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**Science, Technology, Research and Innovation for Development  
(STRIDE)**

**PHASE I**

**Pilot Deployment and R&D of Multi-Feedstock Village-Scale Modularized Kits for Bioethanol Production**



**PHASE II**

**Establishment of Science and Technology-Based Sustainable Village-Scale Bioethanol Industry**

**GRANTEE:** Mariano Marcos State University (MMSU)

**PRINCIPAL INVESTIGATOR:** Dr. Shirley C. Agrupis

**INDUSTRY PARTNER:** BAPAMIN Cooperative; Nipa Wine Making Producers Cooperative; Southern Bondoc Peninsula Cooperative; Ethanol Producers Association of the Philippines; Green Future Innovations, Inc.

**COLLABORATING PARTNER:** Central Luzon State University (CLSU)

**GRANT PERIOD:** October 1, 2014 to September 30, 2017

**GRANT AMOUNT:** PHP8,487,937 (approximately USD180,600)

**Sustainable renewable energy**

The use of ethanol as a gasoline oxygenate is mandated by the Philippine Biofuels Act of 2006. Currently, over 90% of the ethanol used by the petroleum industry in the Philippines is imported, prompting the Philippine Department of Science and Technology (DOST) to include biofuels research as one of its priority areas for Research and Development (R&D).

To complement ongoing initiatives of the Philippine government and to further improve production of bioethanol, MMSU, with support from USAID STRIDE and in collaboration with CLSU, initiated the development and deployment of multi-feedstock village-scale modularized kits for bioethanol production. The successful implementation triggered a Phase II of the project.



*Dr. Shirley Agrupis, Project Investigator, explains the ethanol distillation process*

**Milestones**

- Capacitation of farmers through a series of trainings and workshops involved in the production of bioethanol;
- Formulation of fermentation and distillation protocols for sweet sorghum, nipa sap, and waste coconut water from the copra industry;

- Deployment of five field-tested units of multi-feedstock village-scale modularized bioethanol facilities at MMSU, CLSU, and identified industry partners such as the BAPAMIN Cooperative in Batac City; Cabaggan Women's Organization in Pamplona, Cagayan; and copra producers' cooperative in Mulanay, Quezon. Designs and specifications of the facilities were engineered to suit the nature of the feedstock and the resource counterpart of the industry partners;
- Fabrication of the unified design of MMSU-CLSU multi-feedstock village-scale modularized kits for bioethanol production at an upscale capacity of 850L nipa sap batch, with the facility expected to produce 60-70L 95% azeotrope ethanol per day. This fabrication was implemented during Phase II of the project;
- Provision of development opportunities for local farming communities not only in the production of bioethanol but also for other value-added products from distillation residues or stillage such as feed, fertilizer, nutrient media for micro-algae, and value-added chemicals; and
- Successful launching of village-scale bioethanol refinery at MMSU and CLSU with the facilities to serve as Bioenergy Centers that will cater to the biofuel R&D and other related research of faculty, students, and industry partners.

The Phase I project created nationwide awareness of the promise of a village-scale distributive model to increase local ethanol production in the country in the context of inclusive growth and sustainable development. Convinced of the technical feasibility of the facilities, the National Development Authority (NEDA) allocated Php11.5 million to conduct a feasibility study for the nationwide deployment of the MMSU-CLSU village-scale bioethanol technologies using nipa sap as feedstock.

The project has already gained the support of the mainstream bioethanol industry. In Pamplona, Cagayan, where the village-scale nipa bioethanol plant was deployed, Green Future, Inc. (GFI), committed to allocating appropriate funding to finance a safe depot for 95% hydrous fuel grade ethanol. GFI will use its facilities to further dehydrate the 95% hydrous to anhydrous ethanol to comply with the Biofuels Law. The same design will be adapted to fabricate an additional four units under the Department of Energy (DOE) funding.

### **Moving forward**

The successful implementation of the STRIDE Phase II project with that of the DOE will support and strengthen the nationwide deployment of the village-scale bioethanol plants and will result in the following:

- Participation of rural communities in the vertically-integrated production of bioethanol;
- Participation of small-scale producers in higher levels of vertical integration in the bioethanol industry; i.e., instead of selling a raw product such as juices to large bioethanol plants, they can profit from the sale of fuel-grade ethanol;
- Generation of employment and alleviation of rural poverty through the development of an integrated village-level bioethanol industry;
- Maximization of the use of sustainable feedstocks that do not create issues of food vs fuel; and
- Reduction in the amounts of ethanol importation, which contributes to the ethanol self-sufficiency goals of the country.

All the above expected results buttress the principal goal of the Philippine Development Plan 2011–2016: inclusive growth, which is high growth that is sustained, generates mass employment, and reduces poverty in the rural communities.