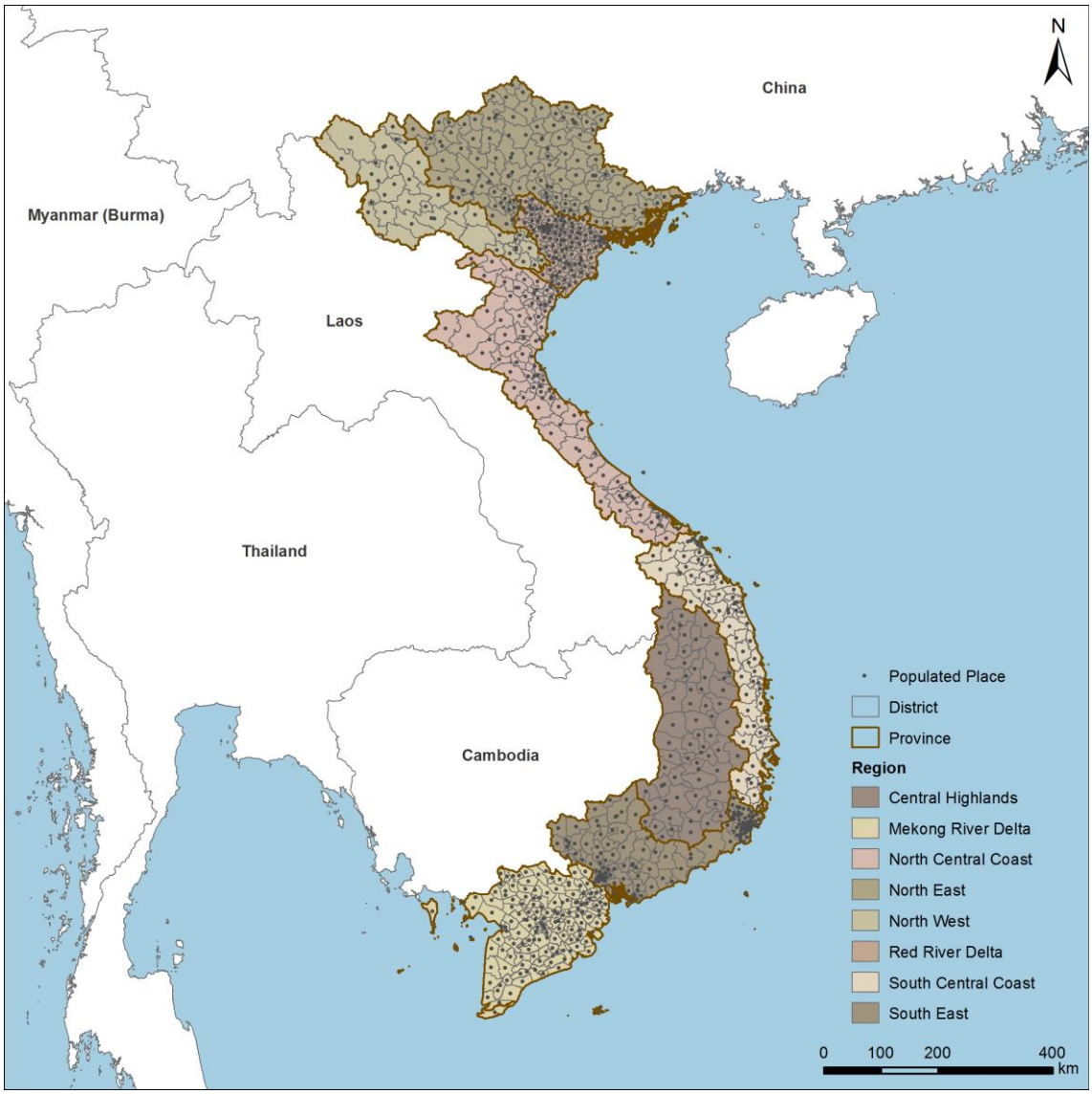


Figure 4.11 – Major settlements in each district (GNS data, CONSULTANT analysis).

It should be noted that this information is not official and population is not available. This data is considered relevant for the project and should therefore be gathered locally.

5 REVIEW OF THE IMPLEMENTATION PLAN

5.1 MAJOR CHALLENGES

5.1.1 CONTEXT

The most significant challenges identified during the IM for this project were the following (**subchapter 3.6**):

- Decision between software and hardware options;
- Comprehensive collection of data;
- Coordination between National and International Consultants.

In the next sections the CONSULTANT will address each of these issues.

5.1.2 SOFTWARE AND HARDWARE OPTIONS

The choice between software and hardware to adopt should be taken collectively between National and International Consultants and MOIT and the WBG, based on each party's previous experience and, especially in the case of MOIT and the WBG, internal policies and complementarity with other projects.

This selection is of great importance and should be made early in the project development since it will influence its design and implementation.

Early on during the IM the discussion on software has focused not so much on the different existing brands but more on the type of software, i.e., whether the option should be open source or proprietary. Following, the CONSULTANT will advise on this issue based on its own experience.

GIS Software

The choice of the right software for building-up a GIS project is a big investment either in time, resources or, sometimes, money. Different types of GIS software are available in the market such as proprietary options (ESRI ArcGIS, MapInfo, Global Mapper, etc.) and open source software (QGIS, GRASS GIS, gvSIG, etc.). A comparison between two of the most used open source (QGIS) and proprietary (ArcGIS) solutions is presented in **Table 5.1**.

Table 5.1 – Comparison between QGIS and ArcGIS.

	QGIS	ArcGIS
Cost	• Free downloadable open source software • Free plugins that enable customization • No maintenance contracts	• Commercial software that includes three desktop versions, • Different extensions and tools in separate modules very expensive (several thousands of dollars) • Costly maintenance contracts
Licensing	• No licensing concerns because QGIS is free and open source software • Loaded on any computer	• Software restricted through a computer license • Installation are regulated by a licensing key

	QGIS	ArcGIS
	• Numerous updates available each year	• Extensions with fixed licensing keys used in just one computer
Development	• Most development done by paid developers through contributions • Huge community of volunteers help on development of new features on QGIS software • The code is available for anyone to see and it can be modified by anyone allowing customization	• As proprietary software the development is performed by ESRI • The code is not available for use • The product that is purchased cannot be modified in anyway.
Platform	• Windows • Mac • Linux	• Windows
Support	• Support via dedicated websites, forums and blogs • Huge community of users can easily support in technical issues • Technical support for QGIS are available via OSGeo.org site • No maintenance contracts	• Specialized support well established in all ArcGIS products • Direct support 24/7 through direct contact to ESRI phone lines or emails. • Depending of maintenance contracts

In terms of security of sensitive data and capacity needed from the end-users, both options are similar, albeit in the latter case QGIS may be associated to a more intuitive and faster to learn alternative.

Based on the CONSULTANT's experience on advanced work with both options, the best solution for this project is the open source solution (QGIS). QGIS is a cross-platform free and open source desktop GIS application that provides visualization, editing and data analysis. QGIS is strong and powerful to use and provides a continuously growing number of capabilities provided by core function and plugins. QGIS provides integration with other open source programs including PostgreSQL, GRASS and MapServer ensuring extensive functionalities.

Database Software

Considering the database, the one to be implemented on this project should be relational to allow the management system to implement the relational model smoothly. Each database implements a different model to structure the data that is being managed in a logical fashion. The design and conceptualization of the database are the first step to preview how a database will work and handle the information contained therein. This type of database management systems requires structures (e.g. tables) to be defined to contain and work with data. Each column holds a different type of information and each record in the database, uniquely identified with keys, are related together, as defined within the relational model. The type of data and the attributes on each table has to be defined after the collection of all available data at different institutions and agencies.

Some of the most commonly used and popular relational database management systems (RDBMS) are presented in **Table 5.2**.

Table 5.2 – Popular relational database management systems.

	PostgreSQL:	MySQL:	SQLite:
Description	The most advanced, SQL-compliant and open-source objective-RDBMS	The most popular and commonly used RDBMS.	A very powerful, embedded relational database management system
Cost	Free, Open source	Proprietary (Oracle), Open source	Free, Open source
Supported Data Types	• bigint • bigserial • bit [(n)] • bit varying [(n)] • boolean: • box • bytea • character varying [(n)]: • character [(n)] • cidr • circle • date • double precision • inet • integer • interval [fields] [(p)] • line • lseg • macaddr • money • numeric [(p, s)] • path • point • polygon • real • smallint • serial • text • time [(p)] [without time zone] • time [(p)] with time zone: • timestamp [(p)] [without time zone] • timestamp [(p)] with time zone • tsquery • tsvector • txid_snapshot • uuid • xml	• Tinyint • Smallint • Mediumint • Int or integer • Bigint • Float • Double, double precision, real • Decimal, numeric • Date • Datetime • Timestamp • Time • Year • Char • Varchar • Tinyblob, tinytext • Blob, text • Mediumblob, mediumtext • Longblob, longtext • Enum • Set	• Null • Integer • Real • Text • Blob
Advantages	• An open-source SQL standard compliant RDBMS • Is supported by a devoted and experienced community which can be accessed through knowledge-bases and Q&A sites 24/7 for free; • Strong third-party support: PostgreSQL is adorned with many great and open-source third-party tools for designing, managing and using the management system. • It is possible to extend PostgreSQL programmatically with stored procedures	• Easy to work with; • Supports a lot of the SQL functionality that is expected from a RDBMS -- either directly or indirectly; • A lot of security features, some rather advanced, are built in MySQL; • Scalable and powerful; • MySQL works in very efficiently way thus providing speed gains.	• The entire database consists of a single file on the disk, which makes it extremely portable; • Although it might appear like a "simple" DB implementation, SQLite uses SQL;
Disadvantages	• For simple read-heavy operations, PostgreSQL might appear less performant than the counterparts	• Known limitations, comes with functional limitations that some state-of-the-art applications might require	• With no management connections to set

	PostgreSQL:	MySQL:	SQLite:
	• Given the nature of this tool, it lacks behind in terms of popularity, despite the very large amount of deployments • Due to above mentioned factors, it is harder to come by hosts or service providers that offer managed PostgreSQL instances.	• Reliability issues: The way certain functionality gets handled, renders it a little-less reliable compared to some other RDBMS's • Stagnated development: there are complaints regarding the development process since its acquisition;	access privileges to the database and tables • In SQLite is not possible to tinker with to obtain a great deal of additional performance.

Compared to other RDBMS, PostgreSQL stands out with its support object-oriented and/or relational database functionality, such as the complete support for reliable transactions, i.e. Atomicity, Consistency, Isolation and Durability. PostgreSQL is extremely capable of handling many tasks in a very efficiently way and can grant security to the data store inside through login and password.

Furthermore, PostgreSQL:

- Has good integration with QGIS, data can be integrated in QGIS writing directly in database;
- Works in different operation systems (LINUX, WINDOWS);
- Runs in different programming languages, including Python, Java, C/C++,.net, Ruby, etc.;
- Has almost unlimited storage space[4]:

Limit	Value
Maximum Database Size	Unlimited
Maximum Table Size	32 TB
Maximum Row Size	1.6 TB
Maximum Field Size	1 GB
Maximum Rows per Table	Unlimited
Maximum Columns per Table	250 - 1600 depending on column types
Maximum Indexes per Table	Unlimited

Taking in consideration the aspects described above and the needs of the GIS database for hydropower the CONSULTANT advises the use of PostgreSQL relational database for this project.

Image Server

Different datasets will be collected but the CONSULTANT recommends that not all should be stored in relational databases, like maps, photos, drawings, documents and *.pdf* files, since the inclusion of this type of data in the database is complex to manage and requires significant programming. Furthermore, it may reduce the easiness of use and loading speed. The alternative is to have this type of data available in a folder on a server, usually referred to as *Image Server*, connected through the database and available in the GIS software.

[4] Source: www.postgresql.org

One of the most widespread Image Servers is GeoServer, a server that swiftly allows the use of maps and aerial photos on GIS base and in map applications. It is another open-source software used as a server for sharing geospatial data and allows greater flexibility in map creation and data sharing using a great variety of formats. GeoServer can display data on any of the popular mapping applications such as Google Maps, Google Earth, Yahoo Maps, and Microsoft Virtual Earth.

Hosting server

The size of the hosting server is highly dependent on the type, amount and volume of data to be collected and the attributes of each layer. Usually, only after defining these data features it becomes possible to envisage the necessary size on server. The biggest volume of information will be given by all the raster information such as maps, digital elevation models, land cover, etc.

