Photo: RAAA

Preparing the contents for the plastic barrel biodigester.

Improving organic fertilizers

Luis Gomero Osorio

Conventional biodigesters were first promoted in Peru during the 1970s. At the time, the aim was to produce energy from livestock manure as an alternative to fuelwood consumption, which was contributing to rapid deforestation. However, many years of concerted efforts did not lead to any widespread adoption. There were many reasons for this: The biodigesters promoted were based on Chinese and Indian models that had been developed under very different social and cultural conditions, and there were no efforts to involve the Peruvian farmers in further development or adaptation. The construction was also relatively complicated and construction costs were high. In addition, most small-scale farmers did not have enough manure available to keep these biodigesters in operation, as most livestock grazed freely on rangeland.

The main objective for introducing this technology had been the production of biogas for energy purposes and no attention was paid to the by-products of the digesters – the effluent and the slurry remaining after decomposition. For many years, this way of thinking prevented further development and promotion of the technology.

By the mid 1990s, member institutions of *Red de Acción en Alternativas al uso de Agroquímicos* (RAAA), a national network of organizations promoting alternatives to agrochemicals, took up the idea again. They realized that biodigesters could be very useful in improving agricultural production. Together with farmers from several regions in the country, RAAA revisited the biodigester concept, but this time the focus was not on the production of biogas. Instead, attention now focused on the by-products of the anaerobic decomposition that takes place in a biodigester: the liquid fraction called *biol* and the solid fraction or *biosol*, which are excellent fertilizers for a variety of crops. A small biodigester is enough to produce these fertilizers and most farmers have enough manure to be able to make use of the technique.

Biodigesters for the production of high quality fertilizer

To facilitate the integration of this technology into the crop production systems, construction and use of the biodigesters had to be kept simple, costs had to be low and the materials needed to be locally available. The first type of biodigester promoted was one made from a tubular polythene sheet of good quality. The tubular sheet, with a minimum length of five metres, is placed on a flat surface. Both ends are closed around two PVC pipes (40 cm long, with a diameter of 10 cm) with rubber strings made of an old inner tube. A plastic soda bottle (1.5 litres) is then cut in half and each of the halves are inserted and glued into the respective PVC pipes, closing one and leaving a small opening in the other. Before closing the biodigester, farmers fill it with equal amounts of water and manure from cattle or other ruminants. It is then closed and allowed to ferment for two to three months. The gas that builds up is released by opening the screw lid of the top half bottle. The cost of this "stomach" model varies between US$16 - 25, depending on the quality of the polythene sheet used. It can produce up to 200 litres of liquid fertilizer every three months, depending on the climatic conditions in the area.

This biodigester was adopted by many small-scale producers on the Peruvian coast, in the lower part of the mountains and in forest areas. However, the design had its weaknesses: The lifespan of the polythene plastic was relatively short, it was often damaged by animals and handling (filling and emptying) was difficult. In addition, the discarded plastic materials from the biodigester polluted the farm.

Aware of the disadvantages of the polythene model, the idea of using a plastic barrel instead of the plastic sheet developed. RAAA adopted this idea from Colombia and soon installed the first biodigester made of a plastic barrel with a capacity of 200 litres. The barrel has an extended lifespan and the biodigester is easy to handle. A total of 100 litres of liquid fertilizer can be obtained every two to three months, or up to

400 litres a year per barrel. The cost of the barrel, which lasts for many years, is less than US$35, and the running costs are minimal.

The biodigesters made of plastic barrels have now largely replaced the polythene biodigesters for producing *biol*. Many farmers produce their own liquid fertilizer, replacing the commercial foliar fertilizers they used to buy for their vegetable, potato, maize and alfalfa crops. Some farmers or farmer groups even sell part of the product, in spite of organizational and marketing difficulties. For example, in Cañete Valley, a farmers' enterprise named "Agrecol" sells *biol* in 20 litre containers at a price of US$4.80.

Benefits and use of biol and biosol

Biol contains many essential elements for plant growth, such as nitrogen, phosphorus, potassium and calcium. It also offers additional benefits to plants because it contains plant growth regulators such as auxines and gibberelin, as well as other substances that stimulate plant development. The solid part, *biosol,* has similar nutrient contents. Both fertilizers favour rooting, the development of the foliage and flowering, and activate seed germination.

Farmers can easily modify the nutrient content of the liquid fertilizer, for example by adding chopped alfalfa, fish entrails, marine seaweed or human urine to the biodigester. The ready-made *biol* can also be enriched with mineral salts to provide additional nutrients to a crop or for other purposes. For example, copper sulphate can be added to the liquid fertilizer to control diseases such as leaf rust in the coffee crop. Some farmers have developed their own secret formulas for making *biol*, based on the addition of a number of natural substances.

Both *biol* and *biosol* can be used as a fertilizer for a wide variety of plants and crops. Before using it, the concentrated *biol* has to be diluted by mixing four litres of the liquid fertilizer with 10 litres of water. After carefully sieving to avoid the clogging of the spraying nozzle, *biol* is applied with a backpack sprayer. The application can be directed to the foliage, the soil, the seed and/or the roots. Between three and five applications are required during the vegetative development of the plants. *Biol* can also be applied to the irrigation water. *Biosol* can be applied directly to the plant, just as one would apply compost.

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Saving energy with better tools

Dave O'Neill

All farmers rely on their own labour and that of their family, but this is often not sufficient to meet all the requirements of crop production, from preparation and harvesting to post-harvest storage and processing. The situation is exacerbated by the reduction in human physical work capacity caused by endemic diseases and most recently by HIV/AIDS.

When human labour fails to meet farmers' needs, it can often be supplemented with draught animal or engine power. However, the poorest farmers cannot afford these options. In such situations it becomes extremely important that the best possible use is made of available energy. This is achieved by improving the mechanical efficiency with which tasks and operations are carried out. As most, if not all, tasks or operations are carried out using tools and equipment, these should be well designed for the tasks to which they are applied. They should also be well maintained and kept in good condition. Tools and equipment that are ill-matched to the job or poorly maintained waste energy, as the human effort is not efficiently converted into mechanical work.

Some of the most widely used tools are the hoe and the sickle. Hoes exist in a variety of forms, characterized mainly by the handle length and blade shape and width. Hoes are used for many purposes but particularly for land preparation and crop weeding. A relatively long handle and large blade are appropriate for land preparation, enabling as much of the user's power as possible to be applied to working the soil surface. Weeding, on the other hand, requires the application of less power and smaller movements but greater control to avoid damage to the crop. A shorter handle and a smaller blade are therefore better suited. In the poorest households, there may be only one hoe, with the result that both these essential crop production activities are carried out inefficiently, with a tool that is not designed for the job.

The sickle is probably the cheapest and most widely used farmers' tool. In Indonesia, it was selected by a group of farmers as the tool with the greatest potential for improvement with respect to durability, increased productivity and reduced drudgery.

Various locally-made sickles were tested and one particular type emerged as the clear favourite. The heart rates of the operators were monitored when working with the different sickles, and was shown to be the lowest for the preferred sickle, implying that the use of this particular sickle was the least demanding. The key design characteristics of this sickle were identified, which then provided the basis for future improved designs. Reduced time needed for sharpening was one of the farmers' main criteria.

When energy is scarce, making the available energy achieve a higher work output is an attractive option. This can be achieved by making tools and equipment more efficient or, at the next level, adopting more efficient working practices. Furthermore, with the serious reduction in human physical work capacity, at both the individual and community levels, as a consequence of HIV/AIDS, it is becoming even more important to identify and pursue these kinds of improvements.

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