



Australian Government

**Australian Centre for
International Agricultural Research**

Final report

project

Using local feeds to reduce the cost of pig and poultry production in Tonga

project number

LPS/2006/149

date published

July 2009

prepared by

Dr Phil Glatz and Dr Colin Cargill
South Australian Research and Development Institute (SARDI)

*co-authors/
contributors/
collaborators*

Dr Zhihong Miao
Dr Viliami Manu
Mr Otenili Pifeleti
Mr Fatuimoana Langilangi
Mr Fisihoi Mone

approved by

Dr Peter Horne

final report number

FR2009-22

ISBN

978 1 921615 08 5

published by

ACIAR
GPO Box 1571
Canberra ACT 2601
Australia

This publication is published by ACIAR ABN 34 864 955 427. Care is taken to ensure the accuracy of the information contained in this publication. However ACIAR cannot accept responsibility for the accuracy or completeness of the information or opinions contained in the publication. You should make your own enquiries before making decisions concerning your interests.

© Commonwealth of Australia 2009 - This work is copyright. Apart from any use as permitted under the Copyright Act 1968, no part may be reproduced by any process without prior written permission from the Commonwealth. Requests and inquiries concerning reproduction and rights should be addressed to the Commonwealth Copyright Administration, Attorney-General's Department, Robert Garran Offices, National Circuit, Barton ACT 2600 or posted at <http://www.ag.gov.au/cca>.

Contents

1	Acknowledgments	5
2	Executive summary	6
3	Background.....	7
4	Objectives	9
5	Methodology	10
5.1	Study tour by Tongan delegation to review pig and poultry feeding systems in PNG and Solomon Islands	10
5.2	Workshop to select best bet feeding systems for demonstration in Tonga	10
5.3	Conduct feeding trials to determine the performance of pig and poultry fed rations formulated from local feed	10
5.4	Set up mini feed mill on commercial pig and poultry farm	12
5.5	Conduct demonstration trials on commercial egg farm and at Tupou College.....	12
5.6	Agriculture diploma students from MOTEYS develop pig production models.....	12
5.7	MAFFF extension service fact sheets.....	12
5.8	Revision of the MOTEYS pig and poultry production curriculum.....	12
6	Achievements against activities and outputs/milestones	13
7	Key results and discussion	15
7.1	Study tour.....	15
7.2	The performance of pig and poultry fed rations formulated with local feed.....	15
7.3	Revision of MOTEYS curriculum and student projects.....	18
7.4	Produce and distribute information in a variety of appropriate forms	18
8	Impacts	19
8.1	Scientific impacts – now and in 5 years.....	19
8.2	Capacity impacts – now and in 5 years	19
8.3	Community impacts – now and in 5 years	19
8.4	Communication and dissemination activities	20
9	Conclusions and recommendations	21
9.1	Conclusions.....	21
9.2	Recommendations	21
10	References	23
10.1	References cited in report.....	23

11	Appendixes	24
11.1	Appendix 1: Small-scale pig production: Background and models used in Vietnam and Indonesia.....	24
11.2	Appendix 2: Establishing and running pig feeding demonstration trials	26
11.3	Appendix 3: Demonstration protocols for establishing a poultry feeding trial	29
11.4	Appendix 4: Pig and poultry production models – Tonga	30
11.5	Appendix 5: Determining the cost of production of running a poultry farm.....	32
11.6	Appendix 6: Travel report by Tongan Government and industry staff	33
11.7	Appendix 7: Pig pen construction as a nursery and model for sustainable development .	35
11.8	Appendix 8: The diet fact sheets.....	38

1 Acknowledgments

The project leader is grateful for the following support:

Funding from the Australian Centre for International Agriculture Research (ACIAR)

The expert guidance and support provided by ACIAR's Dr Bill Winter, Mr Les Baxter and Mrs Catherine Hanley throughout the project

The support provided by the following colleagues from SARDI's Pig and Poultry Production Institute:

Dr Colin Cargill for coordinating the pig feeding trials and his support and advice through the project