Hence, at this stage the CONSULTANT will not elaborate on the technical aspects of the hosting server but rather on the data collection effort by the National Consultant (**subchapter 5.1.3**), whose outcome will influence the selection of the most adequate hosting option.

5.1.3 COLLECTION OF DATA

Apart from the globally available data whose preliminary collection was performed and presented in **chapter 4**, the essential data to be gathered should include the following:

- Project features;
- Hydrological data;
- Meteorological data;
- Topographic maps or data;
- Geological maps or data;
- Land cover maps or data;
- Protected areas maps or data;
- Road and railroad network maps or data;
- Electricity network (transmission and distribution);
- Aerial photos;
- Administrative boundaries;
- Settlements and population information;
- Land Property.

Adding to this, the existing studies/documents will also be necessary:

- National Hydropower Plan from 2007 – and any existing update;
- SHP Development Plans requested to the Province's by MOIT in 2005 – and any existing update;
- Current licensing and approval process for SHP;
- Definitive list of existing/planned hydropower projects;
- List of other existing multi-purpose dams (e.g. from MARD)
- Other info that might be relevant.

The data collection activity will be performed by the National Consultant up to eight months after contract signing, according to the National Consultant's TOR. Additionally, up to two months after contract signing the National Consultant should present a Detailed Data Collection Plan, in articulation with the International Consultant. The CONSULTANT doesn't anticipate these timeframes to leave any margin of delay for such a comprehensive collection.

For the reasons stated previously in **subchapter 5.1.2**, it is of extreme importance that early on in the conceptualization of the database the type and volume of data be estimated. As such, it is necessary at this stage to predict the sheer amount of information that will need to be stored, especially the one related to maps, images and documents to digitize, for a proper design of the system. Also worth mentioning is the format of the files and datasets to include on the database, which are important to be known in due time for compatibility purposes whilst designing the database (and choosing the correct software).

The CONSULTANT predicts that the existing maps and GIS layers (**Annex II**) will become the bulk of the data to store, apart from eventual specific project documents to incorporate (such as reports, site photos, meteo datasets, etc.). It is then of the utmost importance to estimate the size and type of these existing maps and GIS layers as soon as possible. One of the first tasks of the National Consultant should be to make this estimation, along with confirming the existence of maps and GIS layers on Protected Areas and the National Electrical Grid.

Additionally, the preliminary list of existing/planned hydropower projects (**Annex III**) analyzed in **sub-chapter 3.4** already allows a first projection of the number and distribution of projects to consider and the already collected globally available datasets may also be accounted for the overall data volume estimation.

On a different level, the exhaustive list of project features to collect included in the National Consultant's TOR, presented in **Annex IV**, will also constitute a major effort, albeit not as relevant for the early design of the database as the information described above. The data requested on this list is complete and covers all relevant fields. However, the CONSULTANT believes that to put this data collection into practice will be a major challenge given the timeframe of the project.

Therefore the CONSULTANT considers that given the possibility that not all of this data will be able to be collected for every single project, there should be an emergency plan that would focus on the collection of the most essential data, which would be (by theme, in descending order of priority):

1. Energy/Power features (incl. flow/head);
2. Cascade and basin information;
3. Operation rules;
4. Type of grid connection (on-grid or off-grid);
5. Remaining features.

5.1.4 COORDINATION BETWEEN NATIONAL AND INTERNATIONAL CONSULTANTS

Perhaps the biggest challenge in this project will be the seemingly iterative and interdependent cooperation that will occur between National and International Consultants, even though on one side the International Consultant will be focused on advising, whilst on the other side the National Consultant will be focused on the operational perspective.

Still, the Consultants will have to work separately and at distance for most of the duration of the project. It is therefore important to establish a good work and communication plan, with each party's responsibilities, expected deliverables and schedules. **Subchapter 5.2** will address these issues.

Like mentioned above in **subchapter 3.4** during the IM, the National Consultant had not been formally hired yet. The CONSULTANT expects that currently this situation is sorted out and for the planning and scheduling presented ahead will consider that the National Consultant is on-board from the approval of the present Inception Report forward. In the event that this is not the case, the work plan may have to be revised. Likewise, the project duration after the approval of the Inception Report was also reviewed to 12 months to match the National Consultant's timeframe described in their TOR.

5.2 FINAL METHODOLOGY PROPOSAL

5.2.1 CONTEXT

The CONSULTANT does not foresee substantive changes to the preliminary methodology proposed during the tender phase, other than a clearer definition of the coordination with the National Consultant.

The final proposed methodology is depicted in a workflow of interconnected sub-activities and tasks in **Figure 5.1**, and a brief description of the tasks is presented in the following sections.

In **subchapter 5.2.5** the work plan and schedule is presented.

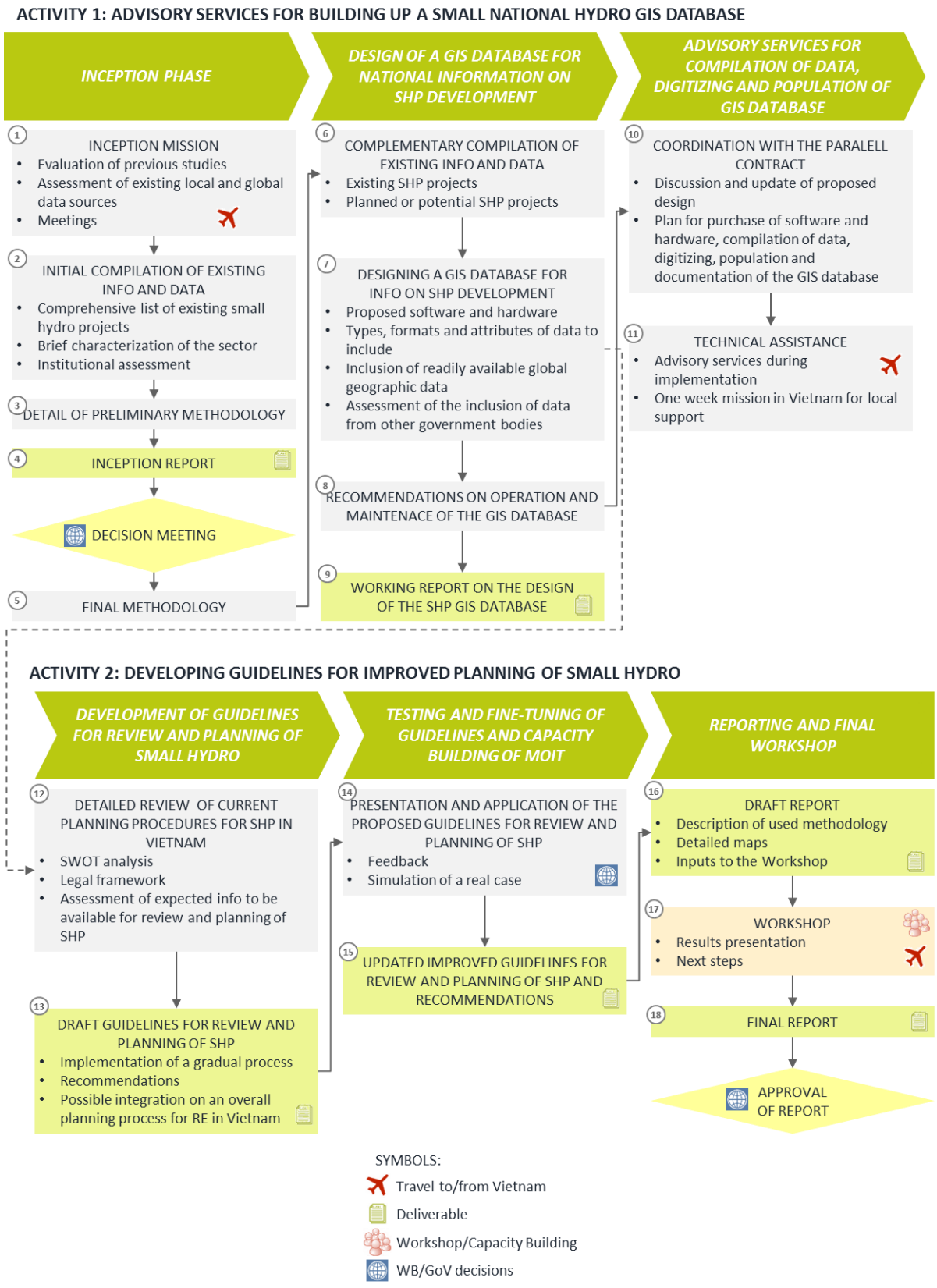


Figure 5.1 – Workflow with the final proposed methodology.

5.2.2 ACTIVITY 1: ADVISORY SERVICES FOR BUILDING UP A SMALL NATIONAL HYDRO GIS DATABASE

Inception Phase

1. *Inception Mission*
2. *Initial compilation of existing info and data*
3. *Detail of preliminary methodology*
4. *Inception Report*
5. *Final methodology*

The Inception Phase is currently in task 4. The Inception Phase shall be concluded with the approval of the Inception Report and accordance to the final methodology after a Decision Meeting.

Design of a GIS database for national information on SHP development

6. *Complementary Compilation of Existing Info and Data*

The data to be collected is divided between global and local data. Collecting global data is the International Consultant's task, while collecting the local data is the National Consultant's task. In **chapter 4**, the existing global datasets where already assessed. In **subchapter 5.1.3** there is a description on the local data necessary to retrieve by the National Consultant. It is advisable that the National Consultant focuses initially only on the data features necessary for the design of the database (type, amount, volume and file format), rather than assembling the data itself.

It is expected that by the end of this task the National Consultant is able to deliver the Detailed Data Collection Plan.

Start: Following the approval of the Final Methodology and the commencement of work by the National Consultant

Duration of the task: 1 month

International Consultant's mission: advise National Consultant on Data Collection Plan; collect globally available data

National Consultant's mission: deliver the Detailed Data Collection Plan; collect locally available data

7. *Designing a GIS Database for Info on SHP Development*

A geographical information system (GIS) comprises hardware, software and data for capturing, managing, analyzing and displaying geographically referenced information.

The main scope of this task is to design the structure of the data to be used in a geographical information system and allow for later population of the database with the collected data. Likewise, the decision between software and hardware to use should be made in this period.

Therefore, the way data is structured should take into account the hardware and software, as well as the current GIS knowledge of the end-users.

Following the Inception Mission it was possible to determine the lack of GIS knowledge within GDE. The easiness of use of the database will be the main purpose of the adopted technology.

In data to be used in geographical information systems, a distinction should be made between geographical data (location) and attribute data (characterization). The relationship of a feature to other features is implied either from the location or the attributes.

Given the extent of the database, geographic coordinates will be preferred over a map projection for the geographical storage of data. The coordinate systems to be adopted will be WGS 84 (World Geodetic System). Whenever distance, areas or volumes should be assessed, the proper Universal Transversal Mercator (UTM) will be used to project the data.

The initial approach for the conceptualization of the GIS database is described next:

- Organizing the information collected by the National Consultant in:
    - Temporal data
        - Meteorological information
        - Runoff information
        - Etc.
    - Spatial data
        - Administrative Information
        - Demographic Information
        - Geographic information
        - Planned and existing small and large hydro
        - Etc.
- Structuring the database and creating the fields with the information needed to categorize the small hydro.
    - The fields are the categories of information to store in the database. Ex. Name, Province, location, etc.
    - Create a logical structure for the database which includes definition of different types of keys (primary, foreign). This allows the relationships between tables that don’t have the same name fields but have the same data type.
- Creating permissions in the access to the database based on the needs of the client in order to protect the data. Definition of different profiles of access, editing and visualization of information on the database and GIS.
- Projecting the Database
    - Definition of tables and fields

- Creation of triggers to automate processes
- Creation of forms to fill the tables in the database.

Start: the task may only proceed after the provision of the Detailed Data Collection Plan including the list of the main features of the data (type, amount, volume and file format) considered in the previous task

Duration of the task: 2 months

International Consultant's mission: conceptualize the GIS database

National Consultant's mission: occasional support on the conceptualization of the GIS database

8. *Recommendations on Operation and Maintenance (O&M) of the GIS Database*

Recommendations on O&M of the GIS Database will focus on the necessary skills to operate it and required specialized support and the hardware, software and training required for the future maintenance and upgrade of the database. Considering the easiness of use a primary goal, the required hardware may be already available for use and the software may be an open source solution.

It is expected the National Consultant has the necessary know-how to provide continuous post-project support to the Client.

