

Country Name	<b>Sustainable Integration of Local Agriculture and Biomass Industries</b>
Socialist Republic of Viet Nam	

**I. Project Outline**

Background	<p>In Viet Nam, with the population increase, food and energy shortages, environmental deterioration and economic disparities were becoming major issues. To address the issues, the Government of Viet Nam was aiming to promote research on and application of rational and effective extraction of natural resources, technology application to environmental pollution control and response, and research on and application of technologies in rural areas in its “Agriculture and Rural Development Five-Year Plan (2006-2010).” Meantime, in Japan, development of the “Biomass Town Plan,” a comprehensive system from production to collection, conversion, and utilization of biomass that makes use of regional characteristics, was being promoted based on the “Biomass-Nippon Strategy” decided by the Cabinet in March 2006.</p>												
Objectives of the Project	<p>The project aimed to develop and demonstrate a model of “Sustainable Integration of Local Agriculture and Biomass Industries” in an area of Southern Viet Nam, focusing on biomass conversions for the production of biofuels, such as bioethanol and biogas, and bio-based materials, through developing a methodology to design the model, developing and demonstrating small-scale regional biorefinery* processes, and studying and developing key technologies for biorefinery processes, thereby contributing to the realization of Biomass Town and the practical operation of the system for sustainable integration of local agriculture and biomass industries.</p> <p>* Biorefinery refers to use of biomass as material and energy without waste.</p> <ol style="list-style-type: none"> <li>Expected Overall Goal: N.A.</li> <li>Project Purpose: A model of “Sustainable Integration of Local Agriculture and Biomass Industries” is developed and demonstrated in an area of Southern Vietnam, focusing on biomass conversions for the production of biofuels, such as bioethanol and biogas, and bio-based materials.</li> </ol>												
Activities of the Project	<ol style="list-style-type: none"> <li>Project Site: Ho Chi Minh City University of Technology (HCMUT) and Cu Chi District, Ho Chi Minh City</li> <li>Main Activities: Setting-up and operation of the Biorefinery Experimental Plant at HCMUT and the Demonstration Plant for Sustainable Integration of Local Agriculture and Biomass Industries at a village level; Developing novel pretreatment/ saccharification of lignocellulosic biomass for bioethanol production; Production of biofuels, functional fertilizer, animal feed, and other valuables from local biomass resources; Developing novel separation technologies for biorefinery; etc.</li> <li>Inputs (to carry out above activities) <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">Japanese Side</td> <td style="width: 50%;">Vietnamese Side</td> </tr> <tr> <td>1) Experts: 21 persons</td> <td>1) Staff Allocated: 32 persons</td> </tr> <tr> <td>2) Trainees Received: 2 persons</td> <td>2) Land, building, office: A project office in HCMUT; a building for the Biorefinery Experimental Plant with some facilities; a carbonization system; ovens; land, building, and a set of biogas system for the Demonstration Plant in Thai My village</td> </tr> <tr> <td>3) Equipment: Machinery for Biorefinery Experimental Plant at HCMUT; Demonstration Plant at Thai My Village; office equipment such as copier and computer and others</td> <td>3) Local cost</td> </tr> <tr> <td>4) Local cost</td> <td></td> </tr> </table> </li> </ol>			Japanese Side	Vietnamese Side	1) Experts: 21 persons	1) Staff Allocated: 32 persons	2) Trainees Received: 2 persons	2) Land, building, office: A project office in HCMUT; a building for the Biorefinery Experimental Plant with some facilities; a carbonization system; ovens; land, building, and a set of biogas system for the Demonstration Plant in Thai My village	3) Equipment: Machinery for Biorefinery Experimental Plant at HCMUT; Demonstration Plant at Thai My Village; office equipment such as copier and computer and others	3) Local cost	4) Local cost	
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Project Period	October 2009 – October 2014	Project Cost	(ex-ante) 380 million yen, (actual) 348 million yen										
Implementing Agency	Ho Chi Minh City University of Technology (HCMUT) Department of Science and Technology/People’s Committee of Ho Chi Minh City (DOST-HCM) Institute of Tropical Biology (ITB)/ Vietnam Academy of Science and Technology (VAST) Hanoi University of Science and Technology (HUST)												
Cooperation Agency in Japan	Institute of Industrial Science, The University of Tokyo (IIS-UT), Graduate School of Agriculture and Life Science, The University of Tokyo (GSALS-UT) National Institute for Rural Engineering, National Agriculture and Food Research Organization (NIRE-NARO)												

