Sustainable use of biogas digester by applying unused biomass

A biogas digester (BD) is a simple and manageable farm equipment that collects biomass and produces gas through anaerobic respiration (Fig. 1). It was introduced as a Clean Development Mechanism (CDM) project in farming households in Vietnam's Mekong Delta. Pig manure is the main feedstock for BD; however, biogas production will diminish if the number of pigs decreases due to sale of mature pigs, disease outbreaks, or lowered profitability. When biogas shortage is prolonged, households become more inclined to stop using BDs. On the other hand, there is plenty of unused biomass like the fast-growing water hyacinth in canal networks and ponds. With the appropriate technology, applying unused biomass as feedstock will make BD use sustainable.

Annual monitoring was conducted on 435 households from 1 June 2013 to 31 May 2014, and results showed that 44 households did not use biogas for more than one day during this period. Cited as the main reason (55%) for the non-use of BD was the absence of pigs due to stoppage of pig raising activities, pig disease, and sale of mature pigs to market (Fig. 2). Can Tho City, where the CDM project is being implemented, is located at the center of the Mekong Delta and surrounded by tributary streams and canal networks. Plenty of productive and unused biomass like water hyacinth grow in these waterways and ponds. If the unused biomass is applied as feedstock for BD in case of pig shortages, BD use will be stabilized. Experiments applying unused biomass to BD were conducted to examine biogas production from selected materials. The experiments consisted of 4 materials: (1) pig manure (control), (2) duckweed (*Pistia stratiotes*), (3) water hyacinth (*Eichhornia crassipers*), and (4) grass weed, including *Oryza rufipogon Griff*. The size of BD was the same as the one used by households. After cutting these materials to 20-30cm, 2.7kg (dry matter weight) of each material was filled to each experimental BD every day continuously for 30 days and the biogas produced from BDs was measured for 60 days from the start of the experiment. The experiments were replicated 3 times. Results of the experiments showed that biogas production from water hyacinth and from both duckweed and grass weed was 70% and 90%, respectively, compared to the control (Fig. 3). As a verification study, one household that installed a BD was asked to apply only duckweed to the BD as feedstock for a year from the beginning. Results of this study showed that biogas from duckweed could be used as cooking fuel continuously, that it substituted with 2.4t of fuel wood, and that it contributed to 1.8tCO_2/year of GHG emission reductions (Fig. 4).

In summary, this technology contributes to sustainable BD use by bridging the gap in BD feedstock when livestock manure is in short supply. One important thing to consider, however, is that farm households that apply unused biomass as feedstock for BDs must have easy and continuous access to the resource. Although the collection time for unused biomass is shorter compared with fuel wood, it is longer compared with livestock manure. Unused biomass, therefore, should be applied as supplemental feedstock only when livestock manure is insufficient.

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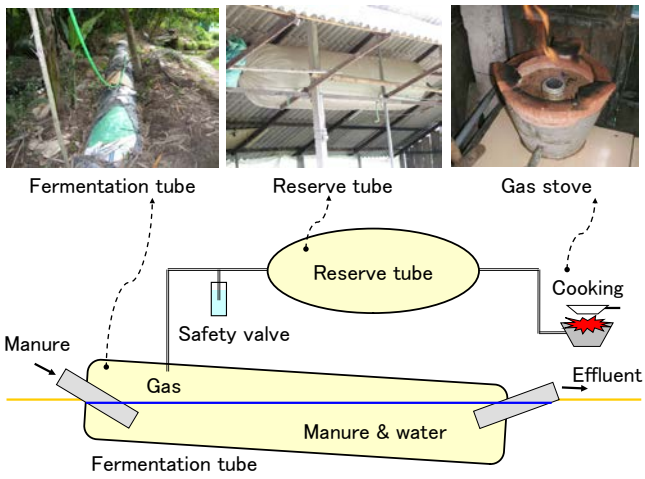

Fig. 1. Plastic-type biogas digester system

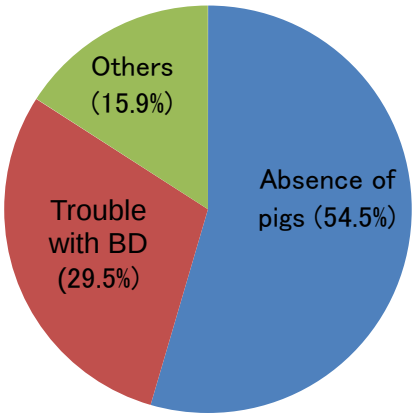

Fig. 2. Reasons for non-use of biogas

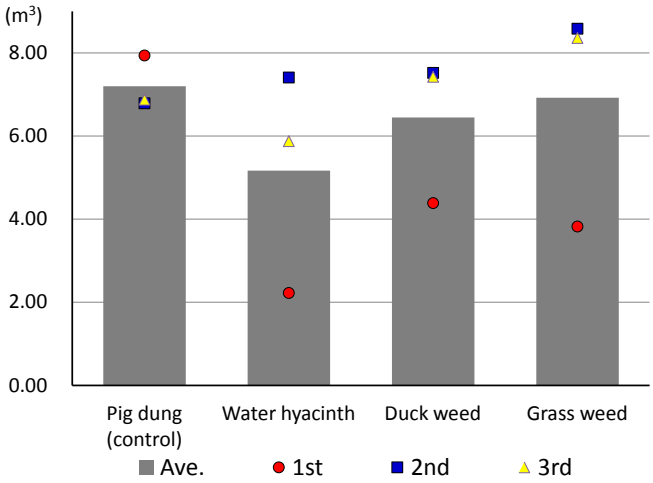

Fig. 3. Biogas production by applying unused biomass

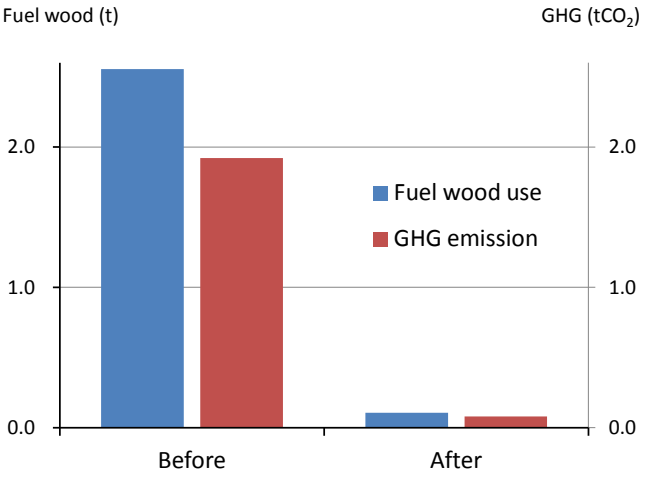

Fig. 4. Results of a verification study on a BD household applying only *Pistia stratiotes*. Graph shows significant drop in fuel wood use and GHG emissions over a one-year period.