Start: the task is planned to align its end with the design of the GIS database

Duration of the task: 2 weeks

International Consultant's mission: provide the recommendations; assess the National Consultant's capacity to provide continuous post-project support to the Client

National Consultant's mission: demonstrate capacity to provide continuous post-project support to the Client

9. *Working report on the design of the GIS database*

The proposed design of the GIS database, and capacity building for its O&M, will be documented in a working report that will become the guidebook for its creation by the National Consultant.

Start: the task is planned to start 1 month after the design of the GIS database (Task 7)

Duration of the task: 1 month

International Consultant's mission: elaborate the Working Report and submitting it to the Client.

National Consultant's mission: future use of the guidebook for the GIS database creation; occasional support on the preparation of the Working Report

Advisory services for compilation of data, digitizing and population of GIS database

10. Coordination with the parallel contract

11. Technical assistance

The CONSULTANT will coordinate closely with the National Consultant during the actual implementation of the management information system (MIS) integrating the GIS database. The proposed design for the GIS database for SHP will be discussed and updated based on the feedback of the WBG, MOIT and the National Consultant. The CONSULTANT will also work on a plan with MOIT and the National Consultant, to be conducted by the latter, on the purchase of software and hardware, compilations of data, digitizing of information, population, and documentation of the GIS database.

The CONSULTANT will be available for advisory services during this process, mainly related to issues that may need the reconfiguration of the design of the GIS database. The CONSULTANT shall go to Vietnam during this period to go through the conducted work and confirm the progress.

The CONSULTANT's experience on digitizing and database populating will be essential to the advisory and to overcome the difficulties that the National Consultant will encounter.

Start: the task may start after the deliverance of the Working Report on the design of the GIS database

Duration of the task: 5 months

International Consultant's mission: provide support to the National Consultant; conduct a mission to Vietnam for personal advisory services; trouble-shooting

National Consultant's mission: implement the MIS integrating the GIS database using the guidebook for the GIS database creation; report feedback from the guidebook use

5.2.3 ACTIVITY 2: DEVELOPING GUIDELINES FOR IMPROVED PLANNING OF SMALL HYDRO

Development of guidelines for review and planning of small hydro

12. Detailed review of current planning procedures for SHP in Vietnam

13. Draft guidelines for review and planning of SHP

The Development of Guidelines for Review and Planning of Small Hydro will take into account the institutional capacity of MOIT, and its main purpose is to establish a framework for review and planning. The first task will comprise a detailed review of the current planning procedures for small hydro in Vietnam, in collaboration with MOIT and other stakeholders, in order to understand the strengths and weaknesses of the current planning.

The proposed Guidelines will focus on the Working Report on the design of the GIS database developed during Activity 1 of the project since it is expected to be started before the National Consultant is able to complete the MIS integrating the GIS database. The Guidelines will be reviewed later in the project during the test phase in tasks 14 and 15.

The collection of all existing legislation will be performed by the National Consultant and will allow an in-depth analysis of the current procedures and help the CONSULTANT target the key issues regarding the process of small hydro planning.

For this task, previous studies related to the development and impacts of small hydro, such as the World Bank report on Cumulative Impacts and Joint Operations of Small-Scale Hydropower Cascades, as well as recent issued EIA for small hydro in Vietnam (if available) will be reviewed.

With the help of the National Consultant and MOIT, the CONSULTANT will seek information on the parallel projects supporting MOIT on the creation of other RES national databases in order to integrate the Guidelines for Review and Planning of Small Hydro in the overall planning process for RE in Vietnam as well as its integration and interaction with the least-cost optimization to introduce more RE in the country.

The guidelines will try to follow a step-wise process, considering different analysis modules and procedures for each step, that may be improved as more data may become available or the institutional capacity of MOIT increase. The planning to improve the database, how more data can be added and how procedures and modules may be updated will be included, as well as a reasonable capacity development plan for MOIT both in GIS analysis as well as in the thematic of small hydropower planning, such as hydrology, environment, grid connection and off grid projects, dams and hydraulics.

Start: the task may start 1,5 month after the deliverance of the Working Report on the design of the GIS database

Duration of the task: 3,5 months

International Consultant's mission: review of the current planning procedures for SHP in Vietnam; develop the draft guidelines; evaluate possible integration on an overall planning process for other RES in Vietnam

National Consultant's mission: collect info on the current licensing process and legal framework for SHP in Vietnam; seek information on the parallel projects supporting MOIT on the creation of other RES national databases

Testing and fine-tuning of guidelines and capacity building of MOIT

14. Presentation and application of the proposed guidelines for review and planning of SHP

15. Updated improved guidelines for review and planning of SHP and recommendations

The Draft Guidelines for Review and Planning of SHP, achieved in Task 13, will be presented to MOIT in order to receive its feedback. The guidelines will be tested in a province or basin, chosen together with MOIT and shall simulate as closely as possible a real case where MOIT is requested by the provincial authorities to review and approve the plans for small hydro. It is expected at this stage that the GIS database is already created by the National Consultant.

The test application should be carried as on-the-job training and together with MOIT and the National and International Consultants.

From the test application, feedback, results, difficulties and lessons learned, the guidelines should be reviewed and improved and recommendation for further capacity building of MOIT should be outlined.

Start: the task may start after creation of the GIS database is complete by the National Consultant

Duration of the task: 3 months

International Consultant's mission: test the application of the database concluded by the National Consultant using the draft guidelines (Task 13); participate on the on-the-job training

National Consultant's mission: conclude the creation of the GIS database before the activity starts; participate on the feedback process; participate on the on-the-job training

5.2.4 REPORTING AND FINAL WORKSHOP

16. Draft report

The previous activities will be reported and a draft will be presented for Client's approval. Initially, the CONSULTANT will summarize the methods and procedures in the design of the GIS Database and the proposed Guidelines for Review and Planning of Small Hydro. The produced national maps of small hydro power can be included, but its comprehensiveness may be limited, as the GIS digitizing is in the scope of the parallel contract by the National Consultant.

The draft report will be ready and distributed at least two weeks ahead of the final workshop to be held at the conclusion of the assignment.

The delivery will have the format of stand-alone reports, slide pack, and relevant GIS layers. It shall be delivered in electronic format suitable for print and web publication.

Start: the task should start two months after Task 14.

Duration of the task: 1 month

International Consultant's mission: develop the draft report

National Consultant's mission: providing input and reviewing the draft report

17. Workshop

A workshop will be held in Hanoi to present the results to the Client, get feedback from stakeholders and discuss next steps. The CONSULTANT will travel to Vietnam in this period.

The workshop shall have two day duration: the first day to present the results to MOIT (session A), the second half-day to present the results to the stakeholders (session B).

Both session A and B intend to promote a framework and comprehensive explanation of the development work, but to different group targets. In the presentation to the Client a deeper focus on the methods will be made, while for stakeholders a focus on results, lessons learned and consequences will be made.

Nonetheless, a single session joint workshop for both MOIT and stakeholders might be considered if found more fruitful. Additionally, the proposed workshop may be included in a joint workshop with the National Consultant.

The workshop sessions are summarized in **Table 5.3**.

Table 5.3 - Workshop sessions target, topics and duration.

Session	Target	Topics	Duration
A	MOIT (+DOIT)	Source data Methodologies Outputs Lessons learned Discussion	1 day
B	Stakeholders	Presentation Methodologies Outputs Lessons learned	½ day

Start: the task may start after the development of the draft report (task 16)

Duration of the task: 2 weeks

International Consultant's mission: prepare the International Consultant's presentations

National Consultant's mission: support the CONSULTANT and MOIT selecting the participants of the workshop; prepare the National Consultant's presentations in case it is decided to have a joint final workshop

18. Final report

Following the draft review by the Client, the feedback from the workshop and the necessary changes, the final reports will be delivered to the Client for his approval.

Start: the task may start after the Workshop.

Duration of the task: 1 week

International Consultant's mission: revise the final reports

National Consultant's mission: revise the final reports

5.2.5 WORK PLAN

Based on the descriptions, responsibilities and durations presented above, the revised work plan and schedule is presented in **Figure 5.2**.
The current timeline depicted represents the deliverance of the present Inception Report. It is followed by an indefinite period of time for the approval of the Inception Report and the conclusion of the hiring process of the National Consultant. Once the National Consultant is on-board and the Report is approved, the National and International Consultant's will start working simultaneously.

The work plan includes important milestones such as deliverables, travel missions, approval processes and the most tangible interactions between the National and International Consultant.

The project duration at this moment was reviewed to 12 months to match the National Consultant's timeframe described in their TOR. Likewise, the activities depicted in **Figure 5.2** for the National Consultant and their overall duration were taken from the deliverables of the project defined in their TOR. The duration of the Detailed Data Collection Plan task by the National Consultant was considered to be 1 month in order to be compliant with the International Consultant's scheduling.

		Oct'14		Nov'14				Dec'14		Month 0				Month 1				Month 2				Month 3				Month 4				Month 5				Month 6				Month 7				Month 8				Month 9				Month 10				Month 11				Month 12			
	INTERNATIONAL CONSULTANT	1	2	3	4	5	6	7	8	-3	-2	-1	0	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	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Task #	**ACTIVITY 1: ADVISORY SERVICES FOR BUILDING UP A SMALL NATIONAL HYDRO GIS DATABASE**																																																										
	INCEPTION PHASE																																																										
Task 1	INCEPTION MISSION																																																									
Task 2	INITIAL COMPILATION OF EXISTING INFO AND DATA																																																									
Task 3	DETAIL OF PRELIMINARY METHODOLOGY																																																									
Task 4	INCEPTION REPORT																																																									
	DECISION MEETING/APPROVAL OF THE INCEPTION REPORT																																																									
Task 5	FINAL METHODOLOGY																																																									
	DESIGN OF A GIS DATABASE FOR NATIONAL INFORMATION ON SHP DEVELOPMENT																																																									
Task 6	COMPLEMENTARY COMPILATION OF EXISTING INFO AND DATA																																																									
Task 7	DESIGNING A GIS DATABASE ON SHP DEVELOPMENT																																																									
Task 8	RECCOMENDATIONS ON OPERATION AND MAINTENACE OF THE GIS DATABASE																																																									
Task 9	WORKING REPORT ON THE DESIGN OF THE SHP GIS DATABASE																																																									
	ADVISORY SERVICES FOR COMPILATION OF DATA, DIGITIZING AND POPULATION OF GIS DATABASE																																																									
Task 10	COORDINATION WITH THE PARALELL CONTRACT																																																									
Task 11	TECHNICAL ASSISTANCE																																																									
	ACTIVITY 2: DEVELOPING GUIDELINES FOR IMPROVED PLANNING OF SMALL HYDRO																																																									
	DEVELOPMENT OF GUIDELINES FOR REVIEW AND PLANNING OF SMALL HYDRO																																																									
Task 12	DETAILED REVIEW OF CURRENT PLANNING PROCEDURES FOR SHP IN VIETNAM																																																									
Task 13	DRAFT GUIDELINES FOR REVIEW AND PLANNING OF SHP																																																									
	TESTING AND FINE-TUNING OF GUIDELINES AND CAPACITY BUILDING OF MOIT																																																									
Task 14	PRESENTATION AND APPLICATION OF THE PROPOSED GUIDELINES FOR REVIEW AND PLANNING OF SHP																																																									
Task 15	UPDATED IMPROVED GUIDELINES FOR REVIEW AND PLANNING OF SHP AND RECOMMENDATIONS																																																									
	REPORTING AND FINAL WORKSHOP																																																									
Task 16	DRAFT REPORT																																																									
Task 17	WORKSHOP																																																									
Task 18	FINAL REPORT																																																									
Task 19	APPROVAL OF REPORT																																																									
	NATIONAL CONSULTANT																																																									
	ACTIVITY 1: PREPARATION AND CREATION OF NATIONAL HYDRO GIS DATABASE																																																									
	INCEPTION REPORT																																																									
	DETAILED DATA COLLECTION PLAN																																																									
	ACTIVITY 2: DEVELOP THE MANAGEMENT INFORMATION SYSTEM FOR NATIONAL HYDROPOWER, DATA COLLECTION, DIGITIZING, AND POPULATION OF GIS DATABASE																																																									
	CREATION OF THE NATIONAL GIS HYDROPOWER DATABASE																																																									
	FULL MIS NATIONAL HYDROPOWER DATABASE																																																									
	GIS HYDROPOWER LAYERS																																																									
	REPORT ON DATA COLLECTION, DIGITIZATION, AND POPULATION OF THE NATIONAL HYDRO GIS DATABASE.																																																									
	ACTIVITY 3: CAPACITY BUILDING OF MOIT																																																									
	OPERATION AND MAINTENANCE MANUAL AND MIS/GIS TRAINING MATERIALS																																																									
	TWO-DAY WORKSHOP TRAINING AND ONE WEEK TECHNICAL TRAINING																																																									
	JOINT FINAL WORKSHOP WITH INTERNATIONAL CONSULTANT																																																									

- International Consultant travel to/from Vietnam
- Deliverable
- Workshop/Capacity Building
- WB/MOIT decisions
- Major interaction between National and International Consultant

- Duration of sub-activity
- Duration of task
- Approval time
- Current timeline
- Start of National and International Consultant's simultaneous work

Figure 5.2 – Work plan and schedule.

