Chapter 7 Conclusions

The main part of this book was written in the early nineties in Cuba, in the midst of a drastic and devastating cut-back in the importation of cereals and protein supplements destined for animal production. Within a 2–3 year time frame, the production of poultry, eggs, meat and milk dropped to approximately 30% of previous levels. Also, while animal production and productivity decreased, animal mortality drastically increased.

The “conclusions” of this book were written some 2–3 years after the main chapters. This was a fortuitous accident because the new economic situation left the author more convinced than ever of the need to develop a simple and farmer-friendly pig production system for the island. It became a personal challenge and objective, and re-enforced a previous held observation about small-size pig operations in the Caribbean, and perhaps generally in the tropics, that most pig farmers just want an economic result, but with locally-available resources, and will gladly accept a feeding system entailing a lower biological performance if only their pigs grow. If the following ideas are valid for other pig producers in the tropics, then the objective shall have been achieved.

Conventional Approach to Pig Production

Pigs in the tropics, between 50 and 110 kg, do not have to eat 3.11 kg of concentrates, generally imported and consisting of 80% maize and 20% soybean meal and convert this at a rate of 3.79 in order to grow 820 g/day (NRC 1988). Actually, most pigs in the tropics probably grow at half this rate. The information set out in Table 1 suggests that in the tropics there are a surprising number of potential and viable sources of energy that might be used, in fact, several appear even as highly efficient, and even more economically attractive, than the cereal-based system. The other fact is that cereals, or grains, are becoming scarcer, therefore more expensive, and soon may be prohibitive for industrial producers of pork, even in temperate zones.

In this regard, in a recent article related to facing food scarcity, it was emphasized that world grain production, after tripling from 1950 to 1990, has not gained at all since 1990, largely because crops cannot effectively use more fertilizer. In fact, land is slowing losing its productivity. This, in addition to the fact that 90 million people are added to the global population each year, and that grain normally accounts for half of human caloric intake, could mean that conventional, grain-based livestock production systems will eventually require modification (Brown 1995).

Zero-grain pig production systems

When using conventional grain-based rations for pigs, approximately one-half of the protein comes from the cereal component (Chapter 3). However, in the case of the feeding systems referred to in Table 1 in which the energy and protein components are offered separately (Preston and Murguecitio 1992), due to the invariable low level of protein in the basal diet, almost all the essential amino acids must be supplied by the supplement. Preston (1995) has argued that this could be an advantage because:

- when the total amount of protein offered is derived almost wholly from supplements, rather than partially from cereal grains, it is better balanced in the essential amino acids, and
- it is easier, and may be cheaper, to find a supplement already balanced with respect to the essential amino acids than compensate for the imbalance in the amino acid profile present in cereal grains.

An additional consideration now under study is that a faster growth rate, per se, one which would invariably involve feeding a biological optimum supply of dietary protein is not necessarily the most profitable. The authors of the information presented in Table 2, reporting the results of similar types of experiments carried out in different countries but using different energy sources, have, in their respective papers, pointed out this important aspect. In all cases, the most profitable experimental treatments (*) were those that used a more restricted amount of protein.

Table 1. Comparison of pig feeding systems under controlled experimental conditions* under normal farm conditions reduce performance by 10–15%.

System	% energy as DM	Liveweight (kg)	ADG (g)	DM conversion	Source
Maize	80	50–110	820	3.40	NRC
					(1988)
Fresh cassava	60–70	20–100	650–790	2.80–3.00	Manner *et al.*
					(1977)
Cooked sweet	73	30–85	770	3.50–3.80	Dominguez *et al.*
potato					(1991)

Ripe bananas	66–71	30–90	560–570	4.50–4.60	Solis *et al.*
					(1985)
Palm press fiber	78	20–90	500–550	4.50–5.00	Ocampo *et al.*
					(1990b)
Sugar palm juice	80	50–80	500	-	Preston
					(1995)
Sugar cane juice	80	30–90	650–700	3.50–4.00	Sarria *et al.*
					(1990)
B molasses	70	30–90	500–550	4.00–4.50	Cervantes *et al.*
					(1984)
C molasses	70	30–90	400–450	5.00–5.50	Cervantes

					et al. (1984)
Processed swill	100	25–90	430	4.00	González *et al.*
					(1984)

Table 2 The relation between protein supplement (kg/d), ADG (g) and profit as manifest by five authors in four countries using three different energy sources.

