

The role of local feed resources in the economic empowerment of smallholder livestock farmers in Pacific island countries

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Agriculture in the Pacific island countries is subsistence and crop-oriented, while rearing livestock is a sideline providing insurance against crop failure. Therefore, the livestock sector is an integral part of agriculture, but it is not as developed as it could be. With increases in the local demand for animal products, livestock production is now being embraced by smallholder farmers.

The relatively underdeveloped status of livestock production is due to

- shortages of adequate, nutritional feed
- social attitudes
- lack of appropriate technologies
- poor disease control
- marketing deficiencies
- poor extension services.

Sustainable livestock production requires good technical knowhow of feed technologies. However, the smallholder farmers who own the majority of the livestock do not fully understand the potential benefits of local feed resources (Aregheore 2000).

Feed resources in the Pacific region can be divided into 'conventional feeds' and 'non-conventional feeds' (Aregheore 2000). Well-processed, non-conventional feeds play an important role in meeting

the feed needs of smallholder ruminant livestock farmers. The high and fluctuating costs of imported feeds and ingredients from overseas, coupled with transportation difficulties, result in periodic shortages and quality deterioration during transit. The use of local feed resources would greatly reduce the cost of feed and the total cost of production of livestock (Aregheore 2000, 2005).

Livestock in the Pacific region

Livestock farming is an integral part of the mixed farming systems that make an important contribution to most economies in the Pacific island countries. They produce food, provide security, enhance crop production, generate cash for rural/urban populations, create a need for services, provide fuel and transport, produce value-added goods, diversify production and income, provide year-round employment, alleviate risk, and form a major capital reserve of farm households.

Ruminants will continue to depend primarily on forage, crop residues and agro-industrial by-products as supplementary feeds during periods of scarcity of forage. However, for the expansion of pig and

poultry industries, high quality energy and protein concentrates are required.

The two types of livestock production in the Pacific are traditional and commercial (Reddy and Sharma 2002). The traditional, small-scale, semi-subsistence production system is almost cost-free because cattle, sheep and goats graze unmanaged pastures, and pigs and poultry scavenge for food. Commercial, large-scale production systems use commercial feed coupled with grazing in the case of ruminant livestock.

Relevance of feeds

Local feed resources are potential suppliers of energy, protein, vitamins and/or minerals (Aregheore 2004) and can meet the nutrient requirements of livestock (Aregheore 2000). What are the implications of using local feeds for ruminants and monogastric animals? Information on the economic benefits of forage, crop residues, and agro-industrial by-products as animal feeds in the region is scant.

For smallholder farmers to increase domestic production of meat, more pasture will be needed; but in view of the contracting pastureland, with conversion to more profitable uses, there is a need to look elsewhere for feeds. The exploitation of the potential of crop residues and agro-industrial by-products is imperative to improve livestock production and incomes of the smallholder livestock farmers.

The use of local feeds to supplement and/or complement imported feed is dependent on breeds, the level of management, and the type of production system. The local feeds that most smallholder livestock farmers use include pastures, kitchen/household wastes, root crops, crop residues, and agro-industrial by-products—all of which are availability all year round. However, their use is not optimised because most

livestock farmers do not yet have the technical knowledge to process them for use in concentrate mixtures.

Integration of livestock with crops and agro-industrial by-products

Ruminant livestock can be integrated with plantation crops and this system of production aims to

- increase the production of meat economically without having to open new areas of land for animal production
- reduce weeding costs through controlled grazing of palatable plants and/or treading and trampling of unpalatable ones
- reduce soil erosion through controlled grazing
- use the dung and urine to fertilise the coconut trees and inter-crops, and thus reduce the cost of inorganic fertiliser
- provide additional income to plantation crop growers through increased productivity
- provide opportunities for diversification.

Integration of ruminant livestock production with crop residues is unexplored among small holders and little data exist on the quantity of crop residues and agro-industrial by-products generated annually by farmers. Cropping, the predominant form of agriculture, generates large quantities of crop residues that could be used by the feed industry.

Intensified livestock production requires high expenditure on feed. This is a potential cause of loss of foreign exchange for Pacific island countries. Substituting domestically available feed for imported feed could reduce the need for imports. Reddy and

Sharma (2002) suggested that there is a need for more research on how this could be achieved, bearing in mind the dietary requirements of livestock and cost-benefit factors related to domestic production.