6 CONCLUSIONS

The objectives of the Inception Mission were accomplished (**subchapter 3.1**). It allowed the CONSULTANT to take the pulse of the current status of small hydropower and geographical information systems at MOIT and the framework for small hydropower development in Vietnam.

The CONSULTANT identified the major challenges for the development of the project (**subchapter 3.6**), addressed their impact (**subchapter 5.1**) and revised the implementation plan accordingly (**subchapter 5.2**).

The CONSULTANT made recommendations on the types of software to use (**subchapter 5.1.2**) but is available for further discussion on this subject.

The CONSULTANT already performed a compilation of globally available data (**chapter 4**).

The CONSULTANT concludes that the methodology originally presented was adequate for the study, but the work plan needed to be slightly reviewed to take into consideration the continuous interaction with the National Consultant and the parallel contract timeframe of 12 months (**subchapter 5.2.5**).

After the approval of the Inception Report and the conclusion of the hiring process of the National Consultant, the CONSULTANT will resume work and start working simultaneously with the National Consultant.

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Annex I – Meeting Reports

Meetings during the Inception Mission:

Location	Date	Participants	Description
WBG	October 13, 2014	WBG CONSULTANT	First Internal Team Meeting
Institute for Hydropower and Renewable Energy (IHR)	October 14, 2014	WBG CONSULTANT IHR	First National Consultant Meeting
MOIT	October 14, 2014	WBG CONSULTANT MOIT	Kick-off Meeting
WBG	October 15, 2014	WBG CONSULTANT MOIT IHR	Working meeting with the General Directorate of Energy (GDE) of MOIT and IHR
Chieng Khoa Commune, Van Ho District, Son La Province	October 15, 2014	CONSULTANT MOIT IHR	Site Visit to Suoi Tan Cascade
WBG	October 17, 2014	WBG CONSULTANT	Second Internal Team Meeting
Ministry of Natural Resources and Environment (MONRE)	October 20, 2014	WBG CONSULTANT MOIT IHR MONRE	Consulting meeting with MONRE
Ministry of Agriculture and Rural Development (MARD)	October 21, 2014	WBG CONSULTANT MOIT IHR MARD	Consultation meeting with MARD
Electricity of Vietnam (EVN)	October 21, 2014	WBG CONSULTANT MOIT IHR EVN	Consultation meeting with EVN
Mekong River Commission (MRC)	October 21, 2014	CONSULTANT MOIT IHR MRC	Consultation meeting with MRC
IHR	October 22, 2014	CONSULTANT MOIT IHR	Second National Consultant Meeting
MOIT	October 23, 2014	WBG CONSULTANT MOIT	Wrap-up Meeting

Meeting Report

Subject: First Internal Team Meeting **Ref.:** VN.2014.AC.001.0 **Number of pages:** 2 **Drafted by:** Jorge André	**Date:** October 13, 2014 **Time:** from 14h00 to 16h00 **Local:** The World Bank Vietnam Office, Sa Pa room, 7th floor, 63 Ly Thai To street, Hanoi, VN

Participants:

- Ky Hong Tran (WB)
- Thi Ba Chu (WB)
- Jorge André (GESTO)
- Hung Tran (GeoViet)

Agenda:

1. Inception Mission Schedule
2. Consultant Presentation
3. Project Overview
4. Next Steps

Key notes:

- The Tentative Working Schedule for the Inception Mission was updated with some slight remarks, like the inclusion of a presentation session with the local consultant on Tuesday morning October 14th. A better definition of the scope of the meetings with MOIT and other stakeholders was made by the WB and the Consultant. Some meetings and the site visit still need confirmation.
- Jorge André presented the document that will be the basis of the project presentation at the Kick-off meeting with MOIT. It included a brief Consultant presentation, including GESTO's local partner GeoViet, represented at the meeting by Hung Tran (its Managing Director), along with the explanation of the framework and implementation plan.
- Jorge André mentioned that one of the main objectives of the current Inception Mission is to revise the preliminary methodology given the feedback and experience received.
- Regarding the document, some remarks were made by the WB: Ky Hong Tran suggested an improved description of the interaction with the local consultant whilst

Meeting Report

Thi Ba Chu suggested the inclusion of the needed input at each stage and output examples.

- Ky Hong Tran insisted on the need for a close interaction with the local consultant during this stage. For a better understanding of the scope of work and level of effort involved in the local consultant's assignment, Jorge André asked for the TOR of the selection of the local consultant as well as his Technical Proposal.
- There was some discussion regarding the full scope of sub-activity "Design of a GIS database for national information on hydropower" that will need further clarification as soon as possible.
- The WB suggested that for meetings outside MOIT, a short version of the presentation should be prepared.
- Jorge André presented an online test-version of a recent similar output of a small scale HPP database done by the Consultant for the Government of Mozambique.
- Jorge André asked about the Team Counterpart and explained the importance of this definition. On behalf of the WB, it will consist of Ky Hong Tran and Thi Ba Chu. Regarding MOIT and the local consultant, it is still to be clarified. Related to this, Jorge André asked clarification about the communication channels in this project. It was decided that Ky Hong Tran and Thi Ba Chu should always be copied on every communication between the Consultant and any recipient.

Collected data:

- No data was collected

Next steps

Task	Responsible	Date
Clarification on the full scope of sub-activity "Design of a GIS database for national information on hydropower"	GESTO and WB	October 14
Provision of the local consultant's TOR and Technical Proposal	WB	October 14
Update of the Tentative Schedule and confirmation of meetings	GESTO and WB	WIP

Meeting Report

Subject: First Local Consultant Meeting **Ref.:** VN.2014.AC.002.0 **Number of pages:** 2 **Drafted by:** Jorge André	**Date:** October 14, 2014 **Time:** from 9h00 to 10h30 **Local:** Institute for Hydropower and Renewable Energy So 8/95 Chua Boc, Dong Da, Ha Noi

Participants:

- Nguyen Minh Viet (Institute for Hydropower and Renewable Energy)
- Tran Thiet Hung (Institute for Hydropower and Renewable Energy)
- Vu Manh Da (Institute for Hydropower and Renewable Energy)
- Chu Ba Thi (WB)
- André Jorge (GESTO)
- Tran Hung (GeoViet)

Agenda:

1. Consultant Presentation
2. Project Overview
3. Next Steps

Key notes:

- Mr. Thi made a brief presentation of the project, objectives and interaction between local and international consultants.
- Mr. Jorge made a project presentation, including a brief Consultant presentation, including GESTO's local partner GeoViet, represented at the meeting by Hung Tran (its Managing Director), along with the explanation of the framework and implementation plan and major issues.
- Mr. Jorge mentioned that one of the main objectives of the current Inception Mission is to revise the preliminary methodology given the feedback and experience received and so the implementation plan may subject to changes.
- Mr. Jorge presented screenshots of an online test-version of a recent similar output of a small scale HPP database done by the Consultant for the Government of Mozambique.
- Mr. Viet explained he totally understood the scope of work and objectives. He also stated that from a technical point of view there are no concerns. From an operational

point of view he stated that the local consultant's task may have some issues related to data collection requirements and the timeframe of the project and showed some concern about the level of effort involved.

- Furthermore, Mr. Viet stated that there is few available data from the provinces and that although the TOR were very specific in data collection, the reality appears to be different. In fact, Mr. Viet estimates that about only one third of the data requested in the local consultant's TOR may be collected. Major examples of missing or incomplete information are: Environmental Impact Assessment, Land-use, Other Purposes Dams (irrigation or water supply), Rules of Operation, etc.
- Mr. Jorge stated that it is very important for him to have the TOR of the selection of the local consultant as well as his Technical Proposal, for a better understanding of the scope of work and level of effort involved in the local consultant's assignment.
- Mr. Jorge asked about the current GIS and database capabilities of the Institute for Hydropower and Renewable Energy. Mr. Viet replied that they have a well prepared IT Dept. that has produced several works in irrigation. Mr. Jorge asked what software's does the Institute use and Mr. Hung replied that they use ArcMap and ArcGIS and PostgreSQL Light or Express.
- Mr. Jorge asked about the Team Counterpart and Focal Point on the Institute and explained the importance of this definition. Mr. Viet said that it is still to be clarified but should include Mr. Anh (who was away on a mission) as a focal point. Communication between the international and the local consultant should include Mr. Viet copied.
- The Institute is to provide logistic support for the site visits to Son La Province.
- Mr. Jorge said that one of the objectives of the Inception Mission is to better clarify the coordination between the local and international consultant.
- Mr. Viet stated that the Institute is totally open for cooperation under the international consultant's Inception Mission. Contacts between the local and international consultant will continue as scheduled with a meeting at the WB offices set for the following day at 9:00.

Collected data:

- No data was collected

Next steps		
Task	**Responsible**	**Date**
Logistical arrangements for site visits to Son La Province	IHR	October 15
Provision of the local consultant's TOR and Technical Proposal	WB	October 14

Meeting Report

Subject: Kick-off Meeting with MOIT	**Date:** October 14, 2014
Ref.: VN.2014.AC.003.0	**Time:** from 13h30 to 16h00
Number of pages: 3 **Drafted by:** Jorge André	**Local:** MOIT 91, Dinh Tien Hoang, Hoan Kiem, Ha Noi

Participants:

- Tran Hoai Trang (MOIT – GDE/Department of Hydropower)
- Pham Thuy Dung (MOIT – GDE/Department of New and Renewable Energy – Coordinator of REDP project)
- Phạm Anh Tuấn (MOIT – GDE/Project Officer of REDP project)
- Ngo To Nhien (MOIT - GDE/Project Officer of REDP project)
- Nguyen Thi Thu (MOIT - GDE/Project Assistant of REDP project)
- Gerner Franz (WB)
- Tran Hong Ky (WB)
- Chu Ba Thi (WB)
- André Jorge (GESTO)
- Tran Hung (GeoViet)
- (Translator)

Agenda:

1. Project Overview
2. Consultant Presentation
3. Next Steps

Key notes:

- Mr. Ky made a brief presentation of the project, objectives and interaction between consultants and Client.
- Ms. Dung stated that the methodology is important but emphasized that the coordination between local and international consultant is key and both consultant's responsibilities should be clearly defined. Ms. Dung continued saying that the implementation of this project shall be divided between the Department of Hydropower and Department of New and Renewable Energy of MOIT and that an important output of the project will be the software's package plan that will allow for proper budgeting.

Meeting Report

- Mr. Jorge made a project presentation, including a brief Consultant presentation, including GESTO's local partner GeoViet, represented at the meeting by Hung Tran (its Managing Director), along with the explanation of the framework and implementation plan and major issues.
- Mr. Jorge mentioned that one of the main objectives of the current Inception Mission is to revise the preliminary methodology given the feedback and experience received and so the implementation plan may subject to changes.
- Mr. Jorge highlighted that an important feedback from the Inception Mission is the Institutional Assessment of the current MOIT's capabilities in GIS database development, operation and maintenance.
- Mr. Jorge presented an online test-version of a recent similar output of a small scale HPP database done by the Consultant for the Government of Mozambique.
- Mr. Franz questioned about the scope of the projects to be included on the database and Mr. Jorge replied that it can be small or large projects, although the focus of the project will be on small hydropower planning.
- After the consultant's presentation Ms. Dung stated that the implementation plan seemed adequate and clear and it is a valid starting point. For better coordination between local and international consultant, Ms. Dung asked Mr. Jorge to review the Terms of Reference for the hiring of the local consultant to see if they meet the necessary requirements, to which Mr. Jorge agreed.
- Ms. Dung declared that there needs to be a clarification on the type of input data, particularly in what relates to the data the local consultant must provide. Ms. Dung also mentioned that following the development of the project it will be necessary to define what type of resources MOIT will need in the future, and that for the full implementation of this and other projects under the Integrated Renewable Energy Database other consultancy services may be required.
- Mr. Jorge requested PMB-REDP send the input data form prepared by the REDP staffs and Department of Hydropower, to which Mr. Tuan agreed.
- Ms. Dung mentioned that important sources of information will be the Department of Hydropower of MOIT but also MONRE and the General Dept. of Irrigation of MARD.
- It was stated that MOIT's definitive Team Counterpart is yet to be defined but the focal point shall be Mr. Thuc and the rest of the team shall be copied in future contacts.
- Contacts between the Clients and Consultants will continue as scheduled with a meeting at the WB offices set for the following day at 9:00.