**II. Result of the Evaluation**

< Special Perspectives Considered in the Ex-Post Evaluation >

The Project Design Matrix (i.e., logical framework) was not prepared, and the Overall Goal was not set for this SATREPS project. Meanwhile, the Terminal Evaluation Summary reads: “The realization of Biomass Town and the practical operation of the system for sustainable integration of local agriculture and biomass industries are an expectation for the future.” Since this expectation is too high for the Overall Goal, it can be regarded as the Super Goal, which we examined as one of “Other Impacts.” Then, we defined the envisaged Overall Goal for this ex-post evaluation as “Research on biomass and other renewable energy is expanded and the research results are shared with potential renewable energy developers and/or policy making agencies towards practical application.” by logic. We verified the achievement status of this envisaged Overall Goal based on the following two aspects, which practically served as the indicators:

- Expansion of research on biomass and other renewable energy based on research outcomes of this project; and
- Sharing of the research results with potential energy developers and/or policy making agencies for practical utilization.

**1 Relevance**

<Consistency with the Development Policy of Viet Nam at the Time of Ex-Ante Evaluation and Project Completion>

As mentioned in “Background” above, this project was consistent with policies such as the “Agriculture and Rural Development

<sup>1</sup> SATREPS: Science and Technology Research Partnership for Sustainable Development

Five-Year Plan” (2006-2010) at the time of ex-ante evaluation. At the time of project completion, the “Vietnam National Green Growth Strategy for the period 2011- 2020 with vision to 2050” held strategic tasks including the use of clean and renewable energy, the development of green industry and green agriculture based on environmentally friendly structures, and the promotion of sustainable consumption.

<Consistency with the Development Needs of Viet Nam at the Time of Ex-Ante Evaluation and Project Completion >

The effective utilization of biomass and simultaneous contribution to the environmental and energy issues were needed as there was abundant biomass accessible as an energy source in the rural areas of Viet Nam, where the industrial structure was based on the agriculture such as rice and livestock production. Such situations at the time of ex-ante evaluation continued to the time of project completion.

<Consistency with Japan’s ODA Policy at the Time of Ex-Ante Evaluation>

In October 2008, the 8th ASEAN+3 Ministerial Meeting approved the “Biomass Town Plan Project in East Asia” under the framework of ASEAN+3. In the said plan, it was decided that Japan was to share the progress of activities on “Biomass Town” to disseminate the sustainable biomass utilization system to East Asia. Ho Chi Minh City was included in the target area. Also, this project was relevant with the “Country Assistance Program for Viet Nam (2009)” that included “Stable Supplies for Resource and Energy,” “Natural Environment Conservation” and “Rural Development and Improvements in Livelihood” as breakdowns of the priority areas.

<Evaluation Result>

In light of the above, the relevance of the project is high.

## 2 Effectiveness/Impact

<Status of Achievement of the Project Purpose at the time of Project Completion>

The project achieved the Project Purpose at the time of project completion. Small-scale regional biorefinery processes were developed. Biorefinery Experimental Plant and Demonstration Plant were installed and operated in HCMUT and Thai My Village, Ho Chi Minh City, respectively. The concept of the “Sustainable Integration of Local Agriculture and Biomass Industries” was formulated. Among several model scenarios for this concept, some showed economic efficiency (i.e., likelihood of cost recovery) while some did not, and the terminal evaluation team pointed out a need for further research for technical development to reduce costs and to apply new technology into practice.

<Continuation Status of Project Effects at the time of Ex-post Evaluation>

The project effects partially continued to the time of ex-post evaluation. Most key research outputs of the project continued to be utilized in research activities. The Biorefinery Experimental Plant at HCMUT was upgraded to the Laboratory of Biofuel and Biomass Research (“the Biomass Laboratory”) using HCMUT’s budget and the laboratory equipment provided under the project was still in operation for academic study and education. Until now, the Plant itself was operated only occasionally as the following studies have involved mostly laboratory tests and less experimental test, but the staff in charge is developing a plan to invite other universities to utilize the Plant for practical training for their students. The Demonstration Plant in Thai My Village was not in operation after project completion, although a security guard was assigned at least to maintain the facility and HCMUT has made several attempts to invite other institutes and some private companies to utilize the facilities. It had been used for piloting practical production during the project, but since the cost of bioethanol production was still high, most of the continued researches after the project were still confined to laboratory works.

