

Local Feed Resources and Indigenous Breeds: Fundamental Issues in Integrated Farming Systems

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Abstract

The tropics present great opportunities for sustainable development thanks to the enormous cultural and biological riches of these regions. The rational exploitation of local feeds and local breeds of livestock will support much more sustainable production systems in the medium and long term. These have received insufficient attention in the past and have not been considered seriously because of the introduction of "exotic" systems based on high inputs, high technology and "breeds of high genetic merit". As a result, local breeds of pigs and cattle in many tropical countries have disappeared or their population is decreasing drastically.

On-farm research has shown that small scale farmers in Vietnam and in many parts of the tropical world continue to work with local breeds because of their good adaptation to the prevailing conditions. A project was carried out in two villages in a rainfed hilly region in Central Vietnam, involving the use of local Mong Cai pigs, local feeds supplemented with duckweed, and plastic biodigesters to produce energy for cooking and the nitrogen-rich effluent as fertilizer for the ponds in which the aquatic plants were grown. A study of the nutrition of Mong Cai, Large White and crossbred pigs showed that the indigenous breed would eat greater quantities of duckweed and use it more efficiently than the exotic breed. Local sows fed duckweed were also more prolific than exotic breeds on small farms with feed resources of low nutrient density.

The studies were carried out with a participatory approach which identified the importance of the local pigs and feed resources and the enthusiastic adoption of the biodigester technology and the production of duckweed based on the fertilized ponds. The priorities of the farmers were identified and a proposed intervention based on restricted milking of local cattle abandoned because it was considered too long term.

Parallel studies in Cambodia led to the development of pig feeding based on juice from the sugar palm (*Borassus flabillifer*) supplemented with boiled soya bean seed and water spinach. Biodigesters were also integrated into the farm.

The various studies demonstrate that the appropriate use of local feed resources and indigenous livestock breeds requires the close integration between crops and livestock within the system. The excreta is recycled on the farm to produce energy and effluent used for fertilizer to produce protein supplements for the livestock.

KEY WORDS: Local feed resources, on farm research, recycling, biodigesters, genotype-environment interactions, indigenous knowledge, local breeds, integrated farming systems

Feed Supply and Population Growth

There is a growing disparity between the expanding world population and the earth's food producing capacity, the rate of increase of which is less than the rate of population growth. As a result, food supplies per capita are decreasing (Brown and Kane 1994). However, an important issue here is the role of livestock. As living standards rise, so does consumption of livestock products. But the feeding systems to produce these products, especially in the industrial countries, use the same feed resources as are eaten by humans, namely cereal grains and soya bean meal. It is estimated that almost 50 % of the world grain supply is consumed by livestock (FAO, 1993). It has been argued (Preston 1995) that if all the world's grain production was reserved for human consumption then there would be enough to feed the 10 billion inhabitants at which point the world population is expected to stabilize.

Alternatives to Cereals as Livestock Feed

The strategy that is proposed is that not only are there many alternatives to cereal grains as the basis of feeding systems for livestock production but that many of these systems result in a more efficient and sustainable use of natural renewable resources. The first step in this strategy is to recognize that the production of cereal grains for livestock feed, as practiced in the industrial countries, is not sustainable because it depends on the inputs of massive amounts of energy derived almost exclusively from fossil fuel. According to the data from Pretty (1995), the production of rice in the USA requires that some 65% of the energy value of the rice is imported into the system in the form of fossil fuel derived inputs. The energy need for maize is less (about 25%) but still substantial.

The examples of alternative energy-rich crops proposed by Preston (1995) include sugar cane, cassava, sugar palm, oil palm and coconut palm. The yields of all these crops expressed in terms of grain equivalent exceed what can be expected from cereal grains. Moreover, many of them, for example the palm trees, can be grown in association with other crops in multi-strata systems and are much less demanding in terms of energy input for cultivation. The limitations of all these alternative crops, as sources of feed for livestock, are in the imbalance of nutrients and specifically protein. On the other hand, they are all low in fibre. In fact, the energy from sugar cane, and the palm trees (oil and sugars) contains no fibre at all.

The feeding systems designed so far, using these new resources, have relied mainly on conventional sources of protein such as soya beans, groundnuts and fish meals (Sarria *et al.*, 1992; Ocampo *et al.*, 1994; Khieu Borin *et al.*, 1995). This is obviously a major constraint as these conventional protein-rich meals are relatively low yielding and soya beans, which is the major protein crop, are not well adapted for growing in the tropics where they yield much less than when grown in sub-tropical regions.

