

Biomass Resource Mapping in Vietnam

INCEPTION REPORT

June 2015



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It is one of several outputs from the biomass **resource mapping component of the activity** '*Renewable Energy Resource Mapping and Geospatial Planning – Vietnam* [Project ID: P145513]. This activity is funded by the Energy Sector Management Assistance Program (ESMAP), a multi-donor trust fund administered by The World Bank. The activity receives additional technical support from being part of a global ESMAP initiative on Renewable Energy Resource Mapping. Further details on the initiative can be obtained from the [ESMAP website](#).

This report is an **interim output** from the associated project, and is therefore **preliminary and unvalidated**. Users are strongly advised to exercise caution when utilizing the information and data contained, and should familiarize themselves with the accompanying reports from this project, and other relevant outputs, to fully understand the context, methodology and constraints. These can be downloaded from the ESMAP website listed above – please refer to the corresponding country project page. During the next phase (2) of this project, survey data will be collected from across the country, and this will be used in the final phase (3) to develop a **final, validated, peer-reviewed** suite of outputs from this project, which will be made publicly available.

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RENEWABLE ENERGY RESOURCE MAPPING: BIOMASS [PHASES 1-3] - VIETNAM

INCEPTION REPORT



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I. PROJECT INTRODUCTION AND BACKGROUND

Fast economic growth and significant population expansion are causing a dramatic increase of electricity demand in Vietnam. According to the "National Master Plan for Power Development for the period of 2011-2020 with an outlook to 2030" (referred to as Power Master Plan VII), the Government of Vietnam (GoV) has set a national target for increasing the total amount of power generation and import from about 19,500 MW in 2010 to 75,000 MW and 146,800 MW by 2020 and 2030 respectively. The total electricity generation and import is expected to be 330 billion kWh in 2020 and 695 billion kWh in 2030.

In order to attain such ambitious target, the GoV has been endeavoring to exploit various sources of power generation and supply: fossil fuels (coal and gas), hydro power, nuclear power, renewable energy (RE) and imported power. As Vietnam has a huge potential of RE resources, the Power Master Plan VII has set a goal to increase the share of the installed power capacity using RE sources to 4,200 MW and 13,800 MW by 2020 and 2030 respectively (5.6% and 9.4% of total installed power capacity of the country). The electricity generated from RE sources will increase to 14.85 billion kWh by 2020 (4.5% of the total electricity generation and import) and to 41.7 billion kWh by 2030 (6% of total electricity generation and import).

By 2020, the installed power capacity is expected to be 1,000 MW for wind power, 500 MW for biomass and 2,700 MW for other RE sources. These capacities are planned to reach 6,200 MW for wind power, 2,000 MW for biomass and 5,600 MW for other RE sources by 2030.

The General Directorate of Energy (GDE) under the Ministry of Industry and Trade (MOIT) is implementing the Renewable Energy Development Project (REDP) funded by the World Bank. The objective of the REDP is to increase the supply of electricity to the national grid from renewable energy sources on a commercially, environmentally and socially sustainable basis. The REDP has three components: (i) Investment Implementation; (ii) Regulatory Development and (iii) Pipeline Project Development. The investment component provides refinancing facility for renewable sub-projects, in which nine small hydropower sub-projects with total capacity of 125.7 MW were approved and being implemented. GDE is implementing several technical assistance activities through two other components to strengthen the capacity of government agencies and stakeholders for developing the sizable renewable energy resources in Vietnam.

In addition to studies on supporting mechanisms for development of renewable energy and cumulative impacts assessment for hydropower cascades, GDE has requested the assistance of the World Bank for a Renewable Energy Resource Mapping project, with funding from the Energy Sector Management Assistance Program (ESMAP). The project development objective for this activity is to increase the output and diversity of renewable electricity generation in Vietnam. The outcome objective is to improve the awareness of the government and the private sector of the resource potential for biomass, small hydropower, and wind¹, and providing the government with a spatial planning framework to guide commercial investment.

Under this World Bank project, biomass mapping was initiated in June 2015 following the previous initiation of wind and small hydro mapping in 2013, both of which are ongoing. The World Bank has

¹ Solar resource mapping is also being carried out, but under a separate activity funded by Spain

contracted an international Consortium of consultants led by Full Advantage Co., Ltd. The Consortium involves several Finnish companies led by Simosol Oy, and two local partners: the Institute of Energy and the Energy Conservation Research and Development Center (Enerteam).

2. OBJECTIVES AND ITINERARY OF THE INCEPTION MISSION

In order to successfully initiate the work, the Consortium conducted an inception mission to Vietnam from 1st to 6th June, 2015. The main objectives of the mission were:

- to meet with the GDE/MOIT and the WB/ESMAP project teams to explain and refine the proposed methodology and timeline;
- to conduct an inception meeting to introduce the project to the key stakeholders in Vietnam and to collect their feedback on the proposed methodology, activities and the timeline of the project;
- to carry out the stakeholder identification and team building exercise;
- to identify and assess sources of data;
- to identify and assess potential competing uses of biomass; and
- to identify and assess potential conflicts with other land-uses or other proprietary issues.

The inception mission started in Hanoi with a kick-off meeting with the GDE/MOIT and the WB/ESMAP project teams at MOIT office on June 2. An inception meeting was then organized at the WB's office in Hanoi on June 3. Several separate meetings with potential data providers and local universities, as well as site visits to a sugar mill and a rice mill in Mekong River Delta region were also organized in order to allow the consultants to better understand the local competence in biomass field surveys and the current uses of biomass in industry. The inception mission itinerary is provided in Annex I.

3. KICK-OFF MEETING

The kick-off meeting with the GDE/MOIT and the WB/ESMAP project teams was held on June 2 at MOIT office (23 Ngo Quyen Street, Hoan Kiem District, Hanoi).

The participants were:

- Mr. Pham Trong Thuc (Director of New and Renewable Energy Department, GDE)
- Ms. Pham Thuy Dung (Project Officer, GDE)
- Ms. Ngo Thi To Nhien (Project Officer, GDE)
- Mr. Tran Hong Ky (Task Team Leader, WB Vietnam)
- Mr. Oliver James Knight (ESMAP)
- Mr. Klas Sander (ESMAP)
- Mr. Ludovic Lacrosse (Team Leader of the Consortium, FA)
- Mr. Jussi Rasinmäki (Simosol Oy)
- Mr. Tran Quang Cu (FA)
- Mr. Bienvenido Anatan (FA)
- Mr. Nguyen Duc Cuong (Institute of Energy)
- Ms. Dang Huong Giang (Institute of Energy)

Mr. Tran Hong Ky opened the kick-off meeting with a brief presentation of the project. It was followed by a presentation by Mr. Jussi Rasinmäki on "*the Mapping Concept*". Two concepts, i.e., remote sensing analysis and field survey were clearly explained. The satellite to be used for the project and the workflow of the field survey were also presented. Mr. Ludovic Lacrosse then presented the "*Three Phases of the Project*" and the "*Objectives, Activities, Outputs and Work Schedule*" of the assignment.

Four key issues were discussed during the kick-off meeting:

- Maintaining and updating the biomass resource maps;
- Potential local consultants for field data collection;
- Timeframe for field data collection;
- Budget for field data collection;

Mr. Tran Hong Ky suggested that the biomass resource maps would be handed over to GDE/MOIT after the project. Mr. Pham Trong Thuc informed that GDE will establish an Information Center in the near future. It was agreed that this Center will take over the maintaining and updating of the biomass resources maps. The consulting Consortium will develop a tool for updating the maps. The consulting Consortium will also train the staff of the Information Center and other local consultants selected by GDE/MOIT on how to maintain and update the biomass resource maps.

The consulting Consortium suggested that, based on its experience from a similar project in Pakistan, the local universities could be hired by GDE/MOIT for field data collection. Three universities were preliminarily identified by the Consortium: Hanoi University of Science and Technology (HUST) in Hanoi, Nong Lam University (NLU) in Ho Chi Minh City and Can Tho University (CTU) in Can Tho City. GDE requested the Consortium to conduct an assessment of the capacities of these three universities. It was agreed that GDE/MOIT will select the local universities for field data collection through a competitive bidding process based on the Terms of Reference (TOR) prepared by the consulting Consortium. Mr. Oliver James Knight suggested that the local universities shall be requested to submit in their proposal the detailed organizational approach for the field data collection.

GDE/MOIT informed that they have a remaining budget from a previous WB project that can be used to finance the field survey. However, this budget must be spent by June 2016. Therefore, the field data collection work has to be completed by May 2016. The Consortium confirmed that such timeframe is possible if the contract on field data collection is signed in August 2015 so that the training on field data collection can be conducted in September 2015.

GDE/MOIT informed that this remaining budget was of the order of 50,000 USD. However, this budget is planned to be used for collection and compilation of all existing data into an accessible format (a "central energy database"), not for a field survey. GDE/MOIT will estimate the budget for field data collection for biomass resource mapping based on the TOR prepared by the consulting Consortium.

4. INCEPTION MEETING

4.1. Date and Venue

The inception meeting was organized in the afternoon of June 3 at the WB's office (63 Ly Thai To Street, Hanoi, Vietnam).