<Status of Achievement for Expected Overall Goal at the time of Ex-post Evaluation>

The envisaged Overall Goal was achieved by the time of ex-post evaluation. HCMUT continued with researches using the technology developed in the project. They also shared the project results with some companies who are interested in adopting the technology. These can be regarded as actions/efforts for utilization of the research outcomes, while the above-mentioned challenge on economic efficiency for practical application in the society still exists. Also, it seems that the collaboration with the local government, which the terminal evaluation of this project recommended for subsidization of initial costs to encourage farmers and business people to apply the new technology, did not take place. In this connection, the Research Institute for Sustainable Energy (RISE), which HCMUT established in 2017 and assigned to oversee the Biomass Laboratory until this task was transferred to the Faculty of Chemical Engineering in February 2019, was expected to invite various stakeholders for research and practical application of its results, but until February its function had been still limited partly due to budget constraints.

<Other Impacts at the time of Ex-post Evaluation>

No negative impact on the natural environment was observed. Regarding the Super Goal-level expectation, the Biomass Town has not been realized yet due to the high cost compared with its output value. Other positive impacts pointed out by HCMUT include the improved capacity of the researchers involved in the project: for example, they commented that they learned many new ideas from the research on lignocellulosic bioethanol and expanded the study to other biomass forms such as bacterial cellulose and nanocellulose.

<Evaluation Result>

Although the project achieved the Project Purpose and Expected Overall Goal, problem has been observed in terms of the Continuation Status of Project Effects at the time of Ex-post Evaluation, i.e. the Biorefinery Demonstration Plant was not in operation after project completion. Therefore, the effectiveness/impact of the project is fair.

### Achievement of Project Purpose and Overall Goal

Aim	Indicators	Results
(Project Purpose) A model of “Sustainable Integration of Local Agriculture and Biomass Industries” is developed and demonstrated in an area of Southern Vietnam, focusing on biomass conversions for the production of biofuels,	A Regional biorefinery system based on the concept of local production for local consumption is developed, bioethanol, biogas and other bio-based agricultural materials are produced from waste-based and unused biomass, and pilot plant(s) are operated.	Status of the Achievement: achieved (partially continued) (Project Completion) - Small-scale regional biorefinery processes were developed as designated, and some key technologies for the biorefinery processes were developed through the research activities. - The Biorefinery Experimental Plant was installed at HCMUT and operated. In this plant, bioethanol was produced from rice straw by Simultaneous Saccharification and Fermentation after alkali pretreatment. - The Demonstration Plant was installed in Thai My Village and operated. The Plant was composed of the integrated process of the carbonization and power generation from lignocellulosic biomass, and the methane fermentation process of animal manure.

such as bioethanol and biogas, and bio-based materials.		(Ex-post Evaluation) - The key technologies for biorefinery processes are utilized as the basic background for further studies at Biomass Laboratory (to which the Biorefinery Experimental Plant was upgraded). - Further studies on reducing the lignocellulosic bioethanol production cost have been being carried out. Compatible studies on converting other lignocellulose materials are also being done by Biomass Laboratory, for example: instead of rice straw (which was studied during this project), water hyacinth, rubber wood saw dust (side product), acacia wood saw dust, paper mud from paper recycling factories. The research results were presented in at least seven papers or presentations in international or local conferences/journals. - The Demonstration Plant is not in operation.
(Expected Overall Goal) Research on biomass and other renewable energy is expanded and the research results are shared with potential renewable energy developers and/or policy making agencies towards practical application.	1) Expansion of research on biomass and other renewable energy based on research outcomes of this project	(Ex-post Evaluation) achieved - Researches are expanded as mentioned in “Project Purpose” above. - HCMUT is in collaboration with Ghent University (Belgium) to research about lignin recovery from rice straw. Lignin is kind of by product from the biomass processing.
	2) Sharing of the research results with potential energy developers and/or policy making agencies for practical utilization.	(Ex-post Evaluation) achieved - Information sharing was done with Toshiba Corporation that was interested in developing biogas for markets. - There were two cases where HCMUT shared the results of this project and the research after the project ended, and also provided laboratory and experiment services to companies: - Tin Thanh Co. Ltd: testing the production bioethanol from water hyacinth in 2015 - An Giang Plant Protection Company: piloting production of rice spirit from rice bran in 2014

Source: Terminal Evaluation Report; questionnaire answer by HCMUT and interview.

### 3 Efficiency

Both the project cost and the project period were within the plan (ratio against the plan: 92% and 100%, respectively). The Outputs of the project were produced as planned. Therefore, the efficiency of the project is high.