Dr Zhihong Miao for developing the diets, data analyses and assistance with preparation of the final report

The support provided by the following colleagues in the Tonga:

Dr Viliami Manu for coordination of project activities

Mr Otenili Pifeleti for running feed trial at the commercial egg farm

Mr Fatuimoana Langilangi for running the student projects

Mr Fisihoi Mone for running the pig feeding trial at Tupou College

Mr Mika Saipaia for coordinating the pig feeding trial at Tupou College

2 Executive summary

The high cost of imported livestock feed and the importation of relatively cheap pig and poultry meat, mainly coming from Australia, New Zealand and Canada has resulted in a reduction in the number of pig and poultry producers in Tonga over recent years. This project aimed to establish a local livestock feed manufacturing industry to revitalise the Tongan pig and poultry industries. The strategy used was to train Tongan government staff and key producers about profitable pig and poultry feeding systems using local feed that have been developed in other South Pacific countries and in Indonesia and to demonstrate these feeding systems in Tonga.

The main agencies supporting the pig and poultry sector in Tonga are the Livestock Division of the Ministry of Agriculture, Food, Forests and Fisheries (MAFFF), Ministry for Training, Employment, Youth and Sport (MOTÉYS) which run an Agriculture Diploma Program at Tupou College which train high school students in pig and poultry production. A project workshop for partners involved in the project was held at MAFFF headquarters, Nuku'alofa, Tonga in October 2007. It was agreed at the meeting that the pig and poultry farmers' association establish a mini mill in partnership with MAFFF. It was recommended that purchase be made of a flake mill, drier, hammer mill and mixer. Three Tongan livestock farmers and a government scientist undertook a study tour to Solomon Islands (SI) and Papua New Guinea (PNG). They spent two days in SI and five days in PNG and met with local research staff and non-government organisations (NGOs) to learn about the operation of mini-mills. The Tongan delegation received advice on how to feed pig and poultry using concentrates, ration dilution and whole ration formulation using local feed resources.

Following the study tour all the project partners discussed suitable feeding systems that could be used for pigs and poultry in Tonga based on examples observed in PNG and SI. A mini mill was purchased from PNG and shipped to Tonga for establishment on a commercial egg farm. Feeding trials with pigs and poultry to demonstrate the feeding systems that incorporate local feeds were run at Tupou College and on a commercial egg farm. For the pig feeding trial, pigs weighing 10-20 kg were allocated to three dietary treatments over a 4-week period; 1) a village diet (containing fresh cassava, fresh coconut and fresh sweet potato vines), 2) a milled diet (containing 80% of local feed resources) and a commercial imported grower diet. For the poultry trial over 8 weeks, adult layers were provided three dietary treatments; 1) a commercial imported layer diet, 2) a commercial imported layer diet diluted with 30% copra meal and a village diet (containing maize, copra meal, fish meal and cassava meal).

In the pig trial the commercial diet resulted in better growth compared to the village diet. Likewise in the layer trial superior egg production was noted when birds were fed the commercial layer diet compared to the village diet. However the birds fed the diet diluted with 30% copra meal had equivalent performance to birds fed the commercial diet raising the potential for using dilution of commercial feeds with locally abundant feed resources as a feeding system. Currently the feeding trials are being repeated using good quality copra meal as the copra meal used in the pig and poultry feeding trials was spoiled during the drying process.

The use of local copra meal to dilute commercial rations is recommended as the best feeding system tested so far in Tonga for pigs and poultry. This feeding system could lead to an expansion of the smallholder egg and chicken meat and pork sectors and make a significant contribution to the meat requirements of the country.