4.2. Participants

The meeting was attended by 21 participants, excluding the representatives of the GDE/MOIT and WB/ESMAP project team and of the consulting Consortium. The participants consisted of ministerial government officers (23.8%), universities and research institutions (57.2%), potential project developers and investors (9.5%) and international organizations (9.5%). The list of participants with their contact details is provided in Annex 2.

4.3. Contents of the Inception Meeting

The inception meeting was essentially an information seminar. Its agenda is provided in Annex 3.

The inception meeting was opened by WB/ESMAP and GDE/MOIT representatives. Mr. Oliver James Knight, WB/ESMAP Senior Energy Specialist, delivered a short speech on the objectives of the inception meeting. Then, Ms. Pham Thuy Dung, GDE/MOIT representative, made a brief presentation of the biomass resource mapping project for Vietnam and called upon the participants for their support in information/data provision during the project implementation.

Following the self-introduction of the participants, Mr. Oliver James Knight presented the "*Renewable Energy Resource Mapping*" project. He first presented ESMAP which is a multi-donor trust fund within the WB, established in 1983 and operated in over 100 countries. With a funding and technical support from ESMAP, a Renewable Energy Resource Mapping (RERM) Initiative was launched by the WB in October 2012. With a budget of 22.5 million USD, the RERM Initiative aims at the strategic level resource mapping to support government planning and commercial development. The project covers biomass, small hydro, solar and wind resources. In Vietnam, RERM Initiative is supporting GDE/MOIT in developing the maps for biomass, small hydro and wind resources.

Mr. Ludovic Lacrosse introduced the consulting Consortium, its organogram and the role of each partner. It was followed by a presentation on the "*Objectives, activities, outputs and work schedule*" of the assignment. He provided the participants with an overall picture of this 18-month biomass mapping project and its final expected outputs.

After that, the "*Status of biomass resource assessment in Vietnam*" was presented by Mr. Nguyen Duc Cuong. The main biomass resources available in Vietnam are agricultural residues (from crops such as paddy, maize, sugarcane, cassava, peanut, coffee, coconut, cashew, etc.), forest-based residues (from forests and wood processing mills), solid wastes and planted energy crops. More than ten previous studies were identified and briefly presented. Mr. Nguyen Duc Cuong also presented the status of biomass utilization for power generation in Vietnam. Bagasse has been used as fuel for cogeneration plants in 40 sugar mills with a total installed capacity of around 150 MW. However, a few cogeneration plants can sell excess electricity to the national grid at a price varying between 580 and 1,000 VND/kWh (0.027-0.046 USD/kWh). There is a rice husk-fired steam boiler plant installed in Tra Noc Industrial Zone, Can Tho City. It generates and sells about 70 tonnes/hr of process

steam to a food processing factory. About ten rice husk-fired power generation projects are under the feasibility study stage.

Finally, Mr. Jussi Rasinmäki presented the "*Benefits, approach and methods, and required input data for the biomass atlas*". He started his presentation with a statement that the final deliverable of the project (i.e., Biomass Atlas for Vietnam) should help commercial project developers in making their decision on building biomass-based power generation plants with a specific emphasis on avoiding side effects on food security and existing alternative uses of biomass. This was simplified using three questions: (1) where to build the biomass-based power plant? (2) which biomass feedstock to use? and (3) which biomass-to-electricity conversion technology to use? Then, Mr. Jussi Rasinmäki presented the approaches and methods which should be used for collecting required data and for producing the biomass atlas. Two types of input data are required: satellite images and field data. The satellite images can be obtained free of charge from Sentinel-1 of the European Space Agency (ESA) while the field data will be collected through the field surveys.

The discussion session was then opened for the participants to give their comments and suggestions on the project implementation. The Consortium and the WB/ESMAP project team also answered the questions of the participants. The inception meeting ended with the concluding remarks of the WB/ESMAP representative.

The presentations are provided in Annex 4 while selected photos of the inception meeting can be found in Annex 5.

4.4. Feedback of Participants

During the inception meeting, several participants expressed their comments and suggestions relative to the project which could be summarized as follows:

- The single onsite interview shall cover all the cropping seasons of a year.
- The existing data sources should be investigated and used if appropriate (for example, the data of all sugar mills in Vietnam from the Vietnam Sugarcane and Sugar Association; the GIS datasets of some crops (sugarcane, maize, etc.) from Hanoi University of Science and Technology (HUST); Agricultural atlas of Vietnam from FAO, land use database from MONRE, etc.).
- The project should focus on agricultural residues as they have higher technical and economic potentials.
- The criteria for converting from theoretical biomass potential map into sustainable technical potential map should be clearly defined.
- The crop cultivation patterns should be included in the survey/interview form.
- The min-average-max values of the crop yields should be included in the survey/interview form.
- GIZ is implementing a biomass energy planning project with a component related to field survey and data collection. A close collaboration between WB/ESMAP and GIZ should be considered to synergize and avoid any duplication in field data collection.

A feedback form was distributed to all participants during the inception meeting in order to get the participants' feedback about the event itself, but also about the biomass mapping project. This helped

initially assess sources of data and identify the possible roles of the stakeholders in implementation of the project. The template of the feedback form is provided in Annex 6.

Fourteen (14) responses (66.7% of total participants in the inception meeting) were received. The summary of feedback from the participants is provided in Annex 7.

The participants' ratings on the topics' relevance and on the meeting in general were analyzed and the results are presented in Table I.

Table I: Rating on the topics relevance and of the meeting in general

| Ratings of the topics relevance | No. of responses (% of total responses) | Overall ratings of the meeting | No. of responses (% of total responses) |
|---------------------------------|---|--------------------------------|---|
| Not so relevant | 0 (0.0%) | Poor | 0 (0.0%) |
| Fairly relevant | 0 (0.0%) | Fair | 0 (0.0%) |
| Relevant | 4 (28.6%) | Good | 8 (57.1%) |
| Very relevant | 5 (35.7%) | Excellent | 5 (35.7%) |
| No answer | 5 (35.7%) | No answer | 1 (7.2%) |
| Total | 14 (100%) | | 14 (100%) |

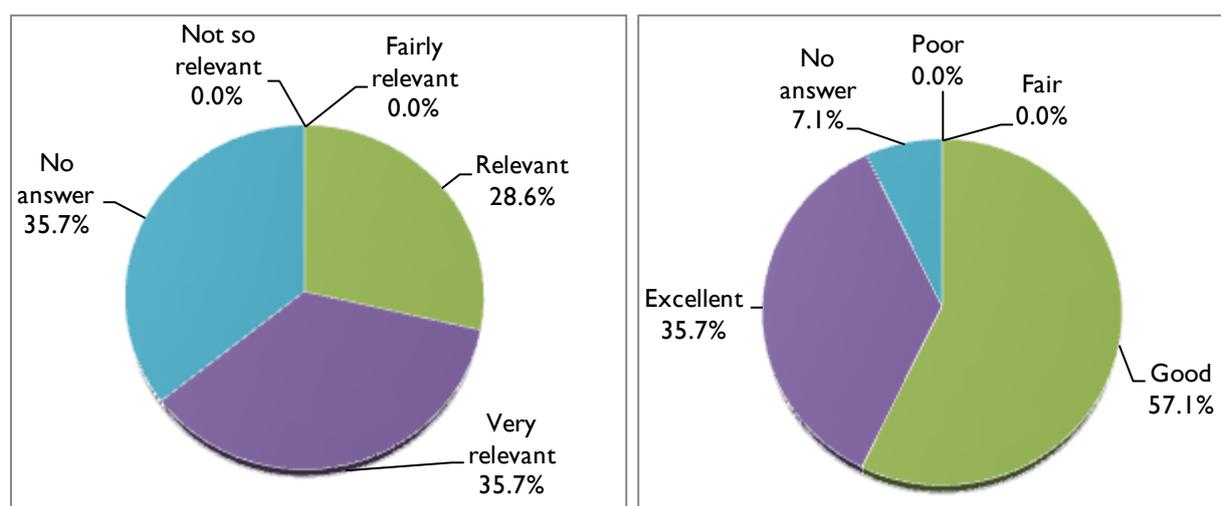


Figure 1: Rating of the topics and of the meeting in general

It can be seen from the results of analysis that the topics were rated as "relevant" or "very relevant" in 64.3% of the responses. However, 5 participants (35.7% of total responses) did not rate the relevance of the meeting topics. The inception meeting was generally rated as "good" by 57.1% and "excellent" by another 35.7% of the respondents.

5. SITE VISITS

5.1. Site visit to Phung Hiep Sugar Mill

A site visit to Phung Hiep Sugar Mill was conducted in the morning of June 5. The mill is located at 10, 1/5 Street, Hiep Thanh Ward, Nga Bay Town, Hau Giang Province.

The participants were:

- Mr. Pham Quang Vinh (Director of Phung Hiep Sugar Mill)

- Mr. Klas Sander (WB/ESMAP)
- Mr. Ludovic Lacrosse (Team Leader of the Consortium, FA)
- Mr. Jussi Rasinmäki (Simosol Oy)
- Mr. Tran Quang Cu (FA)
- Mr. Bienvenido Anatan (FA)
- Mr. Nguyen Duc Cuong (Institute of Energy)
- Mr. Tiet Vinh Phuc (Enerteam)
- Ms. Tran Thi Yen Phuong (Enerteam)

Phung Hiep Sugar Mill (PHSM) is a member of Can Tho Sugar Joint Stock Company (CASUCO). Currently, the government owns 30% of CASUCO. However, it is planned to be completely privatized this year.