Collected data:

- No data was collected

Next steps		
Task	**Responsible**	**Date**
Provision of the local consultant's TOR and Technical Proposal	MOIT	October 14
Revision of the Terms of Reference for the hiring of the local consultant	GESTO	October 15
Clarification on the type of input data	GESTO	October 15

Meeting Report

Subject: Working meeting with GDE and local consultant **Ref.:** VN.2014.AC.004.0 **Number of pages:** 6 **Drafted by:** Jorge André	**Date:** October 15, 2014 **Time:** from 9h00 to 12h00 **Local:** The World Bank Vietnam Office, Can Tho room,6th floor, 63 Ly Thai To street, Hanoi, VN

Participants:

- Tran Hoai Trang (MOIT – GDE/Department of Hydropower)
- Pham Thuy Dung (MOIT – GDE/Department of New and Renewable Energy – Coordinator of REDP project)
- Phạm Anh Tuấn (MOIT – GDE/Project Officer of REDP project)
- Ngo To Nhien (MOIT - GDE/Project Officer of REDP project)
- Do Ngoc Anh (Institute for Hydropower and Renewable Energy)
- Tran Thiet Hung (Institute for Hydropower and Renewable Energy)
- André Jorge (GESTO)
- Tran Hung (GeoViet)
- Chu Ba Thi, WB

Agenda:

1. Initial data requirements
2. IT baseline considerations
3. Initial approach for the conceptualization of the GIS database
4. Next Steps

Key notes:

- Mr. Thi distributed the document prepared by the International Consultant for discussion.
- Mr. Jorge proposed the meeting to follow the topics of the document, namely:
  i. Initial data requirements
  ii. IT baseline considerations
  iii. Initial approach for the conceptualization of the GIS database

Initial data requirements

- Mr. Jorge presented a list of previous studies and plans that will be important for the development of the project:

i. National Hydropower Plan (NHP) from 2007
ii. Small scale hydro plans requested to the Province's by MOIT in 2005
iii. WB Study on National Spatial Data Infrastructure Development Strategy for Vietnam from 2001

- Mr. Jorge asked if the first two were in possession and able to be handed from the GDE, to which Mr. Trang responded affirmatively, although they may be outdated. Mr. Jorge answered that even if they are outdated they will be a good starting point. Regarding the third study, Mr. Jorge will request it directly to the WB. Mr. Jorge showed another relevant WB recent study, already in the Consultant's possession: Cumulative Impacts and Joint Operation of Small-Scale Hydropower Cascades - Case Studies for Selected River Basins in Northwest Vietnam (June 2014). Mr. Jorge also requested other studies that might be relevant to the assignment to be provided.
- Still on the subject of previous studies and plans, Mr. Jorge skipped to the "List of existing and planned projects" topic and asked about the source of following information mentioned in the International Consultant's TOR:
  i. "About 7 GW [of Hydropower] is already under construction and another 4-5 GW is being planned."
  ii. "Today there is about 190 small hydro in operation (about 1.5 GW), and another 180 under construction (2.3 GW). However, a total of more than 600 small hydro sites are under investment study or being planned (>3.5 GW)."
  iii. "The Master Plan (NHP 2007) proposed 22 hydropower projects (33-280 MW), many of which are now being developed."

  The main issues were: understanding if this information came from the 2007 NHP, how were these projects accounted, if there is a list of such projects and what type of info does it have. Mr. Trang replied that most of this info is from the 2007 NHP and that his Department has this information and some updates, especially considering that recently the National Assembly asked the Provinces for the update of the list of projects. Mr. Jorge then proceeded to request this info to be available to the Consultants, stating its importance, to which Mr. Trang responded affirmatively.
- Regarding the Legal Framework, Mr. Jorge asked for the current legislation on the licensing and approval process on SHP, of which the International Consultant had already identified the following documents:
  i. 2012 Governmental Circular (43/2012/TT-BCT) issued by MOIT
  ii. 2008 National Decree (112/2008/ND-CP) issued by MONRE
  iii. 2009 National Decree (29/2011/ND-CP) issued by MONRE
  iv. 2012 Circular (43/2012/TT-BCT) issued by MOIT

  Ms. Dung said that to provide this info to the International Consultant was actually a task for the National Consultant during their assignment.

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- Mr. Jorge then proceeded to show a first draft of the flowchart of the licensing process, as per the International Consultant's preliminary assessment of the procedures. Mr. Trang highlighted that the approval process shown was inaccurate. Mr. Jorge then asked if it would be possible to have this information in this flowchart process, to which Mr. Trang responded affirmatively.
- Speaking about local datasets apart from the detailed information on each SHP, Mr. Jorge presented the following list, in order of priority:
    i. Topographic maps and/or aerial photos
    ii. Hydrological and Meteorological info
    iii. Geological maps
    iv. Land cover maps

  There was some discussion on the scale and number of existing topographic maps. There is national coverage at both the 1:25.000 and 1:50.000 scales. GDE asked for the Consultant's recommendation on which to choose. As a rule of thumb, Mr. Jorge said that the 1:50.000 scales is good for a planning point of view and the 1:25.000 is good enough for pre-feasibility studies. Ms. Dung said that National Consultant should advise on the type and quantity of existing topographic maps, as well as its cost for a plan of investment. Regarding Hydrological and Meteorological info, GDE agrees on their inclusion on the database and said that MONRE should have this type of info. As for the geological maps, Mr. Jorge said they would be nice-to-have, even on a less detailed scale, and gave examples of similar projects where the 1:1.000.000 national geological coverage was used. Ms. Nhien then asked about what GIS layers will the consultant need from GDE and Mr. Jorge said he would address this later, mentioning, for instance, the transmission grid as an example.
- As for global datasets, they are the International Consultant's responsibility, and given their experience, they recommend:
    i. From WorldClim or FAO: Meteorological Data – Rainfall, Temperature, Evaporation
    ii. From NASA: SRTM – Shuttle Radar Topography Mission – Digital Terrain Models, River Network/Catchment areas
    iii. From ICOLD: List of large dams
    iv. From Digital Chart of the World: Rails, roads, water bodies, rivers.
    v. From GADM: Admin boundaries through Admin level 4.
    vi. From Google Map Maker: administrative layers (city points, districts, localities, civil divisions, neighborhoods), geographic features (parks, forests, lakes, islands), points of interest (schools, markets, hospitals, temples, etc.), and transit (roads, rails).
    vii. From Open Street Map (crowd-sourced and updated frequently): the coastline, highways, key locations, natural areas, points of interest, water bodies.
    viii. From Protected Planet: protected lands.

ix. From ESA: GlobCover (land cover) map with a resolution of 300m.

IT baseline considerations

- Regarding IT considerations, the main questions at this stage will be: whether to choose between open source or proprietary software, the server location and storage capacity and the institutional assessment of the current capabilities of GDE. Starting on the latter, the following Q&A was conducted:
  i. Q: Current number of GIS users? A: zero (apart from MapInfo)
  ii. Q: Current number of GIS and database software licenses? A: zero (apart from MapInfo – license for MONRE)
  iii. Q: Access to server (intranet or internet)? A: both
  iv. Q: Operation system of server (LINUX or Windows)? A: windows
  v. Q: Server capacity? A: short, new server needed
  vi. Q: Info located on server or hard disk? A: mainly on hard disk and only some on server. No standard procedure to save working data on server exists.

  The server location and storage capacity shall be recommended by the International Consultant, as well as the final type of open source or proprietary software. There was some discussion on both options pros and cons and Mr. Jorge said that open source is nowadays a reliable option, has a strong community of developers which allows guaranteeing that all the versions and upgrades available are completely trustworthy to develop any project that works with geographical data. As an example, Mr. Jorge said that his staff is composed of advanced users and programmers in GIS and use proprietary software, but that the vast majority of his Clients choose open source software options with excellent results. Advice shall be given on this matter in the Inception Report. Ms. Nhien stated that GDE currently has a Technical Assistance Program on IT and database who will also advise GDE.

Initial approach for the conceptualization of the GIS database

- Mr. Jorge then proceeded to go further in detail on the proposed methodology for the conceptualization of the GIS database. The main activities will be:
  i. Organize the information collected by the consultant team in:
    - Temporal data
      - Meteorological information
      - Runoff information
    - Spatial data
      - Administrative Information
      - Demographic Information
      - Geographic information
      - Planned and existing small and large hydro
  ii. Structuring the database and creating the fields with the information needed to categorize the small hydro.
    - The fields are the categories of information to store in the database. Ex. Name, Province, location, etc.

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- Create a logical structure for the database which includes definition of different types of keys (primary, foreign). This allows the relationships between tables that don't have the same name fields but have the same data type.

iii. Create permissions in the access to the database based on the needs of the Client in order to protect the data.
- Definition of different profiles of access, editing and visualization of information on the database and GIS

iv. Project the Database
- Definition of tables and fields
- Creation of triggers to automate processes
- Creation of forms to fill the tables in database.

Special emphasis was given on the permissions and levels of access of the database. Ms. Nhien stated that GDE will supply a list with tentative permissions list.

- For the arrangements of the site visit next day, Mr. Anh nominated Mr. Hung to accompany Mr. André to Moc Chau HPP at Son La Province, who will be accompanied by Ms. Nhien.

Collected data:

- No data was collected

Next steps

Task	Responsible	Date
Provision of the National Hydropower Plan (NHP) from 2007 and the Small scale hydro plans requested to the Province's by MOIT in 2005	Mr. Trang (GDE)	Week 20-23 Oct
Provision of the Study on National Spatial Data Infrastructure Development Strategy for Vietnam from 2001	WB	Oct 17
Provision of other studies that might be relevant to the assignment	GDE/WB/IHR	asap
Provision of the updated list of existing and planned small and large projects	Mr. Trang (GDE)	Week 20-23 Oct
Assessment of the current legislation on the licensing and approval process on SHP	IHR	During project implementation
Flowchart of the current process of licensing and approval process on SHP	Mr. Trang (GDE)	Week 20-23 Oct

Next steps		
Task	**Responsible**	**Date**
Assessment of the type and quantity of existing topographic maps, as well as its cost for a plan of investment	IHR	During project implementation
Recommendation on the choice between open source or proprietary software	GESTO	During project implementation
Provision of list with tentative permissions and levels of access to the database	Ms. Nhien	Week 20-23 Oct
Clarification on types of GIS layers to be provided by MOIT	GESTO	Week 20-23 Oct

Meeting Report

Subject: Site Visit to Suoi Tan Cascade **Ref.:** VN.2014.AC.005.0 **Number of pages:** 2 **Drafted by:** Jorge André	**Date:** October 15, 2014 **Time:** from 6h00 to 20h00 **Place:** Chieng Khoa Commune, Van Ho District, Son La Province, Vietnam

Participants:

- Trinh Van Trong (Suoi Tan Joint Stock Company – Operational Manager 0984872788 quoctrongihr@gmail.com)
- Ngo To Nhien (MOIT - GDE/Project Officer of REDP project)
- Tran Thiet Hung (Institute for Hydropower and Renewable Energy)
- André Jorge (GESTO)

Agenda:

1. Site visit
2. Site main features
3. Lessons Learnt from the development of the project

Key notes:

- The visited site is owned by Suoi Tan Joint Stock Company. The Institute for Hydropower and Renewable Energy is responsible for its design. It consists on a cascade in the same catchment area with several diversions, penstocks and powerhouses. Some projects are already built and in operation for several years, whilst others are still being constructed or planned. For this reason alone, it is clear that a major effort in planning is important.
- Given the fact that some projects are being implemented in different timeframes, it was given the impression that some of the diversions are independent within the cascade and possibly conflicting with the nearby ones (in terms of diverted flow). Should this be true, it reinforces the idea that an efficient tool for hydropower planning is important.
- Suoi Tan I powerhouse (2,5 MW maximum capacity, approx. 2,5 m3/s flow and 120 m head) appears to comply with international standards and has modern and well maintained equipment. By the time of the visit, it was possible to observe 2 Francis turbines operating out of the 3 existing turbines. The output at the moment was 1,6 MW. When asked about the output throughout the year, Mr. Trong from the Suoi Tan

Meeting Report

Joint Stock Company mentioned that this was actually the driest season of an already dry year, hence this was almost an all-time low.

