Towards local resources-based integrated crop- livestock systems

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The present livestock production systems in most industrialised countries are in direct competition with human needs. Livestock presently consume almost 50% of world cereal grain supplies. In the "intensive" large-scale production systems (Sansoucy 1998), increasingly promoted by corporate agriculture, livestock wastes contaminate soil and water resources, create less than favourable working conditions for the personnel involved in feeding and cleaning, and decrease employment opportunities. To meet food needs in 2050, it is necessary to develop livestock production systems, which do not depend on cereal grain.

In developing countries in the tropics, instead of grain-based livestock systems, alternative production systems must be developed which make optimal use of locally available resources, solar energy, soils, water and people for multiple end purposes. The challenge is to capture the sun's energy in systems of production and utilisation which at the same time will contribute to alleviation of poverty, creation of jobs, a more equitable life-style, protection of the environment and increased biodiversity. Close integration of livestock in the farming system, with recycling of all excreta, will be the basis of an agriculture which can be highly productive and also sustainable (Figure 1).

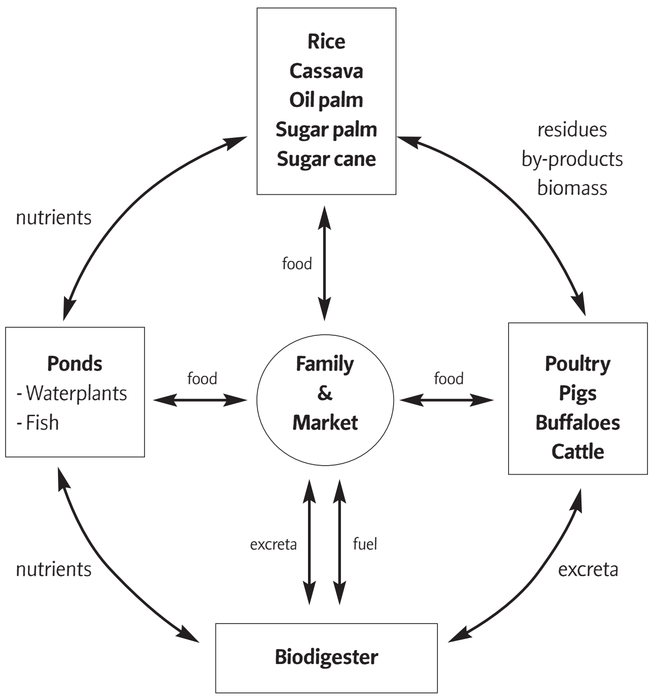

Figure 1: The integrated farming system

Energy crops

In tropical countries, especially in the humid zone, there are many crops and farming systems that considerably exceed the productive capacity of grain cereals. Key plants in this scenario are sugar cane, cassava, and the palm family, especially the oil and sugar palms.

The yield potential of the sugar palm (*Borassus flabellifer*) is extremely impressive. An annual average yield equivalent to 18 tonnes of soluble sugars per hectare has been documented in a study with 12 family farm households in Cambodia (Khieu Borin and Preston 1995). Despite this demonstrated potential almost no research is currently conducted to improve the technology of growing and using this tree, which is found throughout the SE Asian region.

Protein crops

There is an equally great potential to produce high yields of protein in the tropics. But this will be with trees, shrubs and water plants, rather than with soya beans. The *Lemnacaea*, of which "duckweed" is the most widely distributed, have a particularly important role to play in efficient resource utilisation because of their capacity to extract nutrients from water fertilised with wastes (excreta) from livestock and people. A specific feature of this plant is that its protein content can be manipulated according to the nutrient supply in the water. Values in the range of 35-40% protein in the dry matter can be attained when the nitrogen content of the water is in the range of 20 to 30 mg/litre (Leng 1999). Duckweed is easy to harvest and needs no processing prior to being fed to livestock. The protein is highly digestible and the excellent balance of essential amino acids makes it an ideal supplement for chickens, ducks and pigs. Average yields are in the order of 100g fresh biomass/m^2/day equivalent to 8 tonnes of protein/ha/year (Nguyen Kim Khang 2000).

The cassava plant (*Manihot esculenta*) can be managed as a perennial forage crop with repeated harvests of the foliage at 50-70 day intervals. The foliage yield increases over successive harvests (Preston, 2001) as the repeated cutting stimulates new growing points. Yields of 3-4 tonnes of protein/ha/year are possible with this regime. The fresh foliage is an excellent protein source for ruminants, while after ensiling (which converts the toxic cyanide into non-toxic cyanates) it can safely be fed to pigs (Ly and Rodríguez 2001). Cassava is an exploitive crop when grown in monoculture and on sloping land. Managing it as a perennial shrub / tree and associating it with N-fixing legumes, such as *Flemingia macrophylla* or *Desmanthus virgatum*, or fertilising it with heavy dressings of livestock manure or biodigester effluent, are ways in which it can be grown sustainably with enhancement of soil fertility (Preston et al 2000). The presence of cyanide components in the leaves may even serve as an "organic" pesticide, providing protection against a wide range of pests.

Changing the livestock system

The feeds derived from these "alternative" crops (juice from sugar cane and sugar palm, roots of cassava, fruit from oil palm, duckweed biomass and cassava foliage) do not lend themselves to "factory" farming systems which traditionally use dry feeds, easy to store, transport and mix into "least-cost" rations. The "alternative" feeds require "alternative" farming systems such as developed by CIPAV in Colombia (see page 14) which are now widely being adopted and adapted in, among others, Vietnam and Cambodia.

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