Alternative sources of protein were also proposed by Preston (1995). These include the leaves of many trees and shrubs and several water plants as examples of truly tropical feed resources capable of very much higher protein yields than soya beans. The major nutritional limitation of these feed resources is that they are relatively high in fibre, especially the

leaves and foliage from trees and shrubs which puts a constraint on their digestibility, especially by monogastric animal species. Thus the characteristics of these alternative sources of energy and protein, when combined into feeding systems, can be summarized as follows:

- High productivity and efficiency in use of natural resources (eg: land, water and solar energy).
- Relatively low input needed for cultivation.
- Low nutrient density and low digestibility in the case of tree leaves
- Limited shelf life in the fresh state (eg: juice from sugar cane)

Production Systems from Locally Available Resources

These features have important implications for the design of livestock feeding systems. It means that:

- The feeds are not suitable for incorporation into the conventional "balanced rations" in a feed mill, as is done with cereal grains and protein meals
- For maximum economy, the livestock must be located close to the source of the feed as the high volume and short shelf life of the fresh product makes transport expensive
- The feeds are less suitable (compared with a conventional maize-soya mixture) for livestock of high genetic potential in view of the relatively low nutrient density and constraints in protein supply
- More of the original feed will be excreted in the faeces than in the case of cereal-protein meal feeds, because of the lower digestibility (which may be an advantage when manure is an essential component of the production system)
- Genotype-environment interactions will be accentuated

All of these features favour the use of these feed resources in integrated farming systems where there is a close association between crops and livestock. Small scale producers who live on their farms will benefit more from these feeding systems than "corporate" farmers. There will be opportunities for self sufficiency in fuel (in the form of biogas) and fertilizers because of the ready availability and relatively larger amounts of manure. Local breeds and crossbreeds of local with improved strains

are likely to have comparative advantages over "exotic" high performance genotypes.

It is evident from this analysis that the feeding and farming systems that need to be developed in order to take advantage of the opportunities offered by these alternative feed resources will be quite different from those currently practiced in most industrial countries. This in turn has implications for research, training and acquisition and transfer of knowledge. Appropriate knowledge will rarely be found in the scientific publications emanating from institutions in the "North". Farmers who over generations have learned how to use the locally available resources will be more valuable sources of information.

Similarly, appropriate germ plasm is more likely to be found in local ecosystems than in the laboratories and experiment stations of the animal and plant breeders in the industrial countries. There are many examples of where indigenous breeds and local feed resources prove more appropriate than exotic types and imported technologies. Crossbred (F1) Holstein-Zebu cattle were more efficient producers of milk and meat in a tropical environment in Brazil (Madalena 1989) and in Colombia (Rodriguez and Cuellar 1994) than the purebred Holstein. Leaves from the Jack fruit tree (*Artocarpus heterophyllus*) supported higher liveweight gains in indigenous goats in Vietnam than the more digestible foliage from *Trichanthera gigantea* (Keir *et al.*, 1997). Hybrid broiler chickens quickly succumbed to disease and malnutrition when they were put in an environment where "scavenging" local chickens were able to produce normally (Preston T R 1995, unpublished observations).

Local Resources in Integrated Farming Systems in Central Vietnam

A study was carried out in two villages (Binh Dien and Xuan Loc) in a rainfed hilly region in Central Vietnam (Rodriguez *et al.*, 1996). The areas were visited in 1994 and the researcher lived in the villages during 1995. Discussions were held with the People's Committee and the Women's Union to discuss and develop the ideas. The priorities of the farmers were identified and a proposed intervention based on restricted milking of local cattle abandoned in the light of the insistence of the farmers that the expected benefits were too long term and they had more immediate needs. The participatory approach identified the importance

of the local pigs and feed resources and the enthusiastic support for the introduction of low-cost biodigesters and the production of duckweed based in ponds fertilized with the nitrogen-rich effluent.

As a result of the project activities in the village and farmer expectations, research to document the local breeds became a priority. A survey was done to get some baseline data. Local pigs proved more prolific than "exotic" breeds in the households of poor farmers in these areas where available feed resources are of low nutrient density, and especially low in protein (Nguyen Thi Loc *et al.*, 1997). The survey demonstrated a mean weaning rate of 10.3 pigs per sow in Binh Dien and 9.59 in Xuan Loc. The farrowing interval was 181 days. Mortality to weaning was less than 10%. These observations at village level about the efficiency of the Mong Cai breed in the use of local resources were the basis for carrying out an on-station experiment.

