1-2 Outcomes in 3 years

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The project's basic concept is as follows: in both Japan and the target country, academy (university) and government (local or central government and related institutes) come together to tackle solid waste problems in developing countries. This concept implies that university research should be conducted not only for the university or for oneself but also for application in a real-world setting by accepting the government's viewpoint. Moreover, through communication, invitations, and visits among researchers, governmental officers, and students in Japan and the target country, we should grasp the environmental problem on site first. Then, we should request experimental samples and research data from our counterparts. Next, we should proceed with collaborative research, experiments, and the seamless development of methods.

To satisfy both research and education needs, we took the educational approach of sending students overseas to experience positive communication with collaborators and participation in actual research activities on site. Gauging the actual environmental problem directly and engaging in the activity on site, under the professor's supervision, is a positive experience for the elite Asian student, who will assume an active role in society in the future.

Ideally, human resources of the target country and Japan collaboratively tackle the same solid waste problem. Therefore, our educational scope encompassed not only education for the Okayama University student but also education and practice for the collaborative university student or the public organizations officer in the target country.

1. Research results

The research summary is shown in the following table. Twelve research activities were implemented through the collaboration of over twelve overseas universities or governments.

Regarding the experimental study and survey group, biomass waste, which has become a big problem volume-wise in Asia-Pacific countries, was targeted in the development research of extraction technology for effective components through super critical water, and also in the development research of technology in terms of biochar. The biochar research was conducted by three researchers: a researcher studying refinery technology in the biochar production process, a researcher studying utilization of biochar as a soil conditioner, and a collaborative researcher testing the effectiveness of the soil with biochar on plant growth at Hue University. In a survey of the practical technology of practical kitchen waste composting, which was a collaborative project with the University of Guam (UOG), a professor from UOG and the mayor of Dededo city came to Japan to inspect the commercial technologies. In Palau, leachate water from a landfill site—a common

problem in developing countries—as well as river water downstream of the landfill site, was analyzed for water quality, especially heavy metal concentration. Regarding the maintenance of the landfill site, hydraulic conductivity was measured using a proposed noncontact measurement method using permittivity.

Regarding the planning and evaluation research group, a complete system of solid waste management, which involves waste collection, recycling, and incineration processes, was designed and evaluated for the cities of Indonesia, Malaysia, and Cambodia. In a study on Vietnam, a detailed evaluation of waste generation and waste collection in terms of 3R activities was conducted. On the other hand, the "pay as you throw" institution, which was introduced as a countermeasure to reduce the waste disposed at the source, was evaluated for effectiveness. Moreover, the ecological footprint—introduced as an index to evaluate environmental impact on a wide area—was applied to CO_2 emission from individual provinces in China, and also to household levels in Shanghai city.

The aforementioned studies are part of systematic research that covers major kinds of solid waste management topics, such as waste collection and treatment planning, recycling technology, maintenance technology, and environmental impact assessment.

2. Overseas events

To disseminate our research results, three seminars and a symposium were organized in three years. In June 2011, for example, a 3R technical and education seminar was organized at the Institute of Technology Bandung (ITB), with many government officers as participants. Topics related to 3R planning, success stories, personal experiences, etc. were presented by the provincial and local governments of Indonesia, Okayama city, ITB, and Okayama University. Additionally, in August 2012, a seminar in Palau, organized for Palauan citizens, was reported by the local news. Then, in November 2012, we organized a symposium at Hue University, where members from not only Okayama and Hue universities but also other universities and research institutes gave presentations. The symposium's lively and fruitful discussions were reported on TV. In March 2013, an expert seminar was held at the University of Malaya. An expert from Okayama city was one of the presenters, and many government officers and solid waste experts attended the seminar. Through the three seminars and the symposium, our project's results were disseminated far beyond the confines of our researcher group.