- The surge tank on top of the penstock appeared to be working efficient. The upstream dam and intake were in less favorable conditions, with clear signs of the need for maintenance.
- Road access seemed to be a major issue, especially considering the need to transport heavy but fragile equipment such as the turbines and switchboards.
- When asked about environmental aspects, Mr. Trong replied that the major issue was after the operation stage of the project, with the need to comply with new legislation that had been regulated meanwhile.
- Considering the licensing and approval process for the projects, Mr. Trong was asked if from his experience it was possible to rank the major issues between the following topics:
    i. Environment
    ii. Social
    iii. Land-use
    iv. Power Purchase Agreement (Tariff negotiation)

  Mr. Trong considered all of these topics at the same level and mentioned that the most difficult subject is getting access to funding.

Collected data:

- No data was collected

Next steps

Task	Responsible	Date
-	-	-

Meeting Report

Subject: Second Internal Team Meeting **Ref.:** VN.2014.AC.006.0 **Number of pages:** 1 **Drafted by:** Jorge André	**Date:** October 17, 2014 **Time:** from 15h00 to 16h00 **Local:** The World Bank Vietnam Office, 7th floor, 63 Ly Thai To street, Hanoi, VN

Participants:

- Ky Hong Tran (WB)
- Jorge André (GESTO)

Agenda:

1. Project update
2. Next Steps

Key notes:

- Brief update of the previous day Site Visit.
- Brief update of the Working Meeting between the International and National Consultant and GDE past Wednesday October 15. Mr. Ky insisted on the need for a close interaction with the National Consultant during this stage. Mr. Jorge is currently assessing the TOR of the selection of the National Consultant to see if they meet the necessary requirements and to give guidance on the forthcoming cooperation.
- The full scope of sub-activity "Design of a GIS database for national information on hydropower" was clarified. For the International Consultant it should comprise the conceptualization of the database whilst the actual creation of the database should be the National Consultant's responsibility, under guidance and advisory of the International Consultant. Therefore, the National Consultant's TOR should account for this assignment.

Collected data:

- No data was collected

Next steps		
Task	**Responsible**	**Date**
Confirmation of next week's meetings	WB	October 20
Preparation of next week's meetings brief presentation	GESTO	October 20
Revision of the National Consultant's TOR	GESTO	Week Oct 20-23

Meeting Report

Subject: Consulting meeting with MONRE	**Date:** October 20, 2014
Ref.: VN.2014.AC.007.0	**Time:** from 14h00 to 16h00
Number of pages: 3 **Drafted by:** Jorge André	**Local:** MONRE 10 Ton That Thuyet - Cau Giay - Ha Noi, VN

Participants:

- Mr. Hà (MONRE – Head of the Dept. of Water Resources Management)
- Senior Officer of Dept. of Water Resources Management of MONRE (Mr.)
- Senior Officer of Dept. of Water Resources Management of MONRE (Ms.)
- Pham Thuy Dung (MOIT – GDE/Department of New and Renewable Energy – Coordinator of REDP project)
- Phạm Anh Tuấn (MOIT – GDE/Project Officer of REDP project)
- Ngo To Nhien (MOIT - GDE/Project Officer of REDP project)
- Chu Ba Thi (WB)
- Tran Thiet Hung (Institute for Hydropower and Renewable Energy)
- André Jorge (GESTO)
- Pham Khanh Chi (GeoViet)

Agenda:

1. Introduction
2. Project overview
3. Cooperation

Key notes:

- Mr. Tuan made a brief introduction of the REDP project.
- Mr. Thi presented the participants and made an ESMAP project overview.
- Mr. Jorge made a brief project presentation based on the project's objectives and the description of its main activities. He later focused on the necessary cooperation with MONRE. He finalized his presentation with brief output examples.
- For the cooperation with MONRE, Mr. Jorge identified two types of input, one for each Activity:
    i. Activity 1: Advisory services for building up a small national hydro GIS database:
        - Hydrological Data
        - Meteorological Data
        - Protected Areas

ii. Activity 2: Developing guidelines for improved planning of small hydro:
    - Feedback from approval process - National Decree 112/2008/ND-CP and 29/2011/ND-CP
    - Existing guidelines for the approval

- Mr. Hà, the Head of the Dept. of Water Resources Management of MONRE mentioned that hydropower planning is also extremely important for MONRE and not just for MOIT. He mentioned that recently MONRE was requested by the Government to regulate the reservoirs in 11 basins and that it's MONRE's mission to review and upgrade the usage of surface water projects.
- Regarding the Consultant's presentation, Mr. Hà mentioned that the legal documents presented for hydropower approval (National Decree 112/2008/ND-CP and 29/2011/ND-CP) was incomplete since there is a new law from 2012 related to Water Use and Water Resource Management and more specifically to the construction of reservoirs in the basin. Mr. Hà also mentioned that whilst in the past Hydropower projects were viewed as single-purpose, nowadays they are being evaluated with multi-purpose objectives and that their development needs to assess their impacts in terms of environment, social and land-use, water usage and irrigation. Mr. Hà continued stating that usually the licensing process is smoother for large hydro than for small hydro, given that the former is more strictly and clearly regulated than the latter, and that the approval process for hydropower should also take into account the downstream impact. On top of this, it seems that the current approval procedure doesn't consider the multi-purpose option as it should. Mr. Hà concluded this part of the discussion stating that he hopes MONRE may keep having an active voice in hydropower planning and be able to monitor and regulate the sector.
- In terms of the data requirements for Activity 1, Mr. Hà stated that MONRE has both meteo and hydro data, but meteo data is much more comprehensive. Mr. Hà also said that his department has been developing a database including small hydropower data (in MapInfo and MS Excel format) for supporting his work. Data is available to MOIT under a certain service and O&M fee (Data Supply Services regulation between public institutions defined by the Government). Mr. Hà mentioned that regarding protected areas MONRE currently doesn't have much information but this shouldn't be a major issue for small hydropower.
- About the ecological and reserved flow which is essential for hydropower planning and impact assessment, Mr. Hà said that MONRE was requested by the Government to determine these minimum flows downstream of dams and that this assignment should be completed in about 2 years. Also important is the consideration of flood control from the dams through their storage capacity.

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- Ms. Nhien asked about the licensing process needs in MONRE and Mr. Hà replied that a comprehensive application is essential and that after receiving the application MONRE checks with its framework within the Master Plan and goes to the field to make surveys. After the licensing process the promoter is required to make periodical updates and monitoring, but in practice this doesn't happen and they must pay a fine. Mr. Hà concluded saying that projects higher than 2 MW need MONRE's approval and lower than that they are approved at a provincial level (PPC).
- Mr. Hà mentioned that it's correct that the guidelines are based in international standards but consultants should be aware of the regional differences and local sensibilities, and should always contact all relevant stakeholders. Mr. Jorge agreed and replied that under the current initiative a test case will be conducted that will help improve and check the level of adequacy of the guidelines.
- Ms. Dung asked about the process of acquiring data from MONRE. Mr. Hà said that all data must be officially required, and should include the purpose and payment fees.
- The requested meteo and hydro data should be requested to a different operational unit under MONRE, the National Hydro – Meteorological Service (NHMS), who have a list of the existing data.
- Mr. Jorge made a brief assessment of the licensing process in MONRE in the past year of 2013 with a couple of Q&A's, to which Mr. Hà replied:
    i. Q: how many applications received? A: 40
    ii. Q: how many applications evaluated? A: 40
    iii. Q: how many applications approved? A: 20
    iv. Q: if MONRE doesn't approve, the application is rejected? A: the 2004 law allowed that the Water Use Permit (the approval by MONRE) could be issued after construction, so the application might not need MONRE's approval in early stages. From the current 2013 law, the project must get the Water Use Permit before investment decision.

Collected data:

- No data was collected

Next steps

Task	Responsible	Date
-	-	-

Meeting Report

Subject: Consultation meeting with MARD	**Date:** October 21, 2014
Ref.: VN.2014.AC.008.0	**Time:** from 8h30 to 9h30
Number of pages: 2 **Drafted by:** Jorge André	**Local:** MARD So 2, Ngoc Ha, Ba Dinh - Ha Noi, VN

Participants:

- Mr. Tu (MARD/Directorate of Water Resources – Deputy Director/Hydraulic Structures Management Department)
- Phạm Anh Tuấn (MOIT – GDE/Project Officer of REDP project)
- Ngo To Nhien (MOIT - GDE/Project Officer of REDP project)
- Chu Ba Thi (WB)
- Tran Thiet Hung (Institute for Hydropower and Renewable Energy)
- André Jorge (GESTO)
- Tran Hung (GeoViet)

Agenda:

1. Introduction
2. Project overview
3. Cooperation

Key notes:

- Mr. Thi presented the participants and made an ESMAP project overview.
- Mr. Jorge made a brief project presentation based on the project's objectives and the description of its main activities. He later focused on the required cooperation with MARD. He finalized his presentation with brief output examples.
- For the cooperation with MARD, Mr. Jorge identified two types of input, one for each Activity:
    i. Activity 1: Advisory services for building up a small national hydro GIS database:
        - Existing/planned dam info
    ii. Activity 2: Developing guidelines for improved planning of small hydro:
        - Feedback from approval process
- Mr. Tu stated that MARD will cooperate with MOIT/WB with any available data.
- Mr. Tu stated that for the licensing process, MOIT consults MARD for recommendations and suggestions in different stages of the approval process and MARD gives official (written) feedback. Not all hydropower projects require MARD's

Meeting Report

feedbacks but if they have potential impacts on MARD existing dams and/or irrigation systems they need to have written feedbacks from MARD. For MARD, there are a number of multi-purpose projects, but the priority is always irrigation and only after this comes the development of other sectors such as hydropower.

- Concerning inputs for the hydropower database, Mr. Tu mentioned that MARD recently conducted a national survey and created their own database of irrigation schemes, totaling around 6.000 entries, of which around 2.000 entries don't have complete data attributes available. The database includes plotted maps with dams creating reservoirs with a storage capacity higher than 1.000.000 m3 totaling around 900 projects. On this database there is no distinction between the projects that may or may not include hydropower purposes or even which are single or multi-purpose. Mr. Tu estimates that only around 50 projects shall be multi-purpose. This database can be viewed in a public access portal designed by the Vietnam Academy of Water Resources and includes updated hydromet stations and monitoring systems of the reservoirs. Mr. Tu suggested that the local consultant should study more this database in order to build a sharable system that can exchange data when needed.
- Mr. Jorge made a brief assessment of the licensing process in MARD in the past year of 2013 with a couple of Q&A's, to which Mr. Tu replied:
    i. Q: how many applications received? A: the hydropower applications requesting feedbacks are evaluated by the Water Resource and Planning Dept. under Directorate of Water Resources at MARD, a different Dept. from Mr. Tu's.
    ii. Q: how many applications evaluated? A: Mr. Tu's Dept. itself evaluated only 2 applications last year.

Collected data:

- No data was collected

Next steps

Task	Responsible	Date
-	-	-

Meeting Report

Subject: Consultation meeting with EVN	**Date:** October 21, 2014
Ref.: VN.2014.AC.009.0	**Time:** from 10h00 to 11h30
Number of pages: 3 **Drafted by:** Jorge André	**Local:** EVN 11 Cua Bac St., Ba Dinh - Ha Noi, VN

Participants:

- Mr. Hung (EVN – Deputy Director of the EVN Investment Management Dept. in charge of Hydropower)
- Mr. Binh (EVN – Deputy Director the EVN Construction Management Dept.)
- Mr. Trung (EVN – Officer of the EVN Investment Management Dept. overseeing Hydropower)
- Mr. Long (EVN - Officer of the EVN Investment Management Dept. overseeing Hydropower)
- Tran Duc Minh (EVN – International Relations Dept./Expert)
- Pham Trong Thuc (MOIT – GDE/Director of the New and Renewable Energy Dept.)
- Pham Thuy Dung (MOIT – GDE/Department of New and Renewable Energy – Coordinator of REDP project)
- Phạm Anh Tuấn (MOIT – GDE/Project Officer of REDP project)
- Ngo To Nhien (MOIT - GDE/Project Officer of REDP project)
- Chu Ba Thi (WB)
- Tran Thiet Hung (Institute for Hydropower and Renewable Energy)
- André Jorge (GESTO)
- Tran Hung (GeoViet)

Agenda:

1. Introduction
2. Project overview
3. Cooperation

Key notes:

- Mr. Thuc presented the participants and made a REDP project overview.
- Mr. Thi made an ESMAP project overview.
- Mr. Jorge made a brief Small Hydropower Mapping under the ESMAP initiative project presentation based on the project's objectives and the description of its main

activities. He later focused on the requested cooperation with EVN. He finalized his presentation with brief output examples.