The Mong Cai pig of Vietnam appears to have comparative advantages over imported "exotic" strains when the need is to be able to consume large quantities of a voluminous feed such as duckweed (Rodriguez and Preston 1996). Nutritional studies were carried out using a diet of sugar cane juice and duckweed (grown in ponds fertilized with biodigester effluent) fed to local (Mong Cai) pigs, Large White pigs and crossbreds. The purebred exotic (Large White) pigs failed to adapt to the use of duckweed and had to be eliminated from the experiment. In that study, the nutritive value of duckweed was found to be high when fed to indigenous pigs and their crosses. Half the pigs were able to consume enough fresh duckweed to provide a diet with more than 10 per cent protein. This local resource was not useful with the poorly adapted exotic breed.

The excreta produced by the pigs was a valuable resource that could be used in low-cost, plastic biodigesters. The potential benefits of this technology were enthusiastically received, especially by the women. It was calculated that at least 1000 T of firewood were used annually to cook feed for pigs and 678 T of firewood used to cook food for the 364 households in Xuan Loc Village alone. As part of the project activities, more than 50 biogas digesters were installed in Binh Dien and Xuan Loc villages, with an average cost (for materials) of USD 29.00, including

two burners. These provided biogas for cooking of both human and pig food.

There was also a potential connection between the biodigesters (being installed primarily as a source of fuel) and the need to improve the diet of the pigs. Conventional protein supplements are only available in the market in Hue City and are expensive. The proposal was to grow duckweed in ponds fertilized by the nitrogen-rich effluent produced from the biodigesters. Duckweed can contain up to 40% protein in the dry matter when raised in this way (Leng *et al.*, 1995) and can be grown almost anywhere in the tropics where there is water. Farmers quickly learned to grow the plant and to keep it in good condition, and they also learned that it could be used as a high quality protein supplement not only for pigs, but also for ducks and chickens. Common ducks in Vietnam also appear to be able to eat greater quantities of this water plant than do "improved" Muscovy ducks (Bui Xuan Men *et al.*, 1996).

The combined development of the pig, biodigester and duckweed technologies led to an integrated approach which was adopted and refined by the farmers. However, a negative aspect of the project was that original proposals to develop a milk programme with the local cattle was abandoned because it was not acceptable to the people and too many costs and constraints were anticipated.

Pig Production from Sugar Palm in Cambodia

The use of the sap (or juice) from the sugar palm tree (*Borassus flabillifer*) as feed for pigs is another excellent example of a technology developed from indigenous knowledge (Khieu Borin and Preston 1995). This tree grows wild in Asia from the Persian Gulf to the Cambodia-Vietnam border and cultivated in India, Malaysia and occasionally the southern USA. It is used locally for sugar production from the inflorescence and many byproducts from other parts of the tree.

In the study cited above, the fresh juice was fed to crossbred (Yorkshire x Duroc x Haiman) pigs in 14 farm households in a village in the Takeo province of Cambodia. Each farmer had 6 pigs and access to at least 12 sugar palm trees; housing was constructed from palm trunks with roofs thatched with palm leaves and solid concrete floors. Each farm had a plastic biogas digester installed to utilize the effluent.

The pig diet consisted of ad libitum sugar palm juice, together with 400 g/day boiled whole soya bean seed with added lime and salt and 500 g/day water spinach. Liveweight gains ranged from 350-450 g/day. More importantly, the system was more profitable than sugar production which needs much more wood for concentrating the juice. The system was less labour- intensive and the pigs produced effluent as fertilizer for fish ponds, water plants or rice and fruit trees, with no harmful effects on the environment.

The results will be reported more fully in a subsequent paper in this Conference.

Optimizing the Total System

The farming system must be fully integrated in order to optimize the use of locally available "alternative" resources. Strategies for sustainable livestock production in the tropics had been developed in Colombia and elsewhere (Preston and Murgueitio, 1992). Integrated systems were originally based on sugar cane and its byproducts as the source of energy, with legume trees and water plants as sources of protein, for feeding pigs, ducks, sheep, goats and cattle.

The simple biodigester technology had been developed and refined at CIPAV and the principle of using the effluent as a fertilizer for ponds and also in the production of earthworms for compost and/or feed had also been applied.

The results reported here demonstrate that the basic model has many variants but the principles are the same. It is important to identify local feed resources and the preferences of local people for different types of livestock. In all cases, there should be minimum "waste" in the system. By-products and residues originating in one component of the system become inputs for another "productive" activity.

The Beneficiaries

The beneficiaries from a strategy based on local resource use in integrated farming systems are many.

Women will benefit when there is close integration within the farming system. Firewood, the collection and use of which is done by women, can

be replaced by biogas when livestock are confined and the biodigester will be more productive when local, less digestible (by the animal) feed resources are used.

The existence of genotype-environment interactions will have commercial significance when local feed resources are used. They have significance in other ways. They certainly contribute to biodiversity and have positive effects on the environment. They give empowerment to farmers who may be economically "poor" but who are "rich" in knowledge of local resources.

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