3 Background

Livestock production is an important economic activity in Tonga with 80% of households keeping livestock (Table 1). The pig and poultry industries are an important part of social life with nearly 80% of pigs and just over 50% of poultry produced being used to meet community social obligations. Retail prices are comparable with Australia and the sale of live sucker and weaner pigs for feasts accounts for 90% of the pig market. The major issues restraining the development of the commercial pig and poultry sector are the lack of a local feed manufacturing industry, the high cost of imported feed and the importation of relatively cheap pig and poultry meat, mainly coming from Australia, New Zealand and Canada. This has resulted in a decline in the number of pig and poultry producers in Tonga due to the high cost of imported feed (Table 2). The production of broilers is declining because it is cheaper to import chicken meat (Table 3). The Tongan Prime Minister, Dr Feleti Sevele, raised his concerns about this situation at a meeting with ACIAR in late 2006, and suggested that the use of local feed supplies (from indigenous sources or alternative crops) could help reduce the cost of production, maintain or enhance local meat production, provide opportunities for local small farmers and reduce the cost of imported feedstuffs and meat products into Tonga.

The Prime Minister also expressed concern about the cost of imported meat and feed. He felt that the availability of cheaper feed could lead to an expansion of the commercial livestock sector; otherwise Tonga will be dependent on imported meats. The cheaper feed would have a flow on effect leading to an expansion of the smallholder egg and chicken meat and pork sectors, with these farmers making a significant contribution to the meat requirements of the country.

Table 1. Summary of livestock holdings in Tonga in 2001

Species	No of Households	Total No of Livestock	Average No of Livestock/household
Pigs	11,594	113,580	10
Poultry	7,729	177,829	23
Cattle	2,311	10,354	4
Horses	1,640	3,255	2
Goats	805	2,741	3
Ducks	126	1,119	9

Table 2. Costs of pig and poultry feed

Pigs	TOP\$/40kg	Poultry	TOP\$/25kg
Weaner, grower and breeder feed	50	Broiler and layer feed	35

Table 3. The price of eggs, chicken meat and live meat birds

Product	TOP\$
Tray of eggs (2.5 dozen)	10-14
Chicken meat	5-7/kg
Live meat birds	5-8

The major issue restraining the development of the commercial pig and poultry sector is the lack of a local feed manufacturing industry and the high cost of imported feed as well as cheap imports. However, there are adequate supplies of cassava, sweet potato, fresh coconut and maize, which could form the basis of the feed industry. The establishment of small-scale regional feed manufacturing centres (producing 5-10 tonne/week) in areas where local feed supply are plentiful overcomes some of these issues. Personnel involved in the smallholder feed industry must develop the expertise to manufacture the diets. The majority of smallholder farmers lack the basic nutritional knowledge necessary to

formulate practical, nutritionally adequate diets from locally available ingredients. Many also lack the necessary skills and experience to make high quality farm-made feeds suitable for feeding fish, pigs and poultry. Knowledge of the infrastructure required to produce and store dried feeds and ingredients is also limited. The lack of suitable feed-making equipment is the major constraint limiting the development of small-scale feed industry in the Pacific.

The use of cheaper local feed in the alternative feeding systems could lead to an expansion of the smallholder egg and chicken meat and pork sectors, with these farmers making a significant contribution to the meat requirements of the country. If 10% of local feed could be used in pig and poultry rations to replace the imported feed, this would save Tonga an estimated TOP\$5.75 million/annum in imports.

The purpose of this project was for Tongan farmers and government staff to select pig and poultry feeding systems developed in ACIAR projects in other countries that could be easily adapted for the Tongan production systems and to provide the technology and training to farmers through demonstration models established at Tupou College and on a commercial egg farm.

4 Objectives

1. To develop potentially suitable feeding systems for pigs and poultry in Tonga based on information and examples in the PNG and SI.
 - 1.1. Study tour by Tongan staff to review pig and poultry feeding systems in PNG and SI
 - 1.2. Workshop to select best bet feeding systems in Tonga
2. To demonstrate on-station to farmers the most profitable feeding systems that incorporate local feeds
 - 2.1. Establish sites for demonstration of feeding systems in Tonga
 - 2.2. Set up mini feed mill
 - 2.3. Conduct demonstration activities for farmers at Tupou College and on a commercial egg farm
3. To promote the wide-spread adoption of profitable feeding systems for pigs and poultry
 - 3.1. Engage Agriculture Diploma students from MOTEYS to develop pig and poultry production models
 - 3.2. Develop MAFFF extension service leaflets and pig and poultry village training material
 - 3.3. Revise MOTEYS pig and poultry production curriculum

5 Methodology

5.1 Study tour by Tongan delegation to review pig and poultry feeding systems in PNG and Solomon Islands

Tongan staff and industry leaders visited PNG and SI to meet with research staff to discuss pig and poultry feeding systems, to observe feeding of village chickens with locally available ingredients and to attend a workshop on operation of mini mills.