Energy source	Supplement (kg/d) ADG (g)			Country & Source
Sugar cane juice	0.45*	0.68	0.90	Dominican Republic
	838	840	830	Estrella *et al.* 1986
Sugar cane juice	0.47	0.52*	0.66	Colombia
	622	736	670	Moreno (1989) cited

				by
				Sarria 1990
Sugar cane juice	0.30*	0.80	-	Vietnam
	542	684	-	Bul Huy Nhu Phuc *et al.*
				1994
Palm press fiber	0.50*	0.57*	0.64	Colombia
	505	545	532	Ocampo *et al.* 1990b
Boiled sweet potato	0.24*	0.50	-	Cuba
	640	770	-	Dominguez *et al.*
				(1991)

Available protein supplements

The following are protein supplements (both computer and noncomputer designed!) which have been used to provide the requirements for amino acids for growing-finishing pigs on “separate energy/separate protein” types of diets in different countries:

A quantity equal to 40% by dry weight of the daily ration. The supplement was: soybean meal, 24.5%; fishmeal, 33.8%; alfalfa meal, 26.7%; wheat bran, 12.5%; calcium carbonate, 0.875%; salt, 0.175%; DL-methionine 0.275% and 1% of a mineral-vitamin premix (Speedy *et al.* 1991, fed with sugar cane juice in Swaziland).

The amount of 500 g/day of a supplement of: soybean meal, 86%; dicalcium phosphate, 10%; salt, 2% and 2% of a mineral-vitamin premix (Ocampo 1994b) fed with African oil palm in Colombia.

An amount of 500 g/day of a supplement of: soybean meal, 91%; minerals, 6%; salt, 1% and 2% of a vitamin premix (Ngoan Le Duc 1994) fed with a mixture of sugar cane juice and palm oil in Colombia.

One shovelful, twice daily, of cooked chicken heads and guts fed with free-choice diluted B molasses in Trinidad and Tobago (FAO, 1993). Approximately one kilogram, twice daily, of fish silage (Chapter 6) fed with fresh cassava in the rainy season and fresh cane juice in the dry season (author's personal experience in Cuba)

Some 4—5 kg or about 15 plants (approximately one linear meter/pig/day) of soybean forage, fed with fresh sugar cane juice, reconstituted sugar cane juice (each 1 kg low-grade sugar mixed with 2 kg water), diluted B or C molasses or freshly-harvested cassava roots (Pérez 1995). At press, the system shown in Fig. 1 is gaining momentum in Cuba. As a system, it is very versatile, since excess or older forage can be sun-dried and used as hay for rabbits or ruminants. After eight or nine. weekly-sown plots have been planted, the forage in plot no. 1 is still in the milk-stage, does not yet contain the anti-nutritional factor (trypsin inhibitor) and therefore can be used directly for pigs, ducks, even chickens. The length of the rows corresponds to the number of pigs to feed; for instance, 10 pigs might require plots of 10-meter length rows.

