

INTEGRATED PIG FARMING

Before concluding this paper, let us turn to an example of how many of the technologies featured in this paper can be integrated. Here we emphasize the pig as an important recycler of waste. If waste management authorities do not have a good understanding of what a pig can do, they will not have all options before them.

Sadly many pig farms in Vietnam are far from being integrated. Feces and urine are allowed to flow together, and often this slurry is discharged into nearby lagoons, streams and rivers. Lagoon water is often used to wash and cool down the pigs. Disease is rampant. Antibiotics proliferate. The stench is unbearable. Both pigs and farmers are often infected with deadly antibiotic resistant bacteria called MRSA.¹

In spite of the enormous pollution that the pig farmer so often generates, he makes little money. The price of soy bean meal, fish meal, and rice bran (main ingredients in pig feed) has risen in



recent times, while the price of pork has declined. The main cost in raising pigs is the cost of feed (up to 70%). The pig farmer in Vietnam has simply become the means by which feed companies make money.

One of the most exciting ways to dispose of pig waste is to raise the pig on soft bedding comprised of sawdust, shredded straw, coconut dust or some other dry biomass. The feces deposited onto the bedding by the pig is collected twice a day and placed in nearby

mesophilic bins or biopods. Both devices are ideal for growing BSF larvae.

If a mesophilic bin is used to grow larvae, the farmer does not have many feeding options. Here the larvae are destined primarily for chickens who know how to harvest larvae. At night mature prepupae crawl through the aeration holes of the bin and fall onto the ground. They then seek refuge under leaves and other debris around the base of the bin. The following morning, chickens have no problem finding and eating them.

If a biopod is used to grow larvae, the larvae self-harvest into a collection bucket. The farmer is free to feed the larvae to whatever he wishes: chickens, fish, frogs, shrimp and so forth. In the picture above, we see BSF larvae grown in the Mekong on nothing other than pig feces. In the picture below we see the biopods in which they were cultivated.

¹ If you would like to see what a MRSA infection looks like, see: <http://www.staph-infection-resources.com/mrsa-pictures.html>

In this pig-on-bedding concept, urine simply drains into the dry bedding and is absorbed by it. Biochar and effective microorganisms (EM) can be incorporated into the bedding and are quite efficient in preventing the escape of ammonia.

When urine comes into contact with the bedding, beneficial mesophilic microorganisms proliferate. These microorganisms compete with and eliminate a broad variety of swine pathogens. As pigs walk, play and root on and within the bedding, they keep it well aerated.



Since the floor of the pig pen is not flooded with water, everything remains aerated, dry and sanitary. This translates into far less disease and mortality. When properly managed, the bedding has a fresh, pleasant, compost smell. Since the bedding does not smell, filth-bearing flies and rodents are not attracted to it. The pig pen stays remarkably free of flies and rodents.

The bedding also functions as a soft cushion. Concrete floors, by contrast, have a terrible impact on the feet and bone structure of the pig. When pigs are brought to slaughter after having spent their entire lives on a hard concrete floor, they have great difficulty walking. It is inhumane to raise pigs on concrete floors.

The strategy that we propose here for the processing of pig waste is precisely equivalent to raising pigs within a large mesophilic bin filled with dry biomass. In fact the walls of the pig pen could be made out of the same 8-hole brick used in the construction of the mesophilic bin featured earlier in this paper. Over a period of a few months, the bedding is slowly transformed into a mesophilic compost of considerable value. This bedding can be used to fertilize plants, or it could be made available to red worms and converted into vermicompost.

The anaerobic digestion of pig waste is quite popular in Vietnam. Here urine and feces are flushed periodically during the day and routed to biodigesters that generate methane. This involves a great deal of pumping, and in many cases, the water that is pumped is not freshwater but re-circulated water. Care must be taken to assure that this re-circulated water is free of pathogens and does not serve as a vector of disease. The pig is raised in a damp, wet and humid environment where disease can so easily proliferate.

Instead of having larvae and red worms as a valuable feed, the pig farmer has a mixture of methane and carbon dioxide of little comparable value. Instead of having mesophilic compost or vermicompost as a valuable soil amendment and fertilizer, the pig farmer has a raw sludge that should be composted, or otherwise amended, before being incorporated into the soil. The effluent from the biodigester is too rich in NPK to be released into the environment and requires further treatment. Generally this treatment takes place by means of a duckweed pond. In this approach, even the small pig farmer is forced to pump and treat tens of thousands of liters of water each year.