5.2 Workshop to select best bet feeding systems for demonstration in Tonga

Workshop was conducted with pig and poultry farmers and staff from MAFFF, MOTEYS, Tupou College and SARDI to prepare recommendations on demonstration activities.

5.3 Conduct feeding trials to determine the performance of pig and poultry fed rations formulated from local feed

5.3.1 Site selection

Phil Glatz and Colin Cargill visited pig and poultry farms and research facilities in Tonga to determine the appropriate locations to conduct the feeding trials. Inspection was made of MAFFF's Vaini Research Centre which included a pig shed (with sow, weaner and grow out areas) and a poultry shed (capacity of 1,500 layers). The feed mixing facilities included a 4 tonne mixer. Two commercial pig and poultry farms were also visited. The farmers concerned were part of the Tongan delegation that had previously visited SI and Tonga and had attended a feed mixing demonstration activity in Lae, PNG. A visit was made to Tupou College to inspect pig and poultry facilities. The piggery accommodates 30 sows and students carry out the daily husbandry and feeding of pigs. It was decided to run the pig trial at Tupou College and the layer trial at a commercial egg farm.

5.3.2 Rations for pigs and poultry

A simple Microsoft Excel feed formulation spreadsheet was developed by SARDI to formulate pig and poultry diets for evaluation in Tonga. Experimental diets were formulated according to nutrient requirement of hens recommended by NRC (1994) and for pigs recommended by NRC (1998).

The milled pig ration comprised the following:

Cassava meal (58.4%), leucaena leaf meal (15%), coral sand (0.1%), copra meal (15%), meat meal (5%), fish meal (6%), salt (0.3%), vitamin premix (0.1%) and mineral premix (0.1%).

The milled poultry ration was as follows:

Maize (45%), copra meal (16.36%), cassava meal (15%), fish meal (15%), ground limestone or crushed sea shells (7%), sodium chloride (0.3%), dicalcium phosphate (1%), lysine (0.09%), methionine (0.05%), trace mineral premix (0.1%) and vitamin premix (0.1%).

5.3.3 Experimental design

A completely randomised design was used for the pig and poultry feeding trials.

For the pig trial there were three dietary treatments replicated in three pens and run over a 4 week period. The treatments were; 1) a village diet (containing fresh cassava, fresh coconut and fresh sweet potato vines), 2) a milled diet (containing 80% of local feed resources) and a commercial imported grower diet.

For the poultry trial over 8 weeks, adult layers were provided three dietary treatments with each diet replicated six times in six pens each holding two birds. The treatments were 1) a commercial imported layer diet, 2) a commercial imported layer diet diluted with 30% copra meal and a village diet (containing maize, copra meal, fish meal and cassava meal).

5.3.4 Housing

Pig trial: 24 pigs (12 castrated male and 12 female) weighing 10-20 kg supplied by Tupou College were selected. The pigs were allocated to groups according to sex and weight. A total of six grower pens (having dimension 2x1.5 m; concrete floor, in naturally ventilated) were selected, three pigs were allocated to each replicate pen and fed daily for 4 weeks from 3-7 weeks of age. Feed allowance was 0.5 kg feed/day/pig at the beginning of the trial, increasing to 1.5 kg/day/pig. Water was available ad libitum.

Poultry trial: A total of 36 local hens were used for poultry trial; 18 cages (30 cm wide x 45 cm high and 30 cm deep) were selected at random in the middle of naturally cage shed. Two birds were allocated into each cage. Feed allowance was 1 kg feed/week/bird for all treatments. Water was available ad libitum from a nipple line.

5.3.5 Diet preparation

Local ingredients used included copra meal, cassava meal and leucaena leaf meal.