Economic benefits to smallholder livestock farmers

Beef is now the major income earner on land planted with coconuts in Samoa. On a well managed smallholder, integrated cattle-coconut unit a farmer can expect a gross margin of around US\$267 per hectare compared with US\$138 from coconuts alone, which excludes the cost of labour (Lee 1999). In Papua New Guinea, farming cattle under coconuts reduces upkeep costs significantly. With coconuts in monoculture it costs about US\$96 per hectare annually but with cattle it costs only US\$27.

In the Solomon Islands the economic benefits of farming cattle in coconut plantations were from reduced weeding costs, increased copra production, and income from beef sales. Jonah (2004) reported that 40 per cent, 50 per cent and 70 per cent of household income of farmers on Efate Island, Vanuatu, came from beef cattle on small, medium and large farms, with average per farm annual returns from livestock of US\$2,230, US\$4,877, and US\$22,000, respectively.

Cost-benefit analysis

Ruminant livestock

The cheapest and most readily available feed in the region for ruminant livestock farmers is pasture. Sustainable ruminant production depends on correct management of pasture and animals to provide profitable returns on investment in forage production. Livestock need an adequate quantity and

quality forage supply throughout the year at the least possible cost. Maximum production in terms of growth, lactation and reproduction can only be achieved when the forage consumed is in excess of that required for maintenance. During adverse weather conditions, available forage may not satisfy the requirements of grazing livestock and this calls for supplementation with other feed resources.

Rokomatu and Aregheore (2006) compared the cost of supplementing the Fiji Fantastic sheep on a base diet of guinea grass alone (A) with either a concentrate mixture (B) or crushed wheat grain (C) in a 92-day trial and reported that the total cost and cost/kg of supplement for sheep in groups B and C were US\$658.40 and US\$185.50, and US\$2.00 and US\$0.86, respectively. The concentrate mixture was more expensive than the wheat grain supplement; however, the differences observed in daily live-weight gain of group B sheep over other groups seems to justify the supplementation compared to when the sheep were fed a base diet of native guinea grass (Table 1).

Smallholder dairy farmers can use locally available feeds to formulate diets to meet the nutritional requirements of dairy cows, thus reducing the dependence on the use of expensive compounded dairy concentrate from Crest Feeds (Tamani and Aregheore 2006). Economic data on production parameters—milk yield, fat corrected milk, body condition score and apparent nutrient digestibility coefficients—indicated that molasses levels in the range of 5-10 per cent are ideal; however, 10 per cent was best and thus recommended for concentrate diets of lactating dairy cows on a base diet of *Setaria* in Fiji. Formulated diets were able to sustain milk production and body condition scores of cows above the national herd standard, thus demonstrating the potential role local feeds can play in

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Table 1 Performance characteristics of sheep on forage, concentrate mix and wheat

Parameters	Diets			sem ±	lsd	Sig.
	A	B	C			
Forage intake (g)	536	289	287	2.69	4.14	***
Concentrate intake (g)	-	578	-	-	-	
Crushed wheat intake (g)	-	-	235	-	-	
Proportion of forage in total DMI	100	33	55	-	-	
Total dry matter intake (g)	536	867	522	22.11	11.90	***
Feed efficiency (kg DMI/kg live-weight gain)	17.9	11.6	12.4	-	-	-
Total supplement for 92 d (kg)	-	319.1	129.7			
Cost of total supplement (US\$)	-	658.4	185.5			
Cost/kg of supplement (US\$)	-	2.0	0.8			

Notes: A—Guinea grass (*Panicum maximum*); B—Guinea grass plus concentrate mixture; C—Guinea grass plus crushed wheat grain.

sem—standard error of mean; lsd—least significant difference; sig.—significant; *** (P<0.001) at 0.001 per cent level of significance

Source: Rokomatu, I. and Aregheore, E.M., 2006. 'Effects of supplementation on voluntary dry matter intake, growth and nutrient digestibility of the Fiji Fantastic sheep on a basal diet of Guinea grass (*Panicum maximum*)', *Livestock Science*, 100:132–41.

improving the nutrition of animals at within smallholding units.

Trials with crop residues and agro-industrial by-products with ruminants have demonstrated the relevance of local feedstuffs in the region (Tamani and Aregheore 2006) and the general conclusion is that they can be used with other feedstuffs in rations for small and large ruminants with positive effects on performance.