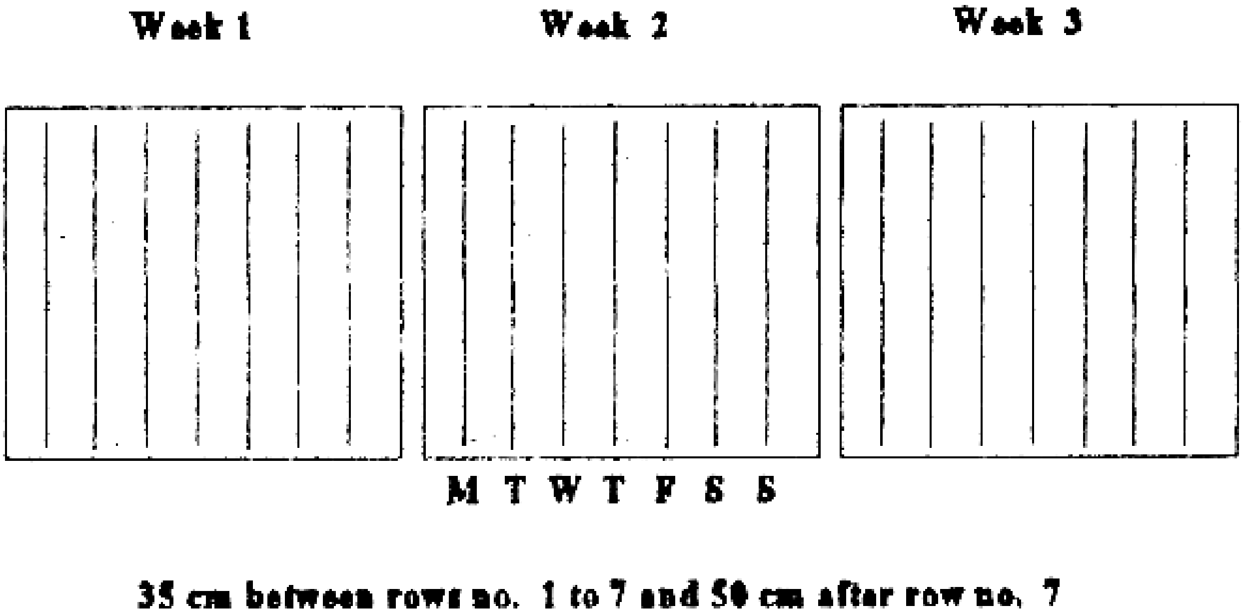

Fig. 1 Soybean forageL 7-row/9-plot system

Sugar cane system

Sugar cane whencrushed using a 2–3 roll-mill is composed (on an airdry basis) of: cane tops, 15%; trash, 5%; sugar cane juice, 40% and pressed cane stalks, 40%; therefore, in order to be economically viable, a feeding system based on sugar cane requires the integration of pigs, ducks and ruminants, both monogastrics and poligastrics.

The “fractionation” of sugar cane for feed and fuel was first proposed in 1986 in the Dominican Republic during an FAO Expert Consultation (Preston 1988). Since then, it has been shown that free-choice sugar cane juice and a restricted amount of a protein supplement can be used for pigs, while the cane tops, the pressed cane stalks, a controlled amount of protein forage and free-choice molasses-urea blocks can be used for feeding ruminants.

The following information definitely supports the economics of sugar cane “fractionation”, that is, the separation of the juice from the fiber in order to obtain two feed resources. An average amount of 28 kg of whole sugar cane was chopped and used solely as ruminant feed or pressed to extract the juice for pigs before the stalks and tops were fed to a group of heifers. The pigs received a daily average of 0.5 kg of soybean meal and 10 kg of fresh cane juice. The heifers on the "leftover fiber diet", received a daily average of 12 kg of pressed stalks, 6 kg of cane tops, 9 kg of protein forage, 0.6 kg rice bran and 0.4 kg of poultry litter. In addition, they consumed 0.7 kg of multinutrient blocks, daily. The control (whole cane) diet, also fed to heifers, consisted of 28 kg of chopped, whole sugar cane, in addition to the same ingredients fed to the heifers on the experimental ration. The result, presented as Figure 2, show that the same 28 Kg of whole cane, "fractionated", produced a total of 1100 g liveweight gain, 500 g with cattle and 600 g with pigs, or almost double the 765 g liveweight gain produced on the whole cane ration. (Molina *et al.* 1995).