These were prepared as follows:

Copra meal-air dried coconuts were placed in flake mill and chopped into fine portions for drying in drum dryer followed by processing through a hammer mill.

Cassava meal-was prepared using the same method.

Leucaena leaf meal-was air dried and then hammer milled.

All ingredients were placed in mixer and the diet prepared as a mash. The ration comprising 30% copra meal added to 70% of the commercial ration was prepared in the mixer.

5.3.6 Parameters measured

Pig feed intake was recorded daily and live weight was recorded fortnightly. Poultry feed intake, egg numbers and egg weight were recorded daily.

5.3.7 Statistical analysis

The treatment effects were assessed with ANOVA in Systat software (Wilkinson, 1996). Bonferroni's post hoc was used to separate means only if significant main effects were detected by analysis of variance. Bonferroni's post hoc test is a multiple comparison test based on Student's t statistic and adjusts the observed significance level when multiple comparisons are made.

5.4 Set up mini feed mill on commercial pig and poultry farm

A mini mill was purchased from Project Support Services Ltd in Lae, PNG and set up in the feed shed at Chris Mafi's commercial egg farm to manufacture the pig and poultry diets.

Feed was prepared in a mash form.

The flake mill was used to slice the copra and cassava into a form for suitable for drying in the drum dryer. The flake mill was fitted with a 3 mm sieve to prepare the meal in a crumble form. The flake mill was fitted with a 1 kW motor. A fan was fitted to extract the material from the machine.

The hammer mill was used to smash and grind the dried material into a form suitable for mixing with other components of the diet.

A large cement mixer was used to mix the materials to ensure there was a homogenous mixture of the ingredient.

5.5 Conduct demonstration trials on commercial egg farm and at Tupou College

The feeding demonstration for pigs was conducted at Tupou College under the supervision of College and MAFFF staff with students assisting with the trial activities.

The poultry feeding demonstration was conducted on a commercial farm under the supervision of MAFFF staff with assistance for farm workers on the commercial farm.

5.6 Agriculture diploma students from MOTEYS develop pig production models

Third year students were selected to develop production models for pig farms seeking to improve housing of pigs and to expand numbers of sows in the enterprise.

5.7 MAFFF extension service fact sheets

Colin Cargill and Phil Glatz reviewed the current extension materials in Tonga on use of local feed for pigs and poultry.

5.8 Revision of the MOTEYS pig and poultry production curriculum

Phil Glatz and Colin Cargill reviewed the current curriculum being used by MOTEYS which run an Agriculture Diploma Program.

6 Achievements against activities and outputs/milestones

Objective 1: To develop potentially suitable feeding systems for pigs and poultry in Tonga based on information and examples in PNG and Solomon Islands

no.	activity	outputs/ milestones	completion date	comments
1.1	Study tour by Tongan staff to review pig and poultry feeding systems in PNG and SI (P)	Study tour completed	August 2008	Three Tongan livestock farmers (Christopher Mafi, Metotisi Vete and Lathu Vehikite) and a government scientist (Otenili Pifeleti) undertook a study tour to SI and PNG from 10-20 August 2007. The purposes of the tour was to learn about the operation of mini-mills, to receive instruction on how to feed pig and poultry using concentrates, ration dilution and whole ration formulation using local feed resources and to learn about village pig and poultry feeding systems.
1.2	Workshop to select best bet feeding systems in Tonga (P)	Workshop completed	October 2008	Production systems used in Vietnam and Indonesia were presented. The issues associated with setting up a mini mill, production systems used in Tonga, establishing and running feeding demonstrations, developing cost of production models for scale up of piggeries and poultry farms, developing training materials, demonstration protocols and communication and reporting were discussed.