Unlike a gasifier, a biodigester is always producing gas, and therefore this necessitates the construction of large storage bags or balloons. These storage devices are generally located in close

proximity to the kitchen, sometimes even within the kitchen. If ever they should leak, there is the very real danger of explosion and fire. Piping gas from the biodigester to the storage device and from the storage device to the stove is far from ideal.

But if the pig farmer no longer has access to biogas for purposes of heating and cooking, he must have other means of producing the energy he needs. This, of course, is where gasifier technology comes in. Here gas does not have to be stored. Rather it is produced on the spot, only as needed. Instead of utilizing pig feces rich in nutrients that can be easily reintegrated into the feed/food chain, the farmer utilizes nutrient-poor biomass such as rice hulls and coffee husks.

In general, just as it does not make sense to make ethanol out of corn or methane out of food waste, it does not make sense to make methane out of pig feces. What is potentially feed should not be turned into fuel. This is especially true in Vietnam where rice hulls and coffee husks are abundant and can be inexpensively gasified. Note that pig feces have roughly the same nutrient value relative to BSF larvae and red worms as food waste.²

There was a time in Vietnam when it made a lot of sense to process pig waste in a biodigester. This solution was far better than simply discharging pig waste into ditches, streams and rivers. But with the advent of living bed technology, BSF/redworm bioconversion and the availability of low-cost rice hull and coffee husk gasifiers, the logic of the biodigestion of pig waste is not as compelling as it once was.

It's a question, not of doing away with the biodigestion of pig waste, but of making more options available to the pig farmer. Some pig farmers might love to get involved in selling larvae, red worms and vermicompost as an additional source of income. Some might want to take things a bit further and grow larvae and red worms to feed catfish or shrimp which they would culture in ponds located on their pig farms. Some might not have sufficient space to construct biodigesters and duckweed ponds. Some might feel a bit uneasy about storing methane in close proximity to a kitchen and might prefer the safety of cooking with gasifier heat. Some might need cured bedding to fertilize their vegetable gardens. This list goes on and on.

Many pig farmers in Vietnam make rice wine, and the mash from this process is fed to pigs to offset the cost of feed. Gasifier heat can now be used in the distillation of rice wine. Gasifier heat can also be used to blanch or cook unprocessed vegetable matter such as fresh taro leaves, sweet potato vines, carrot tops and banana stems.

Many pig farmers search for different types of waste to feed to their pigs. However they are reluctant to feed these wastes directly to their pigs for fear of the transmission of disease. But with gasification and fermentation technologies, the pig farmer is free to pasteurize or ferment many types of waste. Large quantities of restaurant and institutional food waste are available, as well many types of market waste such as vegetable waste, fish by-products and chicken offal. Those pig farmers who operate just outside the city in proximity to large sources of putrescent waste enjoy a distinct advantage over those who do not.

² Dr. Craig Sheppard of the University of Georgia has demonstrated in several experiments that 18% of the weight of fresh pig feces is transformed into fresh BSF larvae. On food waste the percentage of conversion is about 20%.

After the pig farmer prepares his own feed, he does not have to dry and store it, as feed company do. He can feed the freshly processed material immediately to his pigs. This eliminates a costly drying step and results in a substantial savings in the cost of feed.

As the pig farmer combines and integrates technologies, he finds himself in a position where he buys nothing from feed companies. In growing the plants he needs to feed his pigs, he buys nothing from fertilizer companies. In generating the heat he needs to prepare feed or make rice wine, he buys nothing from fuel companies. By raising his pigs in a dry and sanitary environment, he does not buy antibiotics from pharmaceutical companies, and yet experiences far less disease and mortality. For the first time in his life, the Vietnamese pig farmer is in a position to make money.

In this way the pig farmer in Vietnam sustainably produces the four most essential elements of food, fuel, feed and fertilizer. As he becomes self-sufficient and economically stable, his children are not forced to abandon farming and move to the city in search of employment, and the country of Vietnam becomes far more secure in the supply of food for its people.