PHSM has a design crushing capacity of 3,000 TCD (tonnes of sugarcane per day). The crushing season lasts 6-7 months from October to May. The main products of PHSM are refined sugar, molasses and bio-fertilizer.

At present, the average crushing capacity of the sugar mill is around 2,600 TCD. With a bagasse-to-sugarcane ratio of 30%, the amount of bagasse generated is 780 tonnes/day. A major part of this bagasse is used to run a steam boiler, while the remaining part is sold to a private company producing cattle-feed. The selling price of bagasse is 400,000 VND/tonne (around 18 USD/tonne). The ash from the boiler is sold as bio-fertilizer to the farmers at a price of 100,000 VND/tonne (around 4.5 USD/tonne).

The low-pressure steam boiler (25 bar and 315°C) was manufactured by an Indian company and installed in 1997. PHSM has a plan to replace the existing low-pressure boiler by a high-pressure cogeneration plant within the next two years. The new cogeneration plant will consist of a 87 bar / 515°C vibrating-type steam boiler and a 20 MW steam turbine. About 7 MW will be consumed by the sugar mill, and the remaining 13 MW will be sold to the grid. The project is expected to be commissioned early 2017. The Power Purchase Agreement (PPA) is not yet signed as PHSM is waiting for the new feed-in tariffs for biomass-based power projects to be announced by the government soon.

PHSM plans to buy additional biomass to run the planned cogeneration plant for the whole year. Therefore, the steam boiler will be designed to burn a mixture of bagasse with other biomass.

Mr. Pham Quang Vinh noted that the selling price of electricity from biomass-based cogeneration plants in Vietnam is too low (0.058 USD/kWh) compared to other countries in Southeast Asia region (for example, in Thailand, the selling price is more than 0.11 USD/kWh).

Sugarcane is purchased from the farms located within a radius of 60-70 km from the sugar mill. It is transported by barges which have an average capacity of 50 tonnes. PHSM signed the sugarcane purchase contracts with more than 1,000 farmers (average size of the farm is 1 hectare). The contracts are renewed every year.

PHSM has around 10 staff working in the sugarcane supply chain. The barges transporting sugarcane to the sugar mill are operated by external private companies which are hired by the sugar mill.

Farmers are informed in advance about the operating schedule of a barge so that they can load their sugarcane to the barge using smaller boats.

Some selected photos during the site visit to Phung Hiep Sugar Mill are provided in Annex 5.

5.2. Site visit to Hoang Minh Nhat Rice Mill

A site visit to Hoang Minh Nhat Rice Mill (HMN Rice Mill) was conducted in the afternoon of June 5. The rice mill is located at Thoi Khanh A Village, Tan Thanh Commune, Thoi Lai District, Can Tho City.

The participants were:

- Mr. Nguyen Van Nhut (Director of the Rice Mill)
- Mr. Pham Minh Quoc (Vice Chief of Industry Management Division of Can Tho DOIT)
- Mr. Klas Sander (WB/ESMAP)
- Mr. Ludovic Lacrosse (Team Leader of the Consortium, FA)
- Mr. Jussi Rasinmäki (Simosol Oy)
- Mr. Tran Quang Cu (FA)
- Mr. Bienvenido Anatan (FA)
- Mr. Nguyen Duc Cuong (Institute of Energy)
- Mr. Tiet Vinh Phuc (Enerteam)
- Ms. Tran Thi Yen Phuong (Enerteam)

HMN Rice Mill specializes in rice processing. Its design milling capacity is 12 tonnes of paddy per hour. The mill operates for 4-5 months a year processing around 40,000 tonnes of paddy annually.

There are three milling seasons a year: (1) from February to April (the mill is normally operated at 50% of its design capacity), (2) from mid-May to August, and (3) from November to December.

With a rice husk-to-paddy ratio of about 20%, rice husk generated at HMN Rice Mill is around 8,000 tonnes a year (2.4 tonnes/hour max). Around 10% of this rice husk is used for drying paddy. Excess rice husk is sold to the brick-making factories. Until 2010, HMN Rice Mill could not sell out the excess rice husk, especially during the high-milling seasons. Some amount of rice husk had to be disposed into the river causing environmental problems. In 2012, HMN Rice Mill installed a rice husk pelletizing plant with a capacity of 2.4 tonnes of pellets per hour. Since then, no rice husk is disposed into the river.

Rice husk pellets are sold to the local market to be used as fuel for the furnaces or boilers of several industries such as cement, textile, food processing, etc. They are also exported to Korea. The selling price of rice husk pellets at the mill is 1,300 VND/kg (about 0.06 USD/kg).

Rice husk sold to the brick-making factories at a price varying from 400 to 1,000 VND/kg depending on the season (700 VND/kg or 0.032 USD/kg in average).

The rice mill is mainly purchasing paddy from the farms in the area. Sometimes, it has to buy paddy from the farms which are located 50-70 km away from the rice mill. Paddy is transported to the rice mill by boats which have an average capacity of 10 tonnes.

Some selected photos during the site visit to Hoang Minh Nhat Rice Mill can be found in Annex 5.

6. DATA SOURCE IDENTIFICATION

The objective of this activity was to identify and assess relevant data sources from existing documentation and from various government agencies, private sector and non-government organizations (NGOs).

6.1. Desk study of existing relevant documentation

The consulting Consortium, in coordination with the WB project team obtained the existing reports and publications relevant to the biomass resource assessment and mapping in Vietnam. The reviews of these documents are summarized in Table 2.

Table 2: Summarized reviews of existing reports and publications

| No. | Title, Author(s) and Reviews |
|-----|---|
| 1. | <p><i>Agricultural Atlas of Vietnam, by General Statistics Office (GSO) of Vietnam, Pro-Poor Livestock Policy Initiative (PPLPI) and Food and Agriculture Organization (FAO), 2001.</i></p> <p>This study provided a comprehensive set of maps that present a wide range of aspects of agriculture in Vietnam. The full report on this study can be found online at http://www.fao.org/ag/againfo/programmes/en/pplpi/map_agrivietnam.html.</p> <p>Most of the maps based on census statistics were down to the commune level, giving the reader a very detailed picture of spatial patterns in agricultural production. This atlas linked the commune-level census data to a GIS map of corresponding administrative boundaries.</p> <p>This resulted in a set of detailed digital maps that can be used not only to present the data in an easily assimilated manner, but also to facilitate analysis of the data, both within the census dataset and with spatially referenced data from other sources.</p> <p>The 2001 Agricultural Atlas of Vietnam provided a valuable resource for researchers, policy makers, educational institutions, development agencies and other international organizations, as well as for readers with a general interest in agriculture and rural development in Vietnam.</p> <p>The maps were divided into six broad categories: (1) introduction, (2) basic demography and infrastructure, (3) crop agriculture, forestry and aquaculture, (4) livestock, (5) commercial farms and cooperatives, and (6) rural incomes from agriculture, forestry and fisheries.</p> <p>The maps consisted of a series of images taken by Landsat Thematic Mapper (TM) 4 and Landsat TM5 satellites of the American National Aeronautics and Space Administration (NASA) during the early 1990s. Some land cover types, typically associated with certain</p> |

| | |
|----|---|
| | <p>colors included:</p> <ul style="list-style-type: none"> • Evergreen forest; • Thin forests, brush plants and areas with low plant coverage; • Rice cultivation areas that have not yet been harvested; • Area without plant coverage such as harvested rice fields, bare land and hills, farmland with low plant coverage, sand banks, bare rocky mountains, built up areas, etc.; • Sea, rivers and deep lakes; Shallow water <p>The biomass resource mapping project can utilize these atlas and maps, after due verification, for cross-checking and cross-referencing purposes.</p> |
| 2. | <p><i>Vietnam: Rice Husk Market Study, by Robert Chronowski, Tran Quang Cu and Nguyen Le Truong, IFC, 2009.</i></p> <p>The study provided a comprehensive review of the potential for using rice husk energy in Vietnam.</p> <p>The study started with a desk study which provided an overview of the power sector of Vietnam, the rice milling industry, the rice husk generation and uses, the potential rice husk energy conversion technologies, the legal framework for promotion of rice husk power projects as well as the opportunities and barriers to large-scale rice husk power project development.</p> <p>The field surveys were conducted in the highest rice producing provinces in Vietnam, namely: Dong Thap, Tien Giang, An Giang, Tra Vinh, Nghe An, Thai Binh and Soc Trang. These surveys assessed rice husk availability, transportation methods, rice husk trading challenges and other possible barriers, the potential types of rice husk-based energy projects and their locations.</p> <p>Two power conversion technologies using rice husk as fuel were reviewed and analyzed in the study report. They were gasification and direct combustion. Gasification system ranges from 250kW to 5MW with multiple choices of different configurations of gasifier. Direct combustion technology based on steam boiler and turbines has a higher range from 5MW to 250MW.</p> <p>The financial analyses were carried out for several rice husk-based power generation and cogeneration projects using gasification and direct combustion technologies. The sensitivity analyses were also conducted.</p> <p>The results of this study, particularly the data collected from field surveys can be used as good references for the biomass resource mapping project.</p> |
| 3. | <p><i>Strategy (up to 2020, outlook to 2050) and Master Plan (up to 2020, outlook to 2030) on Renewable Energy Development of Vietnam, by IE, sponsored by MOIT WB (2010), 2011.</i></p> <p>The main objective of this study was to prepare and submit a <i>Strategy</i> for RE development in Vietnam up to 2020 with an outlook to 2050, and a <i>Master Plan</i> for RE development up to 2020 with an outlook to 2030 to the Government of Vietnam for consideration and approval. Biomass is one of six main RE resources which was identified, assessed and selected for power generation in this <i>Strategy</i> and <i>Master Plan</i>.</p> |