P = Partner Country, A = Australia

Objective 2: To demonstrate on-station to farmers the most profitable feeding systems that incorporate local feeds

no.	Activity	outputs/ milestones	completion date	comments
2.1	Establish sites for demonstration of feeding systems in Tonga (P)	Sites selected	August 2007	Tupou College and a commercial farm were selected as the pig and poultry feeding demonstration sites.
2.2	Set up mini feed mill at the MAFFF Vaini Research station (P)	Mini feed mill installed	September 2007	A mini feed mill, comprising a flake mill, drier, hammer mill and mixer was ordered from PNG in December 2007 and arrived in April 2008. Delays were experienced in handling containers at Lae and Nuku'lofa wharves. The mill was set up on a commercial egg farm.
2.3	Conduct demonstration activities for farmers at MAFFF and Tupou College (P)	Demonstration activities completed	December 2007	The pig and poultry feeding trials will be completed in November 2008 and are currently being repeated.

P = Partner Country, A = Australia

Objective 3: To promote the wide-spread adoption of profitable feeding systems for pigs and poultry

no.	activity	outputs/ milestones	completion date	comments
3.1	Engage Agriculture Diploma students from CEYS to develop production models (P)	Cost of production models developed	February 2008	At the project workshop it was stated that one of the objectives was to undertake an economic assessment of the cost of locally milled pig and poultry rations compared to the price of the commercially available feed. Spreadsheets of mini-mill operations and pig and poultry production demonstration activities have been prepared and students will be asked to populate spreadsheets with production and price data on ingredients that are cheap and abundant in Tonga.
3.2	Develop MAFFF extension service leaflets and pig and poultry village training material (P)	Fact sheets written and distributed	April 2008	The development of fact sheets has been completed. One-page information leaflets on diets suitable for feeding pigs and poultry were developed by SARDI.
3.3	Revision of CEYS pig and poultry production curriculum (A)	Revision of CEYS pig and poultry curriculum	June 2008	MOTEYS pig and poultry curriculum was reviewed by Phil Glatz and Colin Cargill.

P= Partner Country, A = Australia

7 Key results and discussion

7.1 Study tour

The Tonga delegation spent two days in SI and six days in PNG and met with local research staff and NGOs and learnt about the operation of mini-mills and received instruction on how to feed pig and poultry using concentrates, ration dilution and whole ration formulation using local feed resources. In SI, the Tongan delegation visited Solomon Islands College of Higher Education and inspected the research facility where ACIAR project trials were being undertaken with village chickens being fed with locally available ingredients including corn, fresh cassava, fresh grated coconut, ripe pawpaw, mung beans and fish meal.

At National Agricultural Research Station (NARI) in PNG, the delegation met with NARI scientists and obtained information on feeding trials conducted with chickens and pigs using local feed resources comprising a concentrate ration supplemented with various local feed resources including copra meal, fish meal, waste noodles, cassava and sweet potato.

The Tongan representatives also attended an ACIAR project inception meeting for the project "Improving the profitability of village poultry in PNG". They met representatives from SARDI, NARI, Lutheran Development Service (LDS), Christian Leaders Training Centre (CLTC), Salvation Army, University of Technology (Unitech) and Project Support Services. The Tongan participants heard about the strategies being used to supplement a concentrate poultry ration prepared by commercial mills or regional mini mills with local feed resources to reduce the cost for village farmers of growing small batches of meat birds.

The Tongan delegation also participated in a mini feed mill demonstration at Project Support Services in Lae who distribute small scale agricultural machines in the South Pacific. The Tongan farmers were particularly interested in purchasing a flake mill, drier and hammer mill to utilise the large quantities of cassava produced in Tonga for use in pig and poultry rations.

7.2 The performance of pig and poultry fed rations formulated with local feed

7.2.1 Pig trial results

The results showed that weight gain was higher for both male and female pigs fed on the commercial pig diet compared to the other treatments (Table 4; 5 and Figure 1; 2; 3; 4). There was no significant difference ($P>0.05$) in live weight of pigs between the milled diet and the village diet (Table 1). The copra meal used in the trial was spoiled during the drying process and the trial is being repeated. It is anticipated the growth of pigs on the locally milled diet will be improved.