- For the cooperation with EVN, Mr. Jorge identified two types of input, one for each Activity:
  i. Activity 1: Advisory services for building up a small national hydro GIS database:
     - Existing/planned projects info
  ii. Activity 2: Developing guidelines for improved planning of small hydro:
     - Feedback from approval process
     - Lessons learnt from hydropower projects development
- Mr. Hung declared that he considers EVN has several types of information that may be useful for MOIT's purposes on the current project. By June 2013 EVN accounted for 1237 schemes under planning, which totaled for around 26 GW of installed capacity, of which 129 were over 30 MW, where the remaining projects under 30 MW totaled around 6.8 GW. Most recently, the Government asked MOIT to review the existing Master Plan with more than one thousand schemes and following this the number of schemes under 30 MW, usually considered small hydropower, decreased to around 900.
- Mr. Hung stated that EVN is mainly focused on the development of large hydro of 60 MW or higher and that small hydropower is presently the responsibility of MOIT's GDE. Currently EVN's portfolio consists of 37 schemes, including projects in operation, construction and on the pipeline.
- Mr. Hung mentioned that some large projects are of national importance and may include classified data whose disclosure must be approved by the Ministry of Defense under National Security concerns. On the same topic, Mr. Hung said that for large projects there are different levels of Public Interest and so their regulation may be specially approved by the National Assembly. As for the existing operational rules for large schemes, the single-plant operational rule is approved by MOIT whereas the cascade operational rule is approved by the Prime-Minister himself. For small schemes (<30 MW), operational rules are approved by MOIT.
- Mr. Hung declared that retrieving data for large hydropower schemes shouldn't be a complex task because all information is centralized in EVN. On the other hand, small hydropower schemes info may be harder to retrieve since it is scattered throughout the country in provincial offices.
- All information requested to EVN must follow an official demand and clear statement of the list of required data.
- Relating to the licensing process, MOIT is asking EVN to have feedbacks on large projects and projects that share resources with EVN projects on the 9 main river systems. Connection of SHPs to grid is also requiring close consultation with EVN.

Meeting Report

Collected data:

- No data was collected

Next steps

Task	Responsible	Date
-	-	-

Meeting Report

Subject: Consultation meeting with MRC **Ref.:** VN.2014.AC.010.0 **Number of pages:** 2 **Drafted by:** Jorge André	**Date:** October 21, 2014 **Time:** from 13h30 to 15h00 **Local:** 23 Hàng Tre - Ha Noi, VN

Participants:

- Mr. Phuong (Mekong River Commission – National Coordinator for Hydropower)
- Ms. Hà (Mekong River Commission)
- Pham Thuy Dung (MOIT – GDE/Department of New and Renewable Energy – Coordinator of REDP project)
- Phạm Anh Tuấn (MOIT – GDE/Project Officer of REDP project)
- Ngo To Nhien (MOIT - GDE/Project Officer of REDP project)
- Tran Thiet Hung (Institute for Hydropower and Renewable Energy)
- André Jorge (GESTO)
- Pham Chi (GeoViet)

Agenda:

1. Introduction
2. Project overview
3. Cooperation

Key notes:

- Ms. Dung presented the participants and made a REDP project overview, followed by Ms. Nhien with an ESMAP project overview.
- Mr. Jorge made a brief Small Hydropower Mapping under the ESMAP initiative project presentation based on the project's objectives and the description of its main activities. He later focused on the requested cooperation with Mekong River Commission (MRC). He finalized his presentation with brief output examples.
- For the cooperation with MRC, Mr. Jorge identified two types of input, one for each Activity:
  i. Existing/planned projects info
  ii. Lessons learnt from database and GIS data creation/collection
- Mr. Phuong mentioned that the MRC actually has an updated hydropower database on their basin, with some basic information such as coordinates, installed capacity, main features and even some technical documentation, such as design studies and

Meeting Report

Environmental Impact Assessment studies. This database is updated regularly every 3 months, for which the MRC mainly consults EVN as the major source of information. The database also includes some small hydropower projects. The database is available publicly at the MRC data portal (http://portal.mrcmekong.org/).

- Mr. Phuong presented a 2011 study also accessible to retrieve from the MRC data portal: Planning Atlas of the Lower Mekong River Basin, with relevant information. This Atlas is a work in progress and is periodically updated every 5 years.
- In terms of software, MRC uses ArcMap and its databases are made using MS Excel.
- In 1995 there was an agreement between MRC countries to share all information, especially hydromet stations data. There were two types of hydromet data in Mekong River Basin coming from Vietnam:
  i. Data from MONRE (free of access under the data sharing agreement)
  ii. Data from MRC owned monitoring system

  Recently (2011) MRC owned monitoring system were commissioned to MONRE.
- Mr. Phuong presented a document entitled "Impact of Mainstream Hydropower on Mekong River" where the implementation plan for monitoring and assessment of the river basin was demonstrated, using DHI's software and knowledge base MIKE and SWAT.
- Mr. Jorge asked if MRC is part of the approval process on licensing hydropower in the Mekong basin, to which Mr. Phuong replied negatively.
- All information requested to MRC must follow an official demand.

Collected data:

- No data was collected

Next steps

Task	Responsible	Date
-	-	-

Meeting Report

Subject: Second Local Consultant Meeting **Ref.:** VN.2014.AC.011.0 **Number of pages:** 2 **Drafted by:** Jorge André	**Date:** October 22, 2014 **Time:** from 14h00 to 16h00 **Local:** Institute for Hydropower and Renewable Energy So 8/95 Chua Boc, Dong Da, Ha Noi

Participants:

- Do Ngoc Anh (VAWR - Institute for Hydropower and Renewable Energy)
- Tran Thiet Hung (VAWR - Institute for Hydropower and Renewable Energy)
- Nguyen Quoc Hiep (VAWR - Center for Water Resources Software)
- Ngo To Nhien (MOIT - GDE/Project Officer of REDP project)
- André Jorge (GESTO)
- Pham Chi (GeoViet)

Agenda:

1. Coordination between National and International Consultants
2. Vietnam Academy of Water Resources Visit

Key notes:

- Mr. Anh made a brief presentation of the Vietnam Academy of Water Resources, who has around 1300 workers under 16 departments, of which the Institute of Hydropower and Renewable Energy is one of the most representatives, with around 150 workers. The Institute of Hydropower and Renewable Energy conducts not only studies and support on all of the supply chain for hydropower (from plans to implementation and operation), but also manufacturing of equipment up to 1 MW (specially micro-turbines).
- Mr. Jorge spoke about the necessary coordination between both contracts and mentioned that the complementarity between the International Consultant's experience in integrated hydropower GIS databases and the National Consultant's separate experience in hydropower and GIS databases will be key to the success of the project.
- The participants then proceeded to the manufacturing zone of the Institute where they were able to see turbines, pump-turbines, ram-pumps and generators, amongst other equipment manufactured there.

Meeting Report

- The participants then proceeded to the Center for Water Resources Software, where Mr. Hiep presented the Irrigation Database built for MARD integrated with the Natural Disaster Control System. This includes around 600 hydromet stations, most of which with automated real-time data, including 4 EVN monitoring stations. The system is very comprehensive and includes state-of-the-art technology and processes.
- The GIS database was built using WebGIS, OpenGIS and PostgreSQL open source software's and when asked about his professional preference between open-source and proprietary software, Mr. Hiep chose the former.
- The GIS database has public access through www.thuyloivietnam.vn. It took almost 6 years to accomplish, of which 3 for its initial development. The Center for Water Resources Software has around 50 workers, of which around 10 worked on the development of the system.

Collected data:

- No data was collected

Next steps

Task	Responsible	Date
-	-	-

Meeting Report

Subject: Wrap-up Meeting	**Date:** October 23, 2014
Ref.: VN.2014.AC.012.0	**Time:** from 14h00 to 15h30
Number of pages: 3 **Drafted by:** Jorge André	**Local:** MOIT 4th floor 91, Dinh Tien Hoang, Hoan Kiem, Ha Noi

Participants:

- Pham Trong Thuc (MOIT – GDE/Director of the New and Renewable Energy Dept.)
- Tran Hoai Trang (MOIT – GDE/Department of Hydropower)
- Pham Thuy Dung (MOIT – GDE/Department of New and Renewable Energy – Coordinator of REDP project)
- Phạm Anh Tuấn (MOIT – GDE/Project Officer of REDP project)
- Ngo To Nhien (MOIT - GDE/Project Officer of REDP project)
- Tran Hong Ky (WB)
- Chu Ba Thi (WB)
- André Jorge (GESTO)
- Tran Hung (GeoViet)

Agenda:

1. Update of the Inception Mission
2. Next Steps

Key notes:

- Mr. Ky made a presentation on the objectives of the meeting and the Inception Mission itself.
- Mr. Jorge made a presentation about the objectives and major findings of the Inception Mission and the next steps of the project.
- About the general objectives of the Inception Mission, Mr. Jorge said that they were all fulfilled:
  iv. Personal meetings and presentation
  v. Acquaintance with local conditions
  vi. Fine-tuning of the implementation plan
- Regarding the specific objectives of the Inception Mission, Mr. Jorge said they were all accomplished:
  i. Meetings with the Client
  ii. Meetings with the National Consultant

iii. Meetings with relevant stakeholders
iv. Assessment of available information
v. Compilation of relevant information and data (work still in progress)
vi. IT assessment of MOIT

- Under this last topic, it was mentioned that there is currently no GIS or database software licenses or users in GDE, nor the current server capacity is sufficient. The current operating system is MS Windows. Some key decisions will have to be made in the near future regarding Open Source vs. Proprietary Software, new hardware requirements and hostage and storage options.
- As for the main findings from the mission, the International Consultant will require at this early stage some studies and data in possession of GDE, namely:
  i. National Hydropower Plan (NHP) from 2007 – or any existing update
  ii. Plans requested to the Province's by MOIT in 2005 – or any existing update?
  iii. Other studies that might be relevant
  iv. Current licensing and approval process

  From external sources, it will be required basic info on existing maps and GIS layers and data from other stakeholders, which should be officially requested.
- Mr. Jorge then proceeded to show a tentative work plan with the most important next steps. For the International Consultant it should be the deliverance of the Inception Report, in about 4 to 6 weeks and the completion of the design of the database, in about 3 to 4 months. These schedules are subject to the working start of the National Consultant and the approval process of the report by the WB/GDE. For the National Consultant, it should be the start of the data collection (as soon as possible) and the start of the population of the database, once the design from the International Consultant is done.
- Ms. Dung and Ms. Nhien asked what the most relevant type of data is for the International Consultant, to which Mr. Jorge said that first it would be some basic info on the type and amount of GIS layers available and second the actual detail of all technical features of the schemes.
- Following the presentation there was some open discussion on what type of level of access and permissions to assume when the database is implemented and also on the open source vs. proprietary software issue.
- Mr. Jorge mentioned that the major relevant issues and key decisions, work plan and corresponding milestones and critical path will be approached in the upcoming Inception Report, which will require approval from both the WB and MOIT for the continuation of the assignment.