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| | <p>Three main groups of solid biomass resources were assessed: i) fuel-wood including firewood (e.g., tree barks, leaves and branches, shrubs, etc. from pruning the trees) and wood residues generated from the wood processing plants (e.g., sawdust and wood chips); ii) crop residues, mainly consisting of two types: the agricultural wastes after crop harvesting (such as rice straw, cane trash, maize trash, cassava stem, etc.), and agro-industrial residues after crop processing (i.e. rice husk, bagasse, peanut shells, coffee husk, etc.); and iii) municipal solid wastes (MSW).</p> <p>The main approach for potential assessment of the above-mentioned biomass resources was desk studies. The statistical data from published documents and reports were reviewed and used to calculate theoretical potential.</p> <p>The study also provided a good overview on biomass conversion technologies, e.g. direct combustion, gasification as well as biomass briquetting/pelletizing.</p> <p>The investment costs associated with different types of technologies were also discussed in detail. Those are quite useful information, which the biomass resource mapping project can refer to while recommending similar technologies for different biomass types in Vietnam.</p> <p>The supply curves of all kinds of biomass (e.g., rice husk, bagasse, wood wastes, etc.) were developed. These helped set up the development targets for power generation using biomass up to 2020 and outlook to 2030.</p> <p>The biomass resource mapping project can utilize the data and information from this study as a reference for calculating the theoretical and technical potential of biomass resources in Vietnam.</p> |
| 4. | <p><i>Biomass Business Opportunities Vietnam, by SNV, 2012</i></p> <p>The study aimed to give an insight of biomass resources potential in Vietnam and, from that, to discuss on the specific and integral perspectives of business opportunities and on developing an enabling environment for a sustainable biomass/biofuel market. The study estimated and presented the potentials of different types of biomass resources in Vietnam, including:</p> <ul style="list-style-type: none"> • Agricultural residues: Rice, Corn, Coconut, Coffee • Energy crops and residues: Jatropha, Cassava, Sugar Cane • Forest-based residues: Bamboo, Wood • Others (e.g., MSW, Manure, etc.) <p>The biomass potential assessment was based on the data collected from desk study and through meetings and interviews with field experts for additional background information and data. Biomass potentials were estimated and presented for the whole country, however the potentials at provincial level were also provided in the study, whenever possible.</p> <p>There was a brief review of energy conversion technologies which are suitably used for each type of biomass residues. And a comprehensive overview of the existing institutional and legal framework and the policies related to biomass energy development in Vietnam. Several opportunities for future cooperation between Vietnam and the Netherlands stakeholders (private sectors or other organizations/institutions) were identified. The obstacles (policy, financing, culture, etc.) for the Dutch private sector's involvement in biomass project development in Vietnam were also identified.</p> |

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| | <p>The data and information from this study report (especially, the residue-to-crop ratios) could be useful for the biomass resource mapping project.</p> |
| <p>5.</p> | <p><i>Study and proposed support mechanism for development of grid-connected electricity generated from biomass projects in Vietnam, by IE, supported by MOIT/GIZ, 2013.</i></p> <p>The scope of work of this assignment was to develop and propose the supporting mechanisms for development of grid-connected biomass power projects in Vietnam. The study was carried out through six major activities:</p> <ul style="list-style-type: none"> • to provide an overview on the background and justifications of the policies and schemes relating to biomass power development in Vietnam. • to give an introduction on operating mechanisms in the world that support electricity generation from biomass energy. • to review and evaluate the current status of biomass resources and existing biomass power plants in Vietnam. • to identify biomass resources that can be used for electricity generation, based on a review of biomass development targets as referred to in Decision No. 1028 (concerning the Power Sector Development Master Plan No. 7) • to collect available reports on biomass power in Vietnam, such as reports on capacity, technologies, investment rates, selling price for biomass-generated electricity, as a basis for selecting input data for the prices calculation. • to calculate levelized cost of electricity generation (LCOE) for four main biomass groups such as bagasse, rice husks, fuel wood and rice straw based on the data collected. <p>The results of the study were a main basis to formulate an issued Decision 24/2014/QĐ-TTg dated 24 March 2014 of the Primer Minister on incentive mechanism for grid connected biomass power projects in Vietnam.</p> <p>The data gathered under this project can be used to cross-check the data/information collected for the biomass resource mapping project.</p> |
| <p>6.</p> | <p><i>Biomass power development planning for Mekong River Delta region up to 2020, with a vision to 2030, by IE, approved by MOIT, 2013.</i></p> <p>The objective of the project is to formulate and set up a biomass power development plan for the Mekong River Delta region of Vietnam (covering 13 provinces/cities).</p> <p>The main approach for this study was desk studies in combination with field surveys.</p> <p>The study collected, analyzed and presented information and data on the current status of biomass exploitation, biomass conversion technologies and biomass consumption patterns.</p> <p>Additionally, the current practice for biomass supply chains in the Mekong River Delta region was also reviewed. Price of biomass fuels, means and biomass transport costs were also surveyed and analyzed.</p> <p>Three main types of biomass resources potentials in the Mekong River Delta region such as theoretical potential, technical potential and economic potential were assessed. The economic potential could be used for electricity production.</p> <p>The following types of solid biomass resources are included in the study:</p> |

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| | <ul style="list-style-type: none"> • Agricultural and agro-industrial residues: <ul style="list-style-type: none"> - rice straws, - rice husks, - bagasse, and - corn cobs. • Fuel wood and wood residues: <ul style="list-style-type: none"> - fuel wood such as tree trunks, branches, shrubs, etc. collected from energy crop-cutting, pruning or planting; - wood residues from wood processing industry such as sawdust, edgings, slabs, etc. <p>The study report, together with a roadmap, a list of the potential biomass power projects and specific measures for project implementation, were approved by the Ministry of Industry and Trade.</p> <p>The data and results of this study can be used to cross-check the data and information collected for the biomass resource mapping project.</p> |
| 7. | <p><i>Development and Demonstration of Multi-biomass Fuel Supply Chain for Power Plants and Small Industrial Boilers in Vietnam , by Arvo Leinonen (VTT) and Nguyen Duc Cuong (IE), sponsored by EEP Mekong, 2013.</i></p> <p>The study was conducted under the framework of the Energy and Environment Partnership Programme in the Mekong Region (EEP Mekong) by Institute of Energy (IE) together with Technical Research Centre of Finland (VTT). IE was the project leader organization of the project. VTT's role was to act as a partner in the project.</p> <p>The main objective of the study was to develop and demonstrate the effective and reliable biomass supply chain for the power plants and small industrial boilers based on multi-biomass fuels. The biomass fuel supply is a crucial part of the biomass production and utilization chain for CHP plants/Industrial boilers.</p> <p>The study was divided into five parts: (1) The current biomass supply chains/pre-treatment technologies and costs in Vietnam were analysed; (2) New biomass supply chains and pre-treatment technologies were developed; (3) Case studies of the developed biomass supply chains and pre-treatment technologies were conducted. The case studies were selected based on the interests and plans of the potential investors in construction of biomass-based power plants in different regions of Vietnam. The studied biomass supply chains and pre-treatment technologies were also demonstrated in practice in some extent; (4) the results of case studies and demonstration were analysed and reported, (5) a seminar was organised to present the results of the study to the stakeholders.</p> <p>The recommendations on biomass pre-treatment technologies and biomass supply chains made in this study report can be useful for the biomass resource mapping project.</p> |
| 8. | <p><i>Agricultural Biomass Resource Assessment: Cambodia, Lao and Vietnam, by Landell Mills Limited, Asian Development Bank (ADB), 2013</i></p> <p>This technical report is part of the ADB project, named "Capacity Building for Efficient Utilization of Biomass for Bioenergy & Food Security. The report evaluated the biomass potentials including the quantities of biomass residues generated annually and their energy values. The assessed biomass resources are from agricultural residues and livestock wastes. Agricultural residues consisted of rice husk, rice bran, rice straw, maize stalks, maize cobs,</p> |