Table 4. Live weight (kg) of pigs between treatments

	3 weeks	5 weeks	7 weeks
Treatment	Male	Male	Male
Commercial	9.5	17.3a	21.8a
Milled	8.5	9.6b	10.7b
Village	8.0	9.8b	11.2b
P	0.529	0.002	0.000
SEM	0.444	1.187	1.666

	Female	Female	Female
Commercial	10.1	16.6a	21.2a
Milled	9.0	10.1b	11.3b
Village	9.3	11.3b	12.4b
P	0.597	0.022	0.012
SEM	0.423	1.217	1.850

Table 5. Daily weight gain (g) of pigs between treatments

	3-5 weeks	5-7 weeks
Treatment	Male	Male
Commercial	520.0a	424.1a
Milled	76.7b	76.7b
Village	120.0b	109.2b
P	0.000	0.000
SEM	64.28	50.12
	Female	Female
Commercial	435.0a	381.9a
Milled	73.3b	79.3b
Village	133.3b	106.9b
P	0.004	0.003
SEM	62.82	54.56

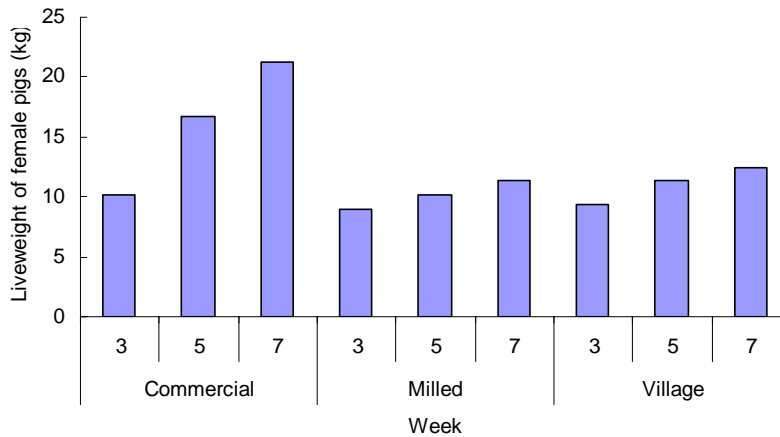


Figure 1. Female pig live weight change during experimental period (3-7 weeks of age)

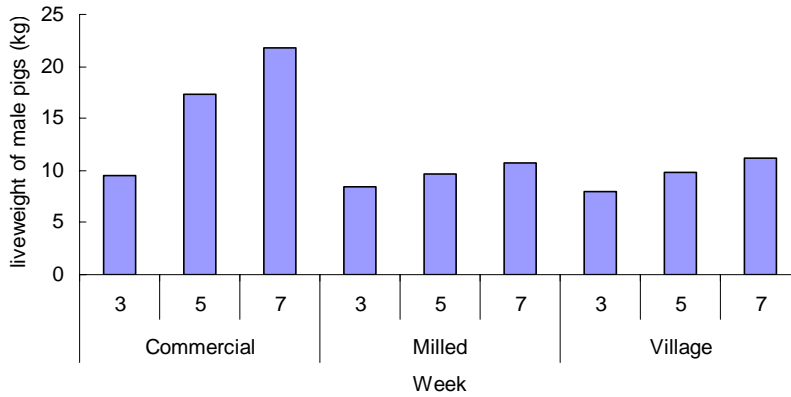


Figure 2. Male pig live weight change during experimental period (3-7 weeks of age)

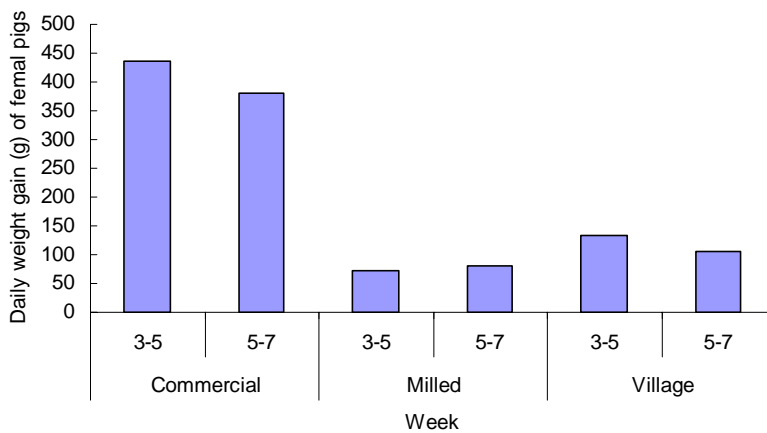


Figure 3. Daily weight gain of female pigs during experimental period (3-7 weeks)