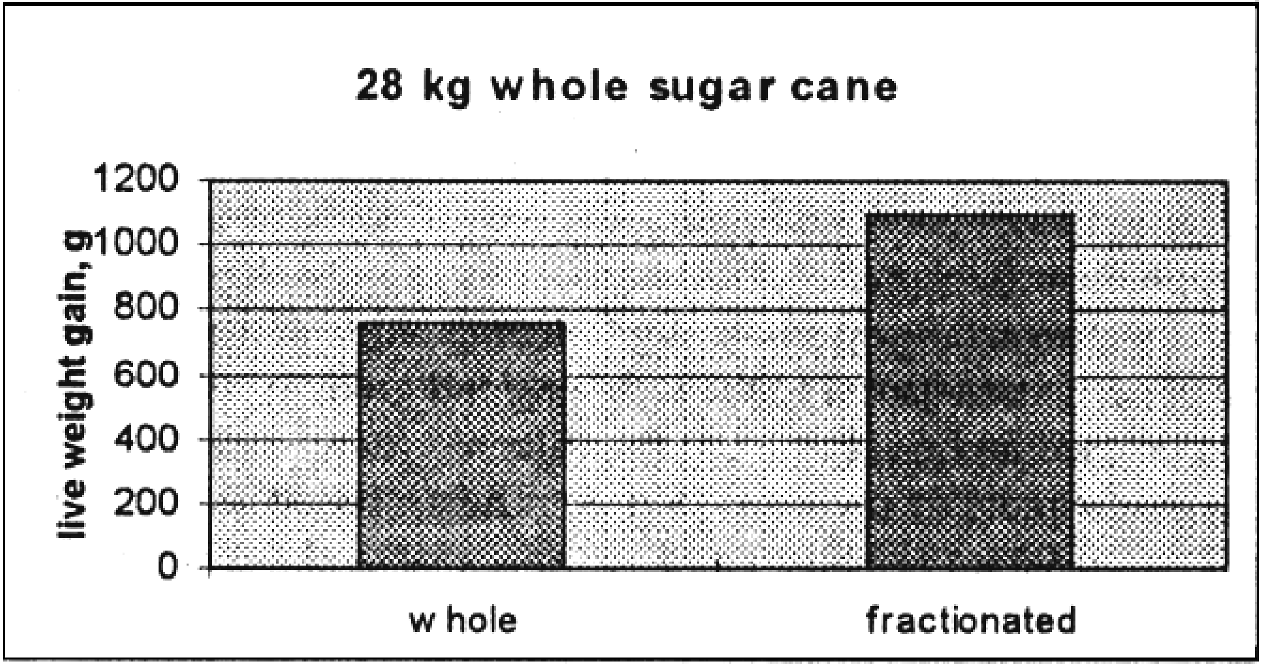

Figure 2. Type of cane

Sugar palm system

Recently, in Cambodia, it has been shown that palm sugar juice can be used to feed pigs, similar to the use of sugar cane juice for pigs in Vietnam(Bui Huy Nhu Phuc *et al.* 1994) and Latin America (Sarria *et al.* 1990). The juice contains approximately 13% sucrose and one tree produces about 4 liters of juice daily which could mean the need for 2 trees/pig/day, approximately. Because the production of palm sugar is basically from December to June in Cambodia, it might be interesting to group-breed the sows so as to produce a sizable number of weaned piglets to correspond with the beginning of the palm juice season, similar to the proposal in the first chapter of this book using cane juice. The protein supplement used was 300 g/day of soybeans, soaked overnight and boiled for 30 minutes. The ADG was almost 500 grams (Preston 1995).

Banana/plantain system

Wherever bananas are grown on a large scale, there is a considerable amount, approximately 10%, of energy-rich, reject material constantly available and this amount could represent more than 3 t/hectare, annually. Bananas, however, contain only 5% protein which limits them as an important pig feed. Another problem is that where bananas are grown generally there are limited amounts of other protein resources, it's really only bananas. In Cuba, the former solution employed was to transport the unripened, reject bananas to swill-processing plants, and process them into “liquid feed” for delivery to the pig feedlots (Chapter 6). With the present tightened economic situation, meaning less gasoline, fewer trucks and tires, in addition to the new and promising use of soybean forage as a protein supplement (Chapter 2), this situation is rapidly changing. The present idea involves setting up small pig fattening units, in the middle of the banana plantations, adjacent to the weighing and grading stations; one pig pen is enclosed and used as a banana ripening room. The protein is planted alongside: plots of soybeans (Fig.3). The proposed daily diet for pigs between 30–90 kg is 8–10 kg of ripe bananas and 4–5 kg (10–15 plants or one meter) of soybean forage in milk-stage prior to the expression of the trypsin inhibitor.

