Pedal Power

The Indian villages of Kinchlingi and Tumba are proving that small-scale biodiesel generation can create self-sufficient, sustainable communities.

Geeta Vaidyanathan and Ramani Sankaranarayanan

WE ARE often asked if our pedal-driven biodiesel reactor could be mechanized. "Automation is possible," we answer, "but when it takes only about three hours of pedalling to produce a month's supply of biodiesel for the village of Kinchlingi's 75 inhabitants, it is not necessary."

Installed four years ago, Kinchlingi's pedal-powered reactor produces biodiesel to fuel a pump-set that supplies drinking water as well as running water to the village's washrooms. Today, villagers are exploring the use of biodiesel to generate electricity for lighting and to fuel small farm equipment.

The Austrian philosopher Ivan Illich said that while being undermechanized is frustrating, overindustrialization enslaves people to the tools of industrialization, and leads to inequity. The goal of CTx GreEn, a Canadian non-profit organization working in India with several partners including Gram Vikas, one of the country's largest non-governmental organizations, is to maximize the efficiency of human effort, while optimizing the amount of mechanization needed. It also aims to make sure that the machinery can be operated with ease, and is manufactured and maintained locally.

CTx GreEn's village-scale reactor requires about an hour of pedal-powered stirring to produce a batch of biodiesel. When demand rises to eight to ten batches of fuel per week, an optional (step-down) motor-drive can replace the typical five-speed bicycle. Only these higher production volumes justify the additional effort and cost of installing, operating and maintaining a motor and generator.

Currently, Kinchlingi grows about two hectares of niger (*Guizotia abyssinica*), a non-intensive, short-duration, edible oilseed crop, to produce the oil it needs to make biodiesel. Well known as a bird seed, niger is an indigenous species, not previously grown in Kinchlingi. But niger is only a stop-gap choice. As the forest nearby

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regenerates over the next eight to ten years and begins to produce non-edible oilseeds, Kinchlingi will use them as feedstock. This will allow villagers to consume the oil they make from niger. In the meantime, Kinchlingi is exploring ways to collaborate with a community nearby that collects and sells karanja (*Pongamia pinnata*), a non-edible, tree-borne oilseed. For now, Kinchlingi is exchanging salt for this feedstock.

Only accessible by foot, Tumba is a cluster of forest villages that also lies in India's Orissa state. Residents currently sell tree-borne oilseeds like karanja, kusum (*Schleichera oleosa*) and mahua (*Madhuca indica*) to petty traders for cash needed to buy food grains, kerosene, salt, oil, chemical fertilizer and other goods not otherwise available in the villages. These traders, in turn, sell the oilseeds to soap manufacturers and other industrial users. Recognizing that the oilseeds can be used to produce biodiesel, the community in Tumba plans to fuel irrigation pumps, a power tiller and even an oil expeller with energy that it will produce on its own. By doing so, villagers are hoping to become self-sufficient in food grains and edible oil, while also freeing up cash to buy other goods. They may even reduce their need for chemical fertilizers, as oil cake, now available as a by-product from oil expelling, could be used as an organic fertilizer.

With a local, renewable source of energy, it is possible to imagine the transformation of Kinchlingi and Tumba into self-sufficient local economies.

The food-fuel crisis and the debate surrounding biofuels have much to do with the efforts of industrial operators who claim that large-scale production is most economical. In India, the federal and state governments have bought into this theory. They are promoting cultivation of *Jatropha curcas*, a non-indigenous oilseed species, by providing huge subsidies to farmers in an effort to reduce the country's dependence on crude-oil imports. Large-scale schemes require the diversion of arable land from food to fuel production, thereby increasing the dependence of rural communities on external inputs. Rather than support farmers, this large-scale, biofuel-for-transportation model puts money into the pockets of the organizations that refine and retail the fuel.

As John Vidal pointed out in the *Guardian* newspaper in August 2008, it is this sort of large-scale scenario that has forecasters predicting that the rush for biofuel crops could trigger a food crisis in developing countries. Pedal-powered, village-scale biodiesel production from indigenous oilseeds as described for Kinchlingi and Tumba, however, could fuel rather than starve local agro-economies. In these situations, scale is tied to the carrying capacity of the land, and to the community's needs and ability to adapt to mechanization rather than being driven by technological requirements alone.

In this way, small-scale biodiesel production connects E.F. Schumacher's "small is beautiful" model to Mahatma Gandhi's ideas on local self-reliance.

Geeta Vaidyanathan and Ramani Sankaranarayanan, co-founders of CTx GreEn, hope their pedal-powered biodiesel project will catalyze an agro-eco-industrial revolution in a remote corner of the world that missed out on the first industrial revolution.

Ctx GreEn's story, vision and projects can all be found at **www.theworkingcentre.org/wscd/ctx/ctx.html**. For more on Gram Vikas' rural development projects in India, visit **www.gramvikas.org**.

Four Hours to Fuel

THE VILLAGE-SCALE biodiesel reactor produces biodiesel in small, five-litre batches from a combination of vegetable oil, lye and alcohol. Five minutes of pedalling combines the lye and alcohol into a homogenous solution in a small stainless-steel mixer. This solution is added to vegetable oil in a larger stainless-steel reactor. An hour of pedalling converts the oil-lye-alcohol mixture into biodiesel and glycerine. A by-product that can be turned into soap, glycerine is more dense than biodiesel and separates within two hours. In total, the production process takes about four hours, which includes one hour of pedalling.

Vegetable oil accounts for 80 per cent of the material costs to produce biodiesel. Extracted by a small, hand-operated oil press, the oil can come from a variety of feedstocks including edible or, preferably, non-edible oilseeds. Once oil has been expelled from the oilseeds, residual oil cake remains. It makes a good organic fertilizer or, if made from edible seeds, a low-cost, highly nutritious feed for livestock. Lye and alcohol, which Kinchlingi currently purchases, account for the remaining 20 per cent of material costs. In the long run, these inputs could be produced entirely from local waste fruit and wood ash.