3. Domestic events

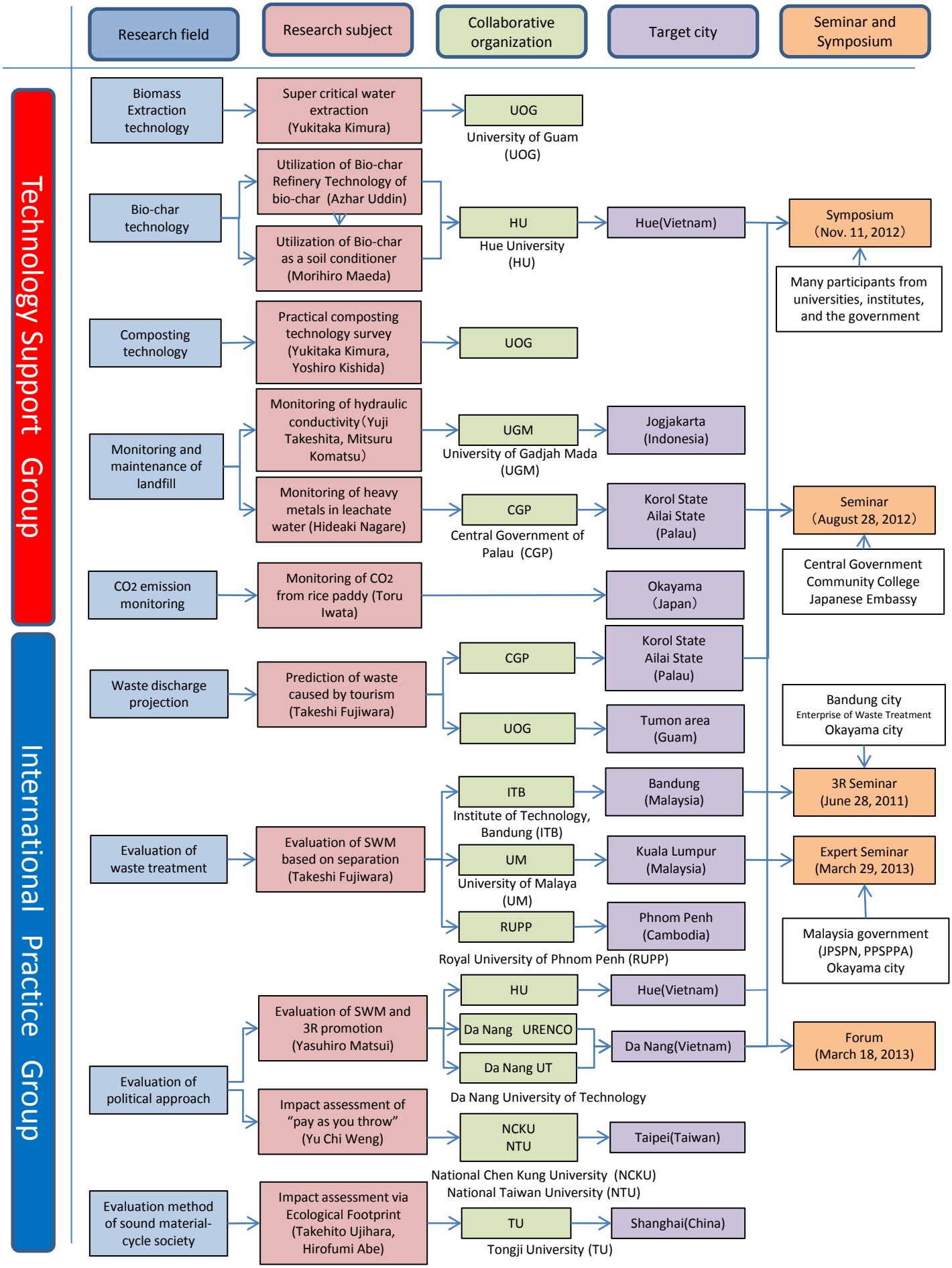
Besides research works, each year we organized an event for citizens called the "Domestic Event for Citizens on Eco-Life and Eco-Technology." The reasons for launching the domestic event are

as follows: (1) solutions to the waste and energy problem may be found in our domestic lifestyle, and (2) we believed we could spread a message about the practical promotion of 3R in developing countries to Asia-Pacific countries by considering ideas generated by environmental associations that are continuously tackling environmental improvement at the domestic level. At this event, we invited several lecturers who promoted remarkable ongoing ecological activities and also organized displays and demonstrations by environmental organizations.