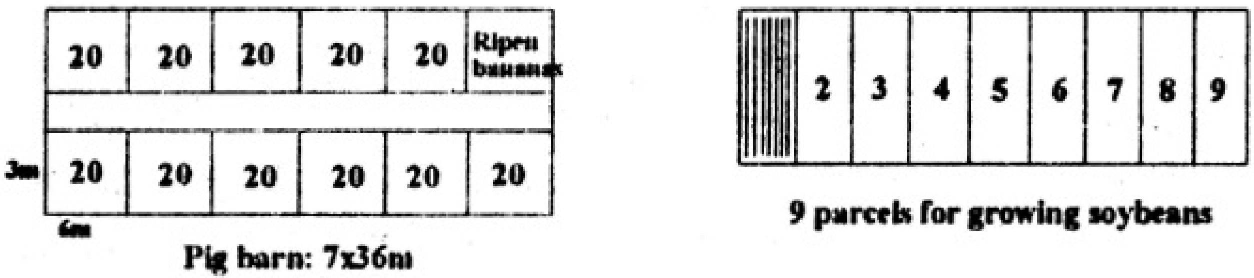

Fig 3. Pigs integrated in the bananna plantations

African palm system

The list of alternative feed resources for pigs in the tropics would not be complete without mentioning the recent and fascinating new contributions from Colombian researchers on the use of different products from the African oil palm for pigs, including perhaps, in the case of the farmer with one or two palms, the use of the whole fruit. In less than 5 years, an entirely new “African oil palm/pig” concept has emerged, has been studied, and the results have been disseminated world-wide (CIPAV/LRRD). The concept is similar to the use of sugarcane products (fresh juice, molasses, scums, low-grade sugar) fed free-choice along with a restricted amount of protein supplement, in fact, no doubt, the sugar cane path to tropical pig sustainability helped open the door to the use of the African palm. It has now been shown that a restricted amount, 500 g, of a soybean meal-based supplement together with free-choice oil-press fiber (Ocampo *et al.* 1990a), crude oil (Ocampo 1994b) or the fresh fruit (Ocampo 1994a) can completely replace cereals for pigs.

References

Brown, L.R. 1995. Facing Food Searcity. World Watch Vol. 8,No.6 10–20

Bui Huy Nhu Phuc, Ogle, B. and Preston, T.R. 1994. Effect of protein level in reconstituted sugar cane juice-based diets for growing pigs. In: Proceedings of National Seminar-Workshop "Sustainable Livestock Production on Local Feed Resources" (Editors: T. R. Preston, B. Ogle, Le Viet Ly and Lu Trong Hieu) Ho

Chi Minh City, November 22–27, 1993 pp 45–50.

Cervantes, A. *et al.* 1984. Utilización de distintos tipos de mieles de caña suplementadas con levadura torula en crema para cerdos en ceba. Cienc. Tec. Agric.Ganado Porcino 7:21

CIPA V/LRRD: Livestock Research for Rural Development Vol 1(1989) to Vol. 8 (1996) Cali, Colombia

Dominguez, P. L., Cervantes, A., Mederos, C.M., Frómeta, M. and Castellanos, M. 1991. Uso del tubérculo y la parte aérea del boniato (Ipomoea batatas (L) Lam) en la alimentación de los cerdos en ceba. Resúmenes IV Congreso ALVEC. La Habana, Cuba. NA-6

Estrella, J. F., Mena, A. and Uen, B. 1986. Evaluación de proteína para cerdos en la fase de finalización en dietas a base de jugo de caña fresca. Centro Investigaciones Pecuarias Santo Domingo, Dominican Republic

FAO, 1993. Terminal Statement of Technical Cooperation Project in Trinidad and Tobago (TCP/TRI/0153) “Sugarcane for Livestock Feeding”. FAO, Rome