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| | <p>maize husks, cassava stalk, sugarcane tops and bagasse, while livestock wastes included cattle, pig, chicken, and buffalo manure.</p> <p>The study calculated and presented the Resource Product Ratio (RPR) for rice residues based on field surveys. The manure generated per head per year was also estimated. The RPRs for other agricultural residues and their energy values are taken from the literature. These data were used for calculating the theoretical biomass energy potential of Vietnam.</p> <p>The competitive uses of biomass were also identified. Biomass residues were used for various purposes including energy and non-energy uses, There are huge amounts of unused biomass. There are also energy losses when biomass is converted into the energy. The energy-loss-rates vary according to the conversion route and technology. The study suggests that more in-depth studies are needed for having more precise and realistic energy potential assessment.</p> <p>The results of this report (especially, the information on RPRs and competitive uses of biomass) are good references for cross-checking with the field data collected for the biomass mapping project.</p> |
| 9. | <p><i>Biogas Survey on Biogas Program Phase II, by ACE-Europe, 2013</i></p> <p>The Biogas Program for the Animal Husbandry Sector in Vietnam – Phase II (BP II) (2007 – 2015) was implemented by the Biogas Project Division of the Ministry of Agriculture and Rural Development of Vietnam in cooperation with SNV Netherlands Development Organization. The project was funded by the Dutch Government. This survey was carried out from December 2012 to March 2013.</p> <p>The main objective of the survey was to explore whether a commercially viable biogas sector has been developed outside the BP II program. The survey also included a comparison between digesters constructed within and outside the BP II program in terms of quality and performance. The other objective was to evaluate how the BP II program impacted on poverty reduction and on household income generation.</p> <p>The field survey was carried out by using structured interviews combined with observations. The study included the interviews of 422 households (141 households participated in the BP II program and 281 from outside the program) in 7 provinces of 5 (out of the 6) regions in Vietnam. The provinces were chosen by narrowing down from the regions to the provinces and to the districts based on a list of criteria. In each districts, 20 households from 2 communes were selected randomly based on the BP II program database, while 40 households were chosen by discussions with district and commune communities. Two interviews were done before the survey to test the quality of the questionnaires.</p> <p>From the survey it was found that a commercially viable biogas market is developing based on the fact that about 40 percent of the digesters were purchased in the free market. The quality of digesters seems good and it was quite hard to make a comparison in term of quality. The reason is that some digesters outside the BP II program were constructed by BP II trained masons. Finally, there is no difference in household income for the households having digesters from biogas programs and the ones who purchased the digesters from the free market.</p> <p>The biomass resource mapping project could take advantage of the household questionnaire to design the biomass survey questionnaire.</p> |

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| 10. | <p>Woody Biomass for Energy Generation in Vietnam, by Winrock and SNV, USAID, 2014</p> <p>This study was carried out in the framework of the USAID Vietnam Clean Energy Program by SNV Netherlands Development Organization. The study provides an overview of the opportunities of woody biomass (residues) for energy generation, including an overview of the current uses and of the potential future uses.</p> <p>Sections 2 and 3 provide a general view on the woody biomass exploitation in Vietnam and the energy potential from the forestry sector. It also gives an overview of the local technology supply. These two sections provide an insight on all form of wood residues which originate from forest harvesting activities and from other wood processing activities such as sawmills and timber factories.</p> <p>Sections 4 and 5 introduce the current wood energy conversion technologies and equipment used in Vietnam, ranging from densification technologies like pelletizing to large scale industrial use of woody biomass. The woody biomass conversion technologies can be classified into three categories: traditional, state-of-the-art and emerging technologies. The conversion chain discussed in the report is from wood chips, pellets, briquettes and charcoal with combustion and gasification conversion to heat and power generation.</p> <p>The study shows the collected data of:</p> <ul style="list-style-type: none"> • Forest area (ha) by categories of natural, plantation, dense and young forest; • Distribution of plantation forest area (ha) by regions; • Annualized timber generation (m³) from plantation and natural forest. <p>Data and information are gathered from existing studies and from research bodies (SNV) and government authorities (MARD, MONRE) in Vietnam. The study also introduces the Vietnam Forest Cover Map (2011), which is useful for biomass mapping.</p> |
| 11. | <p>Productive Biogas: Current and Future Development - Five Case Studies across Vietnam, Uganda, Honduras, Mali and Peru, by SNV and FACT Foundation, 2014</p> <p>This report is the result of the collaboration between SNV and the FACT Foundation. This work presents five case studies of productive biogas and its applications in Mali, Uganda, Honduras, Vietnam and Peru. The target groups are small and medium scale entrepreneurs and enterprises (SMEs).</p> <p>The case studies introduce several applications of productive biogas. In Honduras, a biogas system used to treat contaminated waste water from the coffee harvest and this system produce electricity for coffee farmers. In Peru, a community-based management system uses cattle herd waste to provide electricity for 42 families with a 16 kW biogas electrical generator. In Uganda, a 180 m³ modular bio-digester provides energy to a local rice mill and to 100 families for charging their batteries. In Mali, three pilot biogas systems contributes to the reduction of up to 23% diesel consumption in local businesses of women groups in the three studied villages. In northern Vietnam, 9 biogas systems with capacities from 100 to 500 m³ were installed in medium-scale pig farms.</p> <p>Besides these five case study results, the report presents some lessons learned for extending the productive biogas sector through a systematic analysis on four various parameters namely sustainability, market readiness, replication potential and barriers for market development.</p> |

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| | <p>The case study of biogas systems in medium-scale pig farm in Vietnam is a good reference for the biomass resource mapping project. Many lessons have been learned in terms of the technology, bio-slurry value chain, biogas uses, dilution ratio and economic impacts.</p> |
| 12. | <p>Provincial Biomass Energy Planning for Hau Giang Province, by PECC 3, 2015.</p> <p>This is ongoing project. The overall goal of this study is to assess the potential of biomass, to determine the suitable technologies for a commercial project utilizing biomass for electricity and heat production, and to outline a plan for biomass energy utilization in Hau Giang province.</p> <p>The study focuses on the potentials for power and thermal generation from solid biomass resources within the province of Hau Giang including Vi Thanh city, Nga Bay town, and 5 districts namely Chau Thanh A, Chau Thanh, Phung Hiep, Vi Thuy, Long My and adjacent areas.</p> <p>The following types of solid biomass resources are included in the study:</p> <ul style="list-style-type: none"> • Agricultural and agro-industrial residues: <ul style="list-style-type: none"> - rice straws, - rice husks, - bagasse, and - corn cobs. • Fuel wood and wood residues: <ul style="list-style-type: none"> - fuel wood such as tree trunks, branches, shrubs, etc. collected from energy crop-cutting, pruning or planting; - wood residues from wood processing industry such as sawdust, edgings, slabs, etc. <p>The study started with an assessment of regionally-available biomass potentials (potential analysis/material flow analysis) which allowed identifying inter-provincial biomass material flows. This assessment was very important for developing economically viable projects according to regional or provincial power supply sources.</p> <p>The regional analysis of biomass potential is primarily prepared for the government bodies (municipalities, cities, districts, provinces), but can also be used by the private sector during the project development stage.</p> <p>The analysis will be mainly based on statistical data. However, the onsite expert interviews will be conducted during data validation missions to the province in order to reflect the local circumstances and to validate the assumptions and statistical data. The data already gathered under this study can be used to cross-check the data and information collected for the biomass resource mapping project.</p> |

6.2. Individual meetings with relevant stakeholders

The consulting Consortium interacted directly with relevant stakeholders during the inception mission in order to identify and assess sources of data needed for the project. In addition to several short meetings with the stakeholders during the inception meeting at the WB's office, two key international organizations were met separately.

6.2.1. Meeting with SNV

The meeting with SNV Netherlands Development Organization was held on June 3 at SNV's office (6th Fl., Building B, La Thanh Hotel, 218 Doi Can Street, Hanoi).

The participants were:

- Ms. Dagmar Zwebe (Renewable Energy Sector Leader, SNV)
- Mr. Richard Rastall (REDD+ Technical Adviser, SNV)
- Mr. Ludovic Lacrosse (Team Leader of the Consortium, FA)
- Mr. Jussi Rasinmäki (Simosol Oy)
- Mr. Tran Quang Cu (FA)

SNV has actively been involved in RE development in Vietnam. Some recent studies and projects in the RE sector conducted by SNV include:

- Biomass business opportunities in Vietnam (Mar 2012);
- Off-grid opportunities and challenges in Vietnam (Jan 2014);
- Woody biomass for energy generation in Vietnam (Feb 2014);
- Productive biogas: current and future development (2014);
- SNV Pro-Poor REDD+ (2014);
- Advancing understanding of natural forest carbon stock enhancement as part of REDD+ (2012-2014).

The final reports on these studies and projects were handed over to the Consortium by Ms. Dagmar Zwebe. Some key studies are reviewed and presented in Table 2 above.

Ms. Dagmar Zwebe informed the Consortium that the Ministry of Agriculture and Rural Development (MARD) is implementing the "Low Carbon Agricultural Support Project" using a loan from the Asian Development Bank (ADB). The project aims at enhancing climate smart agriculture development and practices. It is focused on strengthening Low Carbon Agriculture (LCA) policies and institutions; establishing infrastructure support for agri-waste management; and enhancing LCA technology development transfer. These will be part of climate change mitigation and adaptation measures to reduce greenhouse gas emissions in 19 provinces of Vietnam.

Ms. Dagmar Zwebe also provided the Consortium with the brief information on the Forest Carbon Partnership Facility funded by the WB and the UN-REDD Programme supported by FAO/UNDP/UNEP. These two projects are being implemented by VNFOREST (Vietnam Forest Administration) of MARD.