4. Conclusion

An annual debrief meeting was held at Okayama University in February, and then collaborative researchers and a government office were invited to evaluate our annual progress in each research area. This meeting facilitated communication between project promotion members at Okayama University and collaborators of Asia-Pacific countries. The annual research results were summarized in both Japanese and English reports, which can be downloaded from the Waste Management Research Center of Okayama University website.

Through this partnership project, the Waste Management Research Center can play an important role as an information and human exchange center in terms of solid waste management in the Asia-Pacific region. Thus, we should deepen the relationship with collaborative universities and continue conducting practical research and promoting education for Asia-Pacific countries. Finally, we should appreciate the research collaborators, government officers, environmental association members, and research promotion members, all of whom have supported this project.


Research field
Research subject
Collaborative organization
Target city
Seminar and Symposium
Technology Support Group
International Practice Group
Biomass Extraction technology
Super critical water extraction (Yukitaka Kimura)
UOG
University of Guam (UOG)
Bio-char technology
Utilization of Bio-char Refinery Technology of bio-char (Azhar Uddin)
Utilization of Bio-char as a soil conditioner (Morihiro Maeda)
HU
Hue University (HU)
Hue(Vietnam)
Symposium (Nov. 11, 2012)
Many participants from universities, institutes, and the government
Composting technology
Practical composting technology survey (Yukitaka Kimura, Yoshiro Kishida)
UOG
Monitoring and maintenance of landfill
Monitoring of hydraulic conductivity (Yuji Takeshita, Mitsuru Komatsu)
UGM
University of Gadjah Mada (UGM)
Jogjakarta (Indonesia)
Monitoring of heavy metals in leachate water (Hideaki Nagare)
CGP
Central Government of Palau (CGP)
Korol State Ailai State (Palau)
Seminar (August 28, 2012)
Central Government Community College Japanese Embassy
CO2 emission monitoring
Monitoring of CO2 from rice paddy (Toru Iwata)
Okayama (Japan)
Waste discharge projection
Prediction of waste caused by tourism (Takeshi Fujiwara)
CGP
Korol State Ailai State (Palau)
UOG
Tumon area (Guam)
Bandung city
Enterprise of Waste Treatment
Okayama city
3R Seminar (June 28, 2011)
Evaluation of waste treatment
Evaluation of SWM based on separation (Takeshi Fujiwara)
ITB
Institute of Technology, Bandung (ITB)
Bandung (Malaysia)
UM
University of Malaya (UM)
Kuala Lumpur (Malaysia)
RUPP
Royal University of Phnom Penh (RUPP)
Phnom Penh (Cambodia)
Expert Seminar (March 29, 2013)
Malaysia government (JPSPN, PPSPPA)
Okayama city
Evaluation of political approach
Evaluation of SWM and 3R promotion (Yasuhiro Matsui)
HU
Hue(Vietnam)
Da Nang URENCO
Da Nang UT
Da Nang University of Technology
Da Nang(Vietnam)
Forum (March 18, 2013)
Impact assessment of "pay as you throw" (Yu Chi Weng)
NCKU
NTU
National Chen Kung University (NCKU)
National Taiwan University (NTU)
Taipei(Taiwan)
Evaluation method of sound material-cycle society
Impact assessment via Ecological Footprint (Takehito Ujihara, Hirofumi Abe)
TU
Tongji University (TU)
Shanghai(China)