Meeting Report

Collected data:

- No data was collected

Next steps

Task	Responsible	Date
Provision of data already in GDE's possession	GDE	October 2014
Deliverance of the Inception Report	GESTO	November 2014
Hiring and clearance of work for the National Consultant	GDE	asap

Annex II – Existing maps and GIS layers

GIS map layers support to Develop RE mapping

No.	Layer map	Number of pieces
1	Topography	550
2	Transport (National highways, district and commune road, railway)	550
3	River system (Rivers, streams, large lakes)	1400
4	Social and Cultural residential and infrastructure	550
5	Map layer of vegetation cover	550
6	Land administration boundaries (commune level).	550
7	Geology	550
8	Soils	550
9	Climate	550
10	Public area (commission, schools, public area, ...)	550

Note: - Map layer scale 1/50,000 include 550 pieces

- Map layer scale 1/25,000 include 1400 pieces

Annex III – Preliminary list of existing/planned hydropower projects

Small Hydropower Planning (May 2013)									
	Province	**Operation**		**Under construction**		**FS preparing**		**Planning** (no developer)	
		Số DA	**Nlm**	**Số DA**	**Nlm**	**Số DA**	**Nlm**	**Số DA**	**Nlm**
1	Lai Châu	4.0	20.45	8	70.3	22	242.9	9	76.6
2	Điện Biên	7.0	20.54	3	67.5	12	216.4	22	127.8
3	Sơn La	20.0	251.1	18	221.2	13	131.6	9	65
4	Hòa Bình	5.0	13.55	4	15.3	0	0	0	0
5	Phú Thọ	0.0	0	1	2.6	1	4	0	0
6	Lào Cai	27.0	281.55	20	409.1	28	216.75	2	10
7	Yên Bái	15.0	68.425	13	255.9	10	56.8	7	43.59
8	Hà Giang	15.0	192.95	7	93.7	16	176.9	6	35.3
9	Tuyên Quang	0.0	0	1	8	1	9.5		
10	Cao Bằng	10.0	32.4	6	50.9	10	68.5	10	24.4
11	Bắc Kạn	3.0	10.1	1	5	1	4.5	23	26.4
12	Lạng Sơn	1.0	4.5	5	54.4	1	2	7	12.5
13	Thái Nguyên	1.0	1.9	0	0	0	0	0	0
14	Quảng Ninh	1.0	3.6	1	3.6	3	28.4	0	0
15	Thanh Hóa	2.0	2.96	3	30.6			1	6
16	Nghệ An	4.0	38.5	11	174.4	6	93	1	2
17	Hà Tĩnh	2.0	36	0	0	5	63.1	1	1
18	Quảng Bình	1.0	13.5	1	22	3	38.5	21	68.8
19	Quảng Trị	2.0	9.4	6	71.5	0	0	3	8
20	Thừa Thiên Huế	0.0	0	3	55.2	5	52	2	8

21	Quảng Nam	11.0	88	4	189	19	166.8	1	4.2
22	Đà Nẵng	0.0	0	4	50.2	2	5.2	2	6.7
23	Quảng Ngãi	4.0	33.1	1	1.8	13	240.7	3	14.5
24	Bình Định	1.0	6.6	6	64.5	6	43.7	0	0
25	Phú Yên	0.0	0	3	31	1	4.8	1	1.6
26	Khánh Hòa	1.0	28	3	56	1	7		
27	Ninh Thuận	2.0	15.6	1	10.5	2	14.8		
28	Bình Thuận	1.0	33	2	22	4	28	2	9
29	Gia Lai	28.0	168.855	11	71.75	7	34.95	2	12.5
30	Kon Tum	7.0	82.2	15	97.3	20	149.3	2	11.5
31	Đắk Lắk	11.0	57.105	2	10	5	26.2	3	12.2
32	Đắk Nông	8.0	59.3	3	36	13	75.7	1	1.9
33	Lâm Đồng	9.0	84.5	7	77.9	14	92.2	4	21.6
34	Bình Phước	2.0	6.4	3	27.2	3	16	10	28.1
35	Bình Dương	0.0	0	0	0.0	2.0	17.5	0	0
36	Bà Rịa - Vũng Tàu	0.0	0	1	2.5	0.0	0.0	0.0	0.0
37	Tây Ninh	1.0	1.5	1	1.5	0.0	0.0	0.0	0.0
		206.0	**1665.6**	**179.0**	**2360.4**	**249.0**	**2327.7**	**155.0**	**639.2**
Commission untill 2015					***4025.9***	***MW***			

Large Hydropower Projects in Viet Nam (>100MW)

(September 2013)

No	Name of project	Install capacity (MW)	Province
	A. Operation		
1	Hòa Bình	1920	Hòa Bình
2	Thác Bà	108	Yên Bái
3	Yali	720	Gia Lai
4	Đa Nhim	160	Lâm Đồng
5	Hàm Thuận	300	Lâm Đồng
6	Đa Mi	175	Lâm Đồng
7	Thác Mơ	150	Bình Phước
8	Trị An	400	Đồng Nai
1	Tuyên Quang	342	Tuyên Quang
2	Bản Chát	220	Lai Châu
3	Huội Quảng	520	Sơn La
4	Sơn La	2400	Sơn La
5	Bản Vẽ	300	Nghệ An
6	A Vương	210	Quảng Nam
7	Kanak-An Khê	173	Gia Lai
8	Sông Tranh 2	190	Quảng Nam
9	Sông Ba Hạ	220	Phú Yên
10	Đại Ninh	300	Lâm Đồng
11	Plei Krông	110	Kontum
12	Sêsan 3	260	Gia Lai
13	Sêsan 4	330	Gia Lai
14	Srêpok 3	220	Đắc Lắc
15	Buôn Kuôp	280	Đắc Lắc
16	Đồng Nai 3	240	Lâm Đồng
17	Đồng Nai 4	270	Lâm Đồng
18	Nam Chien 1	210	Sơn La
19	Khe Bố	100	Nghệ An
20	Hủa Na	180	Nghệ An
	B. Under construction		
1	Nho Quế 3	135	Hà Giang
2	Lai Châu	1200	Lai Châu
4	Trung Sơn	250	Thanh Hoá

7	A Sap	150	Thừa Thiên Huế
8	Sông Bùng 2	100	Quảng Nam
9	Sông Bùng 4	145	Quảng Nam
10	Đakmi 1	200	Quảng Nam
11	Đakmi 4	140	Quảng Nam
12	Thượng Kontum	260	Kontum
	C. Planning		
1	Đông Phù Yên (storage)	1200	Sơn La
2	Bác Ái (storage)	1050	Ninh Thuận

LIST OF HYDROPOWER PROJECTS (30-100 MW) - PREPARING FOR CONSTRUCTION
October 2013

Các dự án thuộc QH thủy điện nhỏ (công suất 30-100 MW) trên địa bàn các tỉnh đang nghiên cứu

Name Tên dự án	Province Tỉnh	Capacity (MW) Công suất	
Lông Tạo	Điện Biên	42	Dự kiến KC tháng 9/2013
Nậm Pàn 5	Sơn La	34.5	
Sông Lô 6	Hà Giang	44	Đang KS lập DAĐT
Chi Khê	*Nghệ An*	*41*	*Cấp CNĐT 5/2010, đã lập DAĐT*
Sơn Trà 1	Quảng Ngãi	42	
Bảo Lâm (1+2+3)	Cao Bằng, Hà	116.0	
Yên Sơn	Tuyên Quang	70.0	
Cẩm Thủy 2	Thanh Hóa	38.0	
Nậm Mô 1	Nghệ An	95.0	
Vĩnh Sơn 2	Bình Định	80.0	
Pa Ma	Điện Biên, Sơn	80.0	
Phú Tân 2	Đồng Nai	60.0	
Thanh Sơn	Đồng Nai	40.0	

700 MW

Annex IV – List of project features to collect included in the National Consultant's TOR

LIST OF INPUT DATA FOR HYDROPOWER MAPPING

	Data	Unit	Type	Available / not available	Note
I	**General information**				
1	Name of project		text		
2	Location (Province/District/Commune)		text		
3	Install capacity		number		
4	Name of river		text		
5	Break ground date		date		
6	Commission date		date		
7	Total project cost		Usd/vnd		
8	Name of Developer		text		
9	Address		Text		
10	Tel / Fax		number		
11	Email		Text		
II	**Watershed**				
1	Watershed area	Km^2	number		
2	Average annual precipitation	mm	number		
3	Annual flow Qo	m^3/s	number		
4	Frequency and discharge of checking flood	m^3/s	number		
5	Frequency and discharge of design flood	m^3/s	number		
6	PMF flood (if available)	m^3/s	number		
7	Firm discharge	m^3/s	number		
8	Name of hydropower cascade (or dam) on the river		Text		
9	Name of water withdrawal structures (irrigation, water supply …) on the river		Text		
10	Maximum and minimum value of flow module		number		
11	Project's grade		number		
II	**Reservoir**				
1	Full supply water level (FSWL)	m	number		
2	Dead water level (DWL)	m	number		
3	Design flood water level	m	number		
4	Checking flood water level	m	number		

	Data	Unit	Type	Available / not available	Note
5	Reservoir area at FSWL	km^2	number		
6	Volume at FSWL Wbt	10^6m^3	number		
7	Active volume Wt	10^6m^3	number		
8	Dead volume Wc	10^6m^3	number		
9	Flood prevention volume Wpl	10^6m^3	number		
10	Gross volume	10^6m^3	number		
11	Operation rule		Word/file		
III	**Dam**				
1	Coordinates		Longitude, Latitude,		
2	Type		text		
3	Crest elevation	m	number		
4	Cress width B	m	number		
5	Length on cress Lđ	m	number		
6	Maximum height	m	number		
7	Slope Upstream / downstream		number		
IV	**Spillway**				
1	Coordinates		Longitude, Latitude,		
2	Free Spillway				
2a	*Type (ophixerop, labyrinth, thin weir, ...)*		*text*		
2b	*Threshold elevation*	*m*	*number*		
2c	*Number of span*		*number*		
2d	*Dimension BxH*	*m*	*number*		
3	Spillway with valve				
3a	*Type of valve*		*text*		
3b	*Threshold elevation*	*m*	*number*		
3c	*Number of gate*		*number*		
3d	*Dimension BxH*	*m*	*number*		
4	Design flood discharge	m^3/s	number		
5	Checking flood discharge	m^3/s	number		
6	Type of dissipator		text		

	Data	Unit	Type	Available / not available	Note
V	**Waterway**				
	Intake				
1	Type (deep, separated, inside dam ..etc…)				
2	Threshold elevation	m	number		
3	Valve dimension nxBxH	m	number		
4	Trashrack dimension nxBxH	m	number		
5	Emergency valve dimension nxBxH	m	number		
6	Maximum height	m	number		
	Tunnel/Cannal				
7	Total length	m	number		
8	Type (pressure/non-pressure)		text		
9	Clearance dimension : Diameter (Round) or BxH (horse shoe) / BxH (rectangular)	m	number		
10	Slope (average)	%	number		
	Surge tank				
10	Type		text		
12	Diameter	m	number		
	Penstock				
13	Length	m	number		
13	Diameter	m	number		
14	Lining steel	mm	number		
	Forebay				
15	Length	m	number		
16	Dimension BxH	m	number		
	Powerhouse				
17	Coordinates		Longitude, Latitude,		
18	Type of turbine / Manufacturer		text		
19	Number of unit		number		
20	Install capacity Nlm	MW	number		
21	Firm capacity Nbđ	MW	number		
22	Maximum height Hmax	m	number		

	Data	Unit	Type	Available / not available	Note
23	Minimum height Hmin	m	number		
24	Calculation height Htt	m	number		
25	Maximum discharge	m^3/s	number		
26	Average output E0	10^6 KWh	number		
27	Normal running hour	hour			
28	Tailrace water level max/min	m	number		
	Tailrace canal				
29	Length	m	number		
30	Width	m	number		
31	Slope		number		
32	Inclined		number		
VI	**Access road**				
1	New road	km	number		
2	Upgraded road	km	number		
VII	**Total project cost**				
1	Unit cost per 1 KWh output	10^3VNĐ	number		
2	Unit cost per 1 KWh install capacity	10^6VNĐ	number		
VIII	**Connection**				
1	Voltage level	kV	number		
2	Length of transmission line	km	number		
IX	**Resettlement and minority ethic**				
1	Total number of household / people have to resettled		Number		
2	Total number of household / people loss cultivation area / living area		Number		
3	Minority ethic in project area		text		
4	Description of resettlement area		text		
X	**Total land loss for project development**				
1	Cultivation	ha	Number		
1a	*2 rice crops*	*ha*	*Number*		
1b	*Vegetation crop*	*ha*	*Number*		

	Data	Unit	Type	Available / not available	Note
2	Non-agriculture land	ha	Number		
3	Residence land	ha	Number		
4	Land for Specific purpose	ha	Number		
5	River / stream land	ha	Number		
6	Forest	ha	Number		
6a	*Plantation*	*ha*	*Number*		
6b	*Natural*	*ha*	*Number*		
7	Non-used land	ha	Number		
XI	**Religious, cultural and historical structures in the project area**		text		
XII	**Environment Impact Assessment Report**		file		Attach environment report

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