6.2.2. Meeting with GIZ

The meeting with GIZ (Gesellschaft für International Zusammenarbeit GmbH) was organized on June 3, right after the inception meeting.

The participants were:

- Mr. Werner Kossmann (Chief Technical Advisor, RE Support Project, GIZ)
- Ms. Elisabeth Tinschert (Technical Advisor, GIZ)

- Mr. Klas Sander (WB/ESMAP)
- Mr. Ludovic Lacrosse (Team Leader of the Consortium, FA)
- Mr. Jussi Rasinmäki (Simosol Oy)
- Mr. Tran Quang Cu (FA)

The discussion during the meeting focused on the possibility of synergizing between the ongoing project of GIZ and the Biomass Resource Mapping Project in order to avoid any duplication.

The GIZ project opened a tender for the local consulting services. The project consists of two phases. During Phase 1, the data on biomass potential in 63 provinces and cities of Vietnam will be reviewed. The potential provinces will be screened and selected for further detailed study based on the preset screening criteria. About 20 provinces are expected to be selected. In Phase 2, a detailed, onsite survey study will be conducted in order to identify the grid-connected biomass power generation opportunities.

Phase 1 of the project will start soon and is expected to be completed by 30 August 2015. Phase 2 should be completed in March 2016.

It was agreed that the WB/GDE project team will meet with the GIZ team to discuss in more detail the possible cooperation between the two projects. Considering the timeframe of the GIZ project, the agreement on the cooperation should be discussed and achieved before starting Phase 2 of the GIZ project (i.e., before the end of August 2015).

7. TERMS OF REFERENCE FOR FIELD DATA COLLECTION

The Terms of Reference (TOR) for the field data collection were briefly discussed during the kick-off meeting between WB/ESMAP, GDE/MOIT and the Consortium on June 2. The methodology for the field survey and data collection, as well as the role of the local universities was also discussed.

A second meeting on June 4 allowed further elaboration on the TOR. The scope of work, data validation process, the specific conditions of the contract, the overall national coordination of the field survey (IE, SNV or one of the local universities) were also discussed.

Following these meetings, the Consortium prepared and submitted the TOR for the field data collection on June 6. The draft TOR was shared with GDE/MOIT project team by Mr. Tran Hong Ky, Technical Team Leader. A breakdown of number of interviews by province was also submitted to WB/ESMAP team on June 15. These documents can be found in Annex 8.

8. TEAM BUILDING

The objective of this activity was to identify and assess the capability of the local consultants who can help collect onsite data for biomass resource mapping for Vietnam.

8.1. Individual meetings with local universities

A total of six local universities were identified and met during the inception mission:

1. Hanoi University of Science and Technology (HUST)
2. Vietnam National University of Agriculture (VNUA)
3. Vietnam Forestry University (VFU)
4. University of Science and Technology of Hanoi (USTH)
5. Can Tho University (CTU)
6. Nong Lam University - HCMC (NLU-HCMC)

Short meetings with VNUA, VFU and USTH took place during the inception meeting at WB's office. For the three others universities (HUST, CTU and NLU-HCMC), the Consortium managed to arrange separate meetings with them. The meeting reports with these three universities are presented in the following sections.

8.1.1. Meeting with Hanoi University of Science and Technology (HUST)

The meeting with HUST was held at Conifer Hotel on June 2 (10:30 - 12:00).

The participants were:

- Mr. Nguyen Xuan Quang (Head of Thermal Energy Department, School of Heat Engineering and Refrigeration, HUST)
- Mr. Le Duc Dung (Vice Dean, Head of Laboratory, School of Heat Engineering and Refrigeration, HUST)
- Mr. Klas Sander (WB/ESMAP)
- Mr. Tran Hong Ky (Task Team Leader, WB Vietnam)
- Mr. Ludovic Lacrosse (Team Leader of the Consortium, FA)
- Mr. Jussi Rasinmäki (Simosol Oy)
- Mr. Tran Quang Cu (FA)
- Mr. Bienvenido Anatan (FA)

The Consortium briefly presented the requirements and the methodology of the field survey and data collection for the biomass resource mapping for Vietnam.

Mr. Nguyen Xuan Quang presented the projects and studies conducted by HUST, in particular by his School of Heat Engineering and Refrigeration (SHER). HUST has been actively involved in the energy efficiency (EE) and RE sectors in Vietnam. However, most of their projects are in technology research and development (R&D). In the field of biomass energy, HUST/SHER carried out R&D in biomass gasification and combustion in small and medium enterprises, including brick-making industry. The School of Electronics and Telecommunications of HUST is involved in remote sensing and satellite technologies.

Mr. Nguyen Xuan Quang confirmed that HUST has experience in using students for field surveys and data collection. Although HUST has no large-scale project in biomass resource survey and assessment, it was involved in several field surveys on EE & RE in the industry sector.

Mr. Le Duc Dung informed the Consortium that the examination periods are held in December (for first semester) and in early June (for second semester). However, with more than 35,000 undergraduate students, there should be no problem for HUST to mobilize students for field surveys during those periods. The daily rate applied for the field survey by the students in rural area was about 500,000 VND/day (~23 USD/day) including remuneration, accommodation, meals and local travel within the survey area for the surveyor.

Mr. Nguyen Xuan Quang promised to provide more information about HUST and SHER for the Consortium to preliminarily assess their capacity and experience in field survey and data collection.

8.1.2. Meeting with Can Tho University (CTU)

The meeting with CTU was organized on June 4 from 16:00 to 18:00. The meeting took place at the office of CTU's College of Environment and Natural Resources (CENRes).

The participants included:

- Mr. Nguyen Xuan Hoang (Vice Dean of CENRes, CTU)
- Mr. Pham Van Toan (CENRes, Department of Environmental Engineering)
- Mr. Klas Sander (WB/ESMAP)
- Mr. Ludovic Lacrosse (Team Leader of the Consortium, FA)
- Mr. Jussi Rasinmäki (Simosol Oy)
- Mr. Tran Quang Cu (FA)
- Mr. Bienvenido Anatan (FA)
- Mr. Nguyen Duc Cuong (Institute of Energy)
- Mr. Tiet Vinh Phuc (EnerTEAM)
- Ms. Tran Thi Yen Phuong (EnerTEAM)

Mr. Tran Quang Cu opened the meeting with a brief introduction on the objectives of the inception mission and of the meeting with CTU representatives. It was followed by presentations by Mr. Ludovic Lacrosse and Mr. Jussi Rasinmäki on the objectives of the project, on the requirements and methodology for the field survey and data collection for the biomass resource mapping for Vietnam.

Mr. Nguyen Xuan Hoang briefly introduced CTU in general and CENRes in particular. He also provided the Consortium with a presentation of the projects and studies conducted by CTU. In relation to biomass resource survey and assessment, CTU/CENRes were involved in several projects, mainly in the Mekong River Delta region. The largest project in this field is the study on sustainable production of biogas from rice straw (2012-2016, funded by DANIDA). The project is implemented in four provinces: Can Tho, An Giang, Dong Thap and Kien Giang. CTU conducted field interviews of 400 households on their actual use of rice straw, and another 320 households on the use of biogas digesters. In addition, the field research and survey on rice straw to paddy ratio was also carried out.

CENRes has a unit (Department of Land Resources) which specializes in GIS, remote sensing and mapping which was involved in a project of mapping of MSW landfills in the whole Mekong River Delta region.

CTU has a close collaboration with other universities in Vietnam, so it can lead a group of universities to conduct the field survey and data collection for the biomass resource mapping project. They are also willing to be a sub-contractor to another leading university to carry out the surveys in the Mekong River Delta region.

Mr. Nguyen Xuan Hoang promised to provide more information about CTU to the Consortium in order to preliminarily assess their capacity and experience in field survey and data collection.

8.1.3. Meeting with Nong Lam University (NLU)

The meeting with NLU was held on June 6 from 9:30 to 11:30 at EnerTEAM's office.

The participants were:

- Mr. Le Quoc Tuan (Dean of Faculty of Environment and Resources, NLU)
- Mr. Ludovic Lacrosse (Team Leader of the Consortium, FA)
- Mr. Jussi Rasinmäki (Simosol Oy)
- Mr. Tran Quang Cu (FA)
- Mr. Bienvenido Anatan (FA)
- Mr. Tiet Vinh Phuc (EnerTEAM)
- Ms. Tran Thi Yen Phuong (EnerTEAM)

The meeting was opened by the presentation by Mr. Ludovic Lacrosse and Mr. Jussi Rasinmäki on the objectives of the project, on the requirements and methodology for the field survey and data collection for the biomass resource mapping for Vietnam.

Mr. Le Quoc Tuan briefly introduced NLU and the Faculty of Environment and Resources. Then, he presented in details a survey on biomass resources in three provinces of An Giang, Tien Giang and Long An conducted by NLU in cooperation with Waseda University, Japan in 2008-2009. In this project, 600 household interviews had been conducted by the students of NLU. The interviews were carried out two times in order to cover both cropping seasons. The students were supported by the staff of the provincial Departments of Agriculture and Rural Development during the survey. Five interviews a day were assigned to each student. The interviews were geo-localized. The students were also requested to take a photo with the farmer at the surveying site. A group insurance was arranged for the students at 100,000 VND/student.