### 4 Sustainability

#### <Policy Aspect>

There is a strong policy framework to promote renewable energy including biomass energy, such as the “Strategy of Renewable Energy Development to 2030, with a Vision until 2050” and “Decision 24/2014/QĐ-TTg on support development mechanism for biomass power projects in Vietnam” (2014), which gives rules for credit and tax incentives for biomass projects. However, specific policies to promote research on the integration of biomass into local agriculture are still lacking.

#### <Institutional Aspect>

HCMUT (Faculty of Chemical Engineering), HUST (Faculty of Chemical Engineering and Center of Education and Development of Chromatography), and ITB (Department of Applied Microbiology) assigned the respective divisions in charge of the utilization of the project’s research result. According to these institutions, the number of staff involved in these divisions was sufficient since there was no difficulty caused by personnel shortage. At DOST, on the other hand, the person in charge of the project retired, and no other staff was assigned to follow up the project results.

#### <Technical Aspect>

The researchers of HCMUT continued to utilize the project’s technology in the biomass researches after the project ended. Their skills to operate and maintain the equipment provided under the project have been maintained at the sufficient level by continuous utilization of the technology. However, since HUST, ITB and DOST had no projects in this topic after project completion, the staff did not have chance to sustain the skills.

#### <Financial Aspect>

HCMUT and Vietnam National University (VNU), to which HCMUT belongs as a member, continued to allocate the budget to upgrade the laboratory equipment of the Biomass Laboratory. However, the budget was project-based rather than the regular operation and maintenance (O&M) budget. On the other hand, HUST, ITB, and DOST have not received any related project, and thus no budget is allocated.

Biomass-related research funds provided to HCMUT

Research	Amount (USD)	Source of fund	Budget period
Upgrading the analysis equipment power of the Biomass Laboratory	1,500,000	VNU	2014-2016
Project B2018-20-02: Study on conversion of wood saw dust to bioethanol	50,000	VNU	2018-2020

Source: HCMUT

O&M budget for the facilities developed by this project

Item	Amount (USD) and source		
	2016	2017	2018
O&M of Biorefinery Experimental Plant at HCMUT	5,000 Research fund of VNU	7,500 Research fund of HCMUT	20,000 Research fund of VNU
Salary of the security guard for the Thai My Demonstration Plant	2,400 Research fund of HCMUT	2,400 Research fund of HCMUT	2,400 Research fund of HCMUT

Source: HCMUT

#### <Evaluation Result>

In light of the above, some problems have been observed in terms of the policy, institutional, technical and financial aspects of the implementing agencies. Therefore, the sustainability of the effects through the project is fair.

### 5 Summary of the Evaluation

The project achieved the Project Purpose of developing and demonstrating a model of “Sustainable Integration of Local Agriculture and

Biomass Industries.” The effects of the project have partially continued, i.e., HCMUT has continued the utilization and expansion of most of the key research outputs as well as the Biorefinery Experimental Plant in its laboratory researches, however has not been successful in improving the utilization of the Demonstration Plant for bioethanol production. Regarding the sustainability, the institutional set-up and technical capacity of HCMUT are secured for the researches. However, some problems have been observed in terms of the policy, institutional, technical and financial aspects including lack of biomass research-specific policies and no projects in related topics (and thus no research funding) at the implementing agencies other than HCMUT. Considering all of the above points, this project is evaluated to be satisfactory.

### III. Recommendations & Lessons Learned

#### Recommendations for Implementing Agency:

- The O&M expenses of the Biorefinery Experimental Plant are financed by the research fund, and the amount is sufficient at the time of ex-post evaluation. In the future, however, there might be more costly repairs which would require higher O&M budget. Therefore, HCMUT is recommended to consider allocating separate O&M budget.
- The Thai My Demonstration Plant and the Biorefinery Experimental Plant are both modestly operated. HCMUT is recommended to look for chance to cooperate with other provinces or donors like GIZ that are supporting some localities to develop biomass development plans.

#### Lessons Learned for JICA:

- The project could have given more emphasis on economic efficiency of the technologies under research and sharing of the results to local stakeholders so that application of the research outputs in local settings would be easier. On the other hand, a more careful consideration about how the research capacities, including human resource and equipment, can be utilized by the project implementing agency after the project ends, in Vietnam's context, could have helped to increase the sustainability.



Biorefinery Experimental Plant at HCMUT



Biorefinery Equipment at HCMUT



Thai My Demonstration Plant