González, J., Díaz, C.P., Domínguez, P.L., Ly, J. and Torres, Y. 1984. Evaluación de los desperdicios procesados como sustituto del pienso comercial para cerdos en ceba. Cienc. Tec. Agric. Ganado Porcino 7(4):57–74

Maner, J.H., Buitrago, J., Portela, R. and Jimenez, I. 1977. La yuca en la alimentación de cerdos. Bogotá, ICA pp 116

Mena, A. 1981. El uso de jugo de caña como fuente de energía en la alimentación de cerdos. Universidad de Yucatán Mérida México Thesis: Master of Tropical Animal Science

Molina, C.C.H., Molina, D.C.H., Molina, D.E.J. and Molina D.J.P. 1995 Producción de carne bovina y porcina con base en la utilización de la caña de azúcar. CIPAV, Cali, Colombia.

Ngoan Le Duc, 1994 The use of African palm (Elaeis guinnencis) oil as an energy source for pigs. Swedish University of Agricultural Sciences. M. Sc. thesis. Uppsala.

NRC, 1988 Nutrient Requeriment of Domestic Animales. Nutrient Requirement of Swine, 9th revised ed. National Academy Press, Washington

Ocampo, A., Lozano, E. and Reyes, E. 1990a. Utilización de la cachaza de palma africana como fuente de energía en el levante, desarrollo y ceba de cerdos. Livest. Res. Rur. Dev. 2(1): 43–50

Ocampo, A., Castro, C. and Alfonso, L. 1990b Determination del nivel óptimo de proteína al utilizar cachaza de palma Africana como fuente de energía en raciones para cerdos de engorde. Livest. Res. Rur. Dev. 2(2):67–76

Ocampo, A. 1994a Utilizacion del fruto de palma Africana como fuente de energia con niveles restringidos de proteina en la alimentacion de cerdos de engorde. Livest. Res. Rur. Dev. 6(1): 1–7

Ocampo, A. 1994b. Raw palm oil as the energy source in pig fattening diets and Azolla filiculoides as a substitute for soya bean meal. Livest. Res. Rur. Dev. 6(1): 8–17

Pérez, R 1995. CARTA AGROPECUARIA AZUCARERA No.95.5: El forrage verde del frijol de soya como fuente proteica. Minaz

Preston, T. R. 1988. Fractionation of sugarcane for feed and fuel. In: Sugarcane as feed. Proceedings of an FAO Expert Consultation July 7–11, 1986 (Editors: R. Sansoucy, G. Aarts and T. R. Preston) Santa Domingo, Dominican Republic pp 310–319

Preston, T. R 1995. Tropical animal feeding: a manual for research workers. FAO Animal Production and Health Paper, FAO, Rome pp 305

Preston, T.R. and Murgueitio, E. 1992. Strategy for sustainable livestock production in the tropics. Centr. Inv. Siste. Sost. Prod. Agropec. Cali. pp 89

Sarria, P. 1990. La situación de la porcicultura en Colombia y el uso de recursos alimenticios tropicales como alternativa. pp. 22 En: Memorias Taller Regional FAO/IIP “Utilización de los recursos alimentarios en la producción porcina en América Latina y el Caribe” La Habana 21–25 de mayo

Sarria, P., Solano, A. and Preston, T.R 1990. Utilización de jugo de caña y cachaza panelera en la alimentación de cerdos. Livest. Res. Rur. Dev. 2(2):92– 100

Solis, J., Campabadal, C. and Ledezma, R. 1985. Evaluación de diferentes formas de suplir el banano en la alimentación de cerdos durante la etapa de crecimiento y engorde. Resúmenes X Reunión ALPA. Acapulco, Mexico. p 40

Speedy, A. W., Seward, L., Langton, N., Du Plessis, J. and

Dlamini, B. 1991. A comparison of sugar cane juice and maize as energy sources in diets for growing pigs with equal supply of essential amino acids. Livest. Res. Rur. Dev. 3(1):65–73

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