A survey questionnaire in both Vietnamese and English used for this survey was handed over to the Consortium. This may be a useful reference for the development of the survey form for the biomass resource mapping project.

NLU has a close collaboration with many other universities in Vietnam, so it can lead a group of universities to conduct the field survey and data collection for the biomass resource mapping project. They can also be a sub-contractor to another leading university to carry out the surveys in the southern provinces of Vietnam (from Da Nang City to the far South).

Mr. Le Quoc Tuan promised to provide more information about NLU to the Consortium in order to preliminarily assess their capacity and experience in field survey and data collection.

8.1.4. Teleconference about forest inventory data access via the FORMIS II and NFIS projects

A Skype teleconference about the FORMIS II project, and access to the National Forest Inventory data, was held on June 25 at 15:00 .

The participants were:

- Ms. Raisa Sell (Forest Information System Adviser, FORMIS II)
- Mr. Ludovic Lacrosse (Team Leader of the Consortium, FA)
- Mr. Jussi Rasinmäki (Simosol Oy)
- Mr. Tran Quang Cu (FA)
- Mr. Bienvenido Anatan (FA)

The meeting was opened by Mr. Jussi Rasinmäki going over the objectives of the project, the methodology to be applied, and the need for forest inventory data in the project. Ms. Sell then introduced the FORMIS II project, and its relation to the National Forest Inventory (NFIS). NFIS started in 2012 and is scheduled to cover all forest areas in Vietnam by the end of 2016. Both the FORMIS II and NFIS projects are managed by VNFOREST. NFIS produces the forest inventory GIS data, while FORMIS II produces the information system used to disseminate the NFIS results. Currently the FORMIS system has the inventory data for two provinces, the remaining 13 provinces inventoried in 2014 will be integrated to the system in the coming weeks. The 25 provinces to be inventoried during 2015 are expected to be available in FORMIS between April to June 2016. The remaining 20 provinces, to be inventoried in 2016, will be available in 2017. The FORMIS system has an open-access data-sharing platform to which Ms. Sell sent a link after the meeting (<http://maps.vnforest.gov.vn/>). Mr. Rasinmäki downloaded one province dataset from the data-sharing platform and verified that the data content matches the needs of the biomass-mapping project.

Hence, it was concluded that the project can rely on the FORMIS data-sharing platform to collect the forest inventory data needed to produce the biomass atlases.

8.2. Preliminary capacity assessment of local universities

Only four of six identified universities sent additional information for the preliminary assessment of their capacity and experience in field survey and data collection:

1. Hanoi University of Science and Technology (HUST)
2. Can Tho University (CTU)
3. Nong Lam University - Ho Chi Minh City (NLU-HCMC)
4. Vietnam National University of Agriculture (VNUA)

Mr. Tran Ngoc The (Researcher at the Science, Technology and International Cooperation Division), informed, via email, that Vietnam Forestry University is involved in the National Forest Inventory for the period of 2013-2016. In the field of biomass resources, VFU has been implementing some R&D on biomass gasification and pyrolysis technologies. VFU did not send any additional information as requested by the Consortium for preliminary assessment of their capacity and experience.

Mr. Ha Duong Minh from USTH also informed, via email, that his laboratory was funded six months ago. It still lacks experience in large-scale biomass resource assessment projects. USTH did not send any additional information as requested by the Consortium for preliminary assessment of their capacity and experience.

A preliminary assessment of the capacity and experience of the four remaining local universities is summarized in Table 3.

Table 3: Preliminary assessment of local universities capacity and experience

| Name of university | Background information | Capacity and experience in the fields of biomass resources and energy | Cooperation with other universities |
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| <p>Hanoi University of Science and Technology (HUST)</p> <p><i>Address:</i> 1 Dai Co Viet Road, Hanoi City, Vietnam</p> <p><i>Contact person:</i> Dr. Van Dinh Son Tho School of Chemical Engineering Tel: 0-973-604-372 Email: thovds@gmail.com</p> <p>Dr. Nguyen Xuan Quang School of Heat Engineering and Refrigeration Tel: 0-916-127-468 Email: quang.nguyenxuan@mail.hust.com</p> | <ul style="list-style-type: none"> • HUST was founded in 1956. • HUST has 22 faculties and schools. In addition, it has 17 research institutes and centers. • The School of Electronics and Telecommunications of HUST has a unit (the Department of Aerospace Electronics) which specializes in remote sensing and satellite technologies. • HUST has around 1,800 teaching and supporting staffs, and more than 35,000 undergraduate students. | <ul style="list-style-type: none"> • HUST is a member of 7 international organizations and university networks: Association of Universities of the Francophonie (AUF), ASEAN-European Academic University Network (ASEA-UNINET), Southeast Asia Engineering Education Development Network (SEED-NET), Greater Mekong Sub-region Academic and Research Network (GMSARN), Greater Mekong Sub-region Tertiary Education Consortium Trust (GMSTEC), South East Asia Technical Universities Consortium (SEATUC), and Asia-Oceania Top University League on Engineering (AOTULE). • HUST has been jointly carrying out around 50 research projects with international donors (such as UNDP, EU) and with different partners from Japan, Germany, France, Italy, etc. • Key projects related to energy and biomass resources implemented by HUST are: <ul style="list-style-type: none"> - Establishing a database of GHGs for the Clean Development Mechanism (CDM) support. - Assessment on energy savings and GHGs reduction potential in five industrial sectors in Hanoi. - Assessment of Vietnam renewable energy policy. - Jatropha market survey in Vietnam (2013, NIRAS-RCEE). - Comprehensive survey of energy saving services for small and medium enterprises (2015, NIRAS-RCEE). - Effective energy efficiency policy implementation targeting "new Modern Energy CONsumers" (MECON) in the Greater Mekong Sub-region (2014-2015, University College London). | <ul style="list-style-type: none"> • HUST has a close cooperation network with: <ul style="list-style-type: none"> - Thai Nguyen University (Thai Nguyen Province). - Hue University (Thua Thien-Hue Province). - Quy Nhon University (Binh Dinh Province). - HCMC University of Technology (Ho Chi Minh City). - Can Tho University (Can Tho City). |