Monogastric livestock

Ajuyah and Toomata (1997) reported improvements in feed conversion efficiency and total reduction in cost of total feed and feed cost per live weight gain of birds when 50 per cent of copra meal replaced soybean meal in broiler chickens (Table 2).

Ochetim (1986) reported that cassava can totally replace maize in small and large-scale pig production if fed fresh, dried as chips, pellets, and meals, or ensiled. For

poultry, its substitution for maize is limited due the low protein content, which makes achieving a balanced feed formulation difficult (Ochetim 1993).

In a trial Ochetim and Beia (1989) used copra meal and fresh fish for fattening pigs and reported that growth rates were comparable with those achieved using imported compound feed. Considerable economic benefit resulted from the use of the local feed. Thorne (1992) observed a lower daily live-weight gain in pigs fed local feed compared to those fed with 50 per cent and 100 per cent imported feed. However, the lower gain was compensated for by significantly higher returns, due to the reduction in feed costs from the use of the local feed.

Ochetim (1986) reported that complete replacement of maize and soyabean with cassava, spent grain, copra cake and oil, and meat and bone meal, or with the

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use of Western Samoa pig grower diet, reduced growth rate, voluntary feed intake and feed efficiency, but the costs of feeding pigs up to 60 kg live weight were reduced by 55 per cent and 15 per cent, respectively, compared with the maize-soyabean diet. The results indicated that although the complete replacement of maize and soyabean with the local feed resources reduced nutritional performance of growing pigs, the substitutions were economically advantageous.

Results from broiler and pig studies in the region have demonstrated the significant advantages of replacing one or more imported feed ingredients with local ingredients and the inverse relationship between levels of inclusion, cost of production, and performance traits. The most practical concept for increased use of local feeds in monogastric livestock diets should be based primarily on reduction in the cost of production.

Except in a few cases, most feeds used for livestock in the region are imported. Some of the commercial feeds imported have components of local feeds that were

exported from the region (Aregheore 2000). There are promising technologies available that optimise local feed resources—crop residues, agro-industrial by-products and productive multipurpose crops in the Pacific (Aregheore 2005).

The smallholder livestock farmers can contribute towards meeting feed needs in the Pacific island countries in the following ways.

- Seek information from animal nutritionists involved in the development of locally available feeds. It is important to understand the efficacy and levels at which these feeds can be incorporated with other feedstuffs in the nutrition of poultry, pigs, beef, dairy cows, goats and sheep.
- Identify and quantify local feeds in the areas of operation of the smallholder livestock farmer.
- Seek technical assistance on how to develop them for livestock. Liaise with regional organisations involved in animal nutrition research to gather information and technical assistance.

Table 2 Performance and economic evaluation of broiler chickens fed soybean and copra meal based diets

Production traits	Control	Copra meal
Live weight at 42 days (g)	2,047	2,023
Cumulative feed intake from 7 to 42 days (g)	3,651	35,51
Feed conversion ratio from 7 to 42 days	1.78	1.76
Economics of production		
Feed cost ST\$/kg of feed	1.06	0.97
Feed cost ST\$/bird	4.05	3.61
Feed cost ST\$/kg live weight gain	1.89	1.70

Notes: Copra meal replaced 50 per cent soybean meal. US\$1 = ST\$2.85 (Samoan tala).

Source: Ajuyah, A.O. and Toomata, A.P., 1997. Growth performance and economic evaluation of broiler chicken fed copra meal based diet with and without exogenous feed enzymes, VIII Pacific Science Inter-Congress:8.

Conclusions

Smallholder livestock farmers operate where crop residues and agro-industrial by-products such as copra meal, palm kernel meal, brewers' grains, molasses, citrus pulp, rice bran, and coffee pulp are produced but wasted. The efficient utilisation of these feeds could reduce the level of feed imports from overseas and improve the economic status of smallholder livestock farmers in the region. However, to use local feed resources effectively the smallholder livestock farmer must be able to handle relatively large quantities when they are available and store the processed feed for use in times of shortage.

The economic benefits of domestic feed production are enormous. It will reduce imports and export of surplus production (copra meal and palm kernel meal; molasses) with competitive prices; and stimulate the establishment of a domestic feed milling industry that would provide employment opportunities and increased household income.

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