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| <p>Can Tho University (CTU)</p> <p><i>Address:</i> 3/2 Street, Xuan Khanh Ward, Ninh Kieu District, Can Tho City, Vietnam</p> <p><i>Contact person:</i> Dr. Nguyen Xuan Hoang College of Environment and Natural Resources Tel: 0-919-804-899 Email: nxhoang@ctu.edu.vn</p> | <ul style="list-style-type: none"> • CTU was founded in 1966. • CTU has 7 colleges and 4 schools. It also has 2 research and development institutes. • College of Environment and Natural Resources (CENRes) is most actively involved in the fields of biomass resource management and biomass energy technologies. CENRes has a unit (Department of Land Resources) which specializes in GIS, remote sensing and mapping. • CTU has more than 1,200 teaching and supporting staffs, and around 40,600 students (bachelor, master and PhD). | <ul style="list-style-type: none"> • CTU has been implementing a number of education and research projects funded by various international donors such as WB, DANIDA, VLIR (the Flemish Interuniversity Council, Belgium), NWO (Netherlands Organisation for Scientific Research), CARE, OXFAM, IFS (International Foundation for Science), ISET (International Symposium on Endovascular Therapy), SDC (Swiss Agency for Development and Cooperation), ACIAR (Australian Center for International Agricultural Research), IRD (Institut de Recherche pour le Développement), NEDO, JIRCAS (Japan International Research Center for Agricultural Sciences), and Sida. • Key projects related to energy and biomass resources implemented by CTU are: <ul style="list-style-type: none"> - Sustainable production of biogas from waste straws (2012-2016, funded by DANIDA). The project is implemented in four provinces of Can Tho, An Giang, Dong Thap and Kien Giang. CTU conducted field interviews of 400 households on their actual use of rice straw, and another 320 households on the use of biogas digesters. In addition, the field research and survey on rice straw to paddy ratio was also carried out. - Designing databases on municipal solid waste (MSW) landfill in Mekong Delta by GIS (2013-2014, funded by Can Tho University Research Fund). In this project, a Web-GIS system was developed to build a database of MSW landfills of 13 provinces of Mekong Delta region. The provincial users are allowed to access via this Web-GIS system for updating and sharing the data. - Developing techniques of agricultural production in the Mekong Delta in response to climate change (2011-2016, funded by Japan International Research Center for Agricultural Sciences). - Feasibility study for a biogas and a biomass | <ul style="list-style-type: none"> • CTU is the largest university in Mekong River Delta region. It has a strong cooperation network with 23 universities and institutes in 12 of 13 provinces of the region (except Ben Tre province). • In addition, CTU has a close collaboration with other universities in Vietnam in teaching and research activities, such as: <ul style="list-style-type: none"> - College of Natural Sciences of the Vietnam National University (VNU)-Hanoi - University of Science and University of Technology of VNU-Ho Chi Minh City - University of Industry (HCMC) - University of Technical Education (HCMC) - Nong Lam University (HCMC) - Binh Duong University (Binh Duong Province) - Thu Dau Mot University (Binh Duong Province), and - Hue University (Thua Thien-Hue Province). |
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| | | <p>combustion plant on Phu Quoc Island, Vietnam (2005-2006, funded by EU/ASEAN Energy Facility Programme).</p> <p>- Bio-Energy Complex - Southeast Asia (2002-2004, funded by the Luxemburg Government).</p> | |
| <p>Nong Lam University - Ho Chi Minh City (NLU-HCMC)</p> <p><i>Address:</i> Linh Trung ward, Thu Duc District, Ho Chi Minh City, Vietnam</p> <p><i>Contact person:</i> Dr. Le Quoc Tuan Faculty of Environment and Resources Tel: 0-918-284-010 Email: quoctuanenvi@gmail.com</p> | <ul style="list-style-type: none"> • NLU-HCMC is current name of the Blao National College of Agriculture which was founded in 1955. • NLU-HCMC has 12 faculties and 3 departments. It also has 13 research institutes and centers. • Faculty of Environment and Resources (FER) is involved in biomass resources and land use management, while the Center for Agricultural Energy and Machinery which is involved in biomass energy technology field. FER also specializes in GIS and remote sensing technologies. • NLC-HCMC has around 890 teaching and supporting staffs, and more than 22,700 students. | <ul style="list-style-type: none"> • NLC-HCMC has been involved in a number of projects funded by various international donors, such as Sida, EU, JICA, ICRAF (World Agroforestry Center), IRRI (International Rice Research Institute), ILRI (International Livestock Research Institute), IFS, Mekong River Commission, SEARCA (Southeast Asian Regional Center for Graduate Study and Research in Agriculture). • Key projects related to energy and biomass resources implemented by NLU-HCMC are: <ul style="list-style-type: none"> - Biogas recovery and power generation from pig manure under Clean Development Mechanism (2008, funded by the People's Committee of Binh Duong province). - Development of Jatropha curcas in degraded soil areas of An Giang province to produce bio-fuels (2008-2015, funded by the People's Committee of An Giang province). - Survey on biomass resources in three provinces of An Giang, Tien Giang and Long An (2008-2009, in cooperation with Waseda University, Japan). In this project, 600 household interviews have been conducted by the students of NLU. The interview was carried out 2 times in order to cover two cropping seasons. The students were supported by the staff of the provincial Departments of Agriculture and Rural Development during the survey. | <ul style="list-style-type: none"> • NLU-HCMC has a close cooperation network with other universities in Vietnam, such as: <ul style="list-style-type: none"> - <i>In the Northern provinces:</i> Thai Nguyen University (Thai Nguyen Province), University of Science of VNU-Hanoi (Hanoi), and Vietnam National University of Agriculture (Hanoi) - <i>In the Central provinces:</i> Hue University of Sciences (Thua Thien-Hue Province), University of Education of the University of Da Nang (Da Nang City), Tay Nguyen University (Dak Lak Province), and Dalat University (Lam Dong Province) - <i>In the Southern provinces:</i> University of Social Sciences and Humanities (HCMC), HCMC University of Natural Resources and Environment (HCMC), University of Science (HCMC), HCMC University of Technology (HCMC), Hoa Sen University (HCMC), Can Tho University (Can Tho City), An Giang University (An Giang Province), Binh Duong University (Binh Duong Province), and Thu Dau Mot University (Binh Duong Province) |

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| <p>Vietnam National University of Agriculture (VNUA)</p> <p><i>Address:</i> Ngo Xuan Quang Street, Trau Quy Town, Gia Lam District, Hanoi, Vietnam</p> <p><i>Contact person:</i> Dr. Ngo The An Center for Agricultural Research and Ecological Studies (CARES) Tel: 0-912-254-886 Email: ntan@vnua.edu.vn</p> | <ul style="list-style-type: none"> • VNUA (formerly known as the University of Agriculture and Forestry) was found in 1956. • At present, VNUA has 15 faculties and schools. In addition, it has 11 research institutes and centers. • Engineering Faculty is involved in energy fields, while the Center for Agricultural Research and Ecological Studies (CARES) is involved in natural resource management and rural development. Faculty of Information Technology specializes in GIS, remote sensing, and information systems. • VNUA has around 1,340 teaching and supporting staffs, and 38,500 students. | <ul style="list-style-type: none"> • Since 2001, VNUA has being involved in more than 20 projects financed by several international donors such as the Ford Foundation, European Commission (EU), the World Resources Institute (WRI), Toyota Foundation, USDA, the Rockefeller Foundation, DANIDA, JICA, the World Bank, etc. • In addition, VNUA receives funds from domestic donors such as MARD, MONRE for their R&D activities. • Key projects related to energy and biomass resources implemented by VNUA: <ul style="list-style-type: none"> - Mapping forest and non-forest cover land of Thanh Hoa and Nghe An provinces for the years 2000, 2005, 2010 and 2013/2014 (funded by Winrock International). - Impact of a REDD+ project on local land uses and livelihoods in two target villages in Nghe An province (2012). In this study, satellite images from Landsat TM and ETM+ were used. The changes in land cover and land uses are assessed by comparing the satellite images and ground data collected by the ground truth point (GTP) sampling scheme. - Impact of reducing emissions from deforestation and forest degradation and enhancing carbon stocks (2011-2015, funded by EU). - Energy crop production on severely degraded and polluted soils in Quang Ninh province (2010-2013, funded by Ministry of Foreign Affairs of the Netherlands). - Supporting for the small and medium-size enterprises in agro-processing in Vietnam and Burundi (2008-2009, in collaboration with University of Burundi and Gembloux Agricultural University). | <ul style="list-style-type: none"> • VNUA has a strong collaboration network with other agricultural universities, such as: <ul style="list-style-type: none"> - Bac Giang Agriculture and Forestry University (Bac Giang province) - Hue University of Agriculture and Forestry (Thua Thien-Hue Province), and - Nong Lam University (Ho Chi Minh City) • VNUA also cooperates with other universities in education and research activities: <ul style="list-style-type: none"> - Hong Duc University (Thanh Hoa Province) - Tay Bac University (Son La Province), - Can Tho University (Can Tho City), and - Tay Nguyen University (Dak Lak Province) |
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8.3 Conclusions and recommendations on university capacity assessment

All four assessed universities are among the largest universities in Vietnam, each with more than 20,000 students. Except for HUST, the other three universities (CTU, NLU and VNUA) specialize in agriculture and forestry.

All four universities have units (departments or faculties) specializing in GIS, remote sensing and mapping technologies.

All four universities have strong experience in field survey and data collection. Considering their nation-wide cooperation network with other universities, any of these four universities can be hired to be a national coordinator for the assignment of "Nationwide Collection of Biomass Resource Data" for the "Biomass Resource Mapping of Vietnam".

It is recommended that GDE/MOIT will request these four universities to submit their proposal for the above-mentioned assignment. The contractor(s) will be selected based on the criteria specified in the Terms of Reference (TOR) of the assignment.

9. NEXT ACTIVITIES OF PHASE I

The remaining major activities of Phase I are as follows:

- to finalize the TOR for field data collection after receiving comments from GDE/MOIT and WB;
- to prepare a detailed Project Implementation Plan, including a revised overall Work Schedule for Phases 2 and 3;
- to prepare and conduct Phase I Workshop, during which Phase I's outputs will be presented and Phase II Implementation Plan will be discussed.

It is expected that the final comments on the draft TOR for field data collection (as provided in Annex 8) will be received soon so that the Consortium can revise and finalize the TOR within July 2015.

A draft Project Implementation Plan, including a detailed Work Schedule is planned to be submitted to WB/ESMAP by mid-August 2015. This Plan will be finalized after Phase I workshop and submitted to WB/ESMAP by mid of September 2015.

Phase I workshop is planned to be held at the end of August for the Consortium to present Phase I's deliverables (Implementation Plan for Phases 2 and 3 and detailed Work Schedule) to the WB/ESMAP and GDE/MOIT project teams and other selected stakeholders. If the local consultants for field data survey have been selected before Phase I workshop, the Training of Trainers' Workshop for the field survey execution can be conducted right after Phase I workshop.

10. CONCLUSIONS AND RECOMMENDATIONS

The key stakeholders of the biomass resource mapping project were met by the Consortium during the inception mission.

Several available sources of biomass data were also identified and assessed. The Consortium will contact these sources again to acquire the necessary data and information for the biomass resource mapping project.

Several local consultants/universities were met. Their capacity and experience in field survey and data collection were also assessed. This preliminary assessment should help GDE/MOIT to pre-select the potential universities who can be invited to submit the proposals for field survey and data collection services.

It is recommended that:

- A coordinating meeting with GDE/MOIT, WB, GIZ and FA Consortium should be held as soon as possible to further discuss about the cooperation in biomass field survey and data collection.
- The TOR and other administrative procedures should be completed as soon as possible in order to issue the bidding documents for field survey and data collection to the pre-selected local consultants.

II. ANNEXES

Annex 1: Completed inception mission itinerary

Annex 2: List of participants of the inception meeting

Annex 3: Agenda of the inception meeting

Annex 4: Presentations

Annex 5: Selected photos of the inception mission

Annex 6: Participants feedback form

Annex 7: Summary of feedbacks from the inception meeting participants

Annex 8: Draft TOR for field data collection