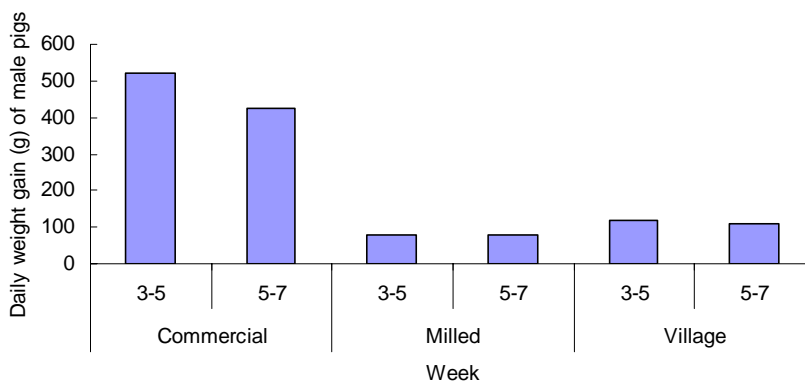


Figure 4. Daily weight gain of male pigs during experimental period (3-7 weeks)

7.2.2 Poultry trial results

A commercial layer diet diluted with 30% of copra meal resulted in similar egg production compared with the imported commercial layer diet (Table 6 and Figure 5). However, layers fed on the diet formulated with local feed produced the lowest ($P < 0.05$) numbers of eggs and this was due to the quality of the copra meal.

Table 6. The numbers of eggs laid and average egg weight (g) between the treatments during a 3 week laying period from 34-37 weeks

Treatment	No of eggs
Commercial	6.6a
Commercial+30%copra meal	6.7a
Local feed	1.9b
P	0.026
SEM	0.955

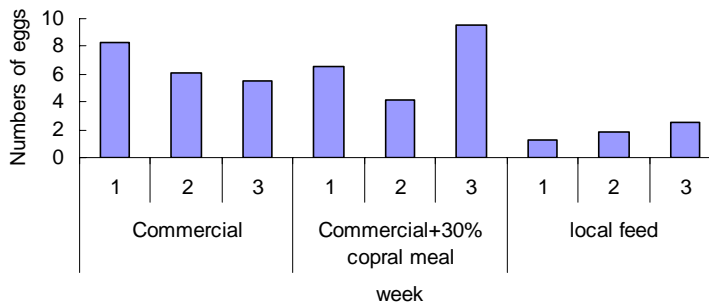


Figure 5. Numbers of eggs laid for treatments during experimental period

7.3 Revision of MOTEYS curriculum and student projects

A review of the teaching curricula at MOTEYS was conducted and the key points suggested for inclusion in a revised curriculum were to include integrated farming, provide information on local feed resources, details on feed milling equipment, feed formulation, experimental design and statistical analysis.

Students supported by the project assisted with feed manufacture and developed the design of pig and poultry housing systems suited to Tonga which has already seen the scale up of operational models from smallholder to semi commercial (see Appendix 7). Some of these students have subsequently been employed by MAFFF.

7.4 Produce and distribute information in a variety of appropriate forms

7.4.1 Fact sheets

Information leaflets on best practice feeding methods for pigs and poultry were developed by SARDI. The leaflets show pictures of the feed ingredients, how they are prepared, amount of each ingredient to include in the diet based on using a 4 litre bucket as the unit of measurement and how the diet is fed to pigs and chickens (Appendix 8).

7.4.2 Newsletter

A newsletter was printed by MAFFF with a focus on pig and poultry and outputs from project. Handouts on pig and poultry in the newsletter provided basic management advice for interested farmers and was also given to students.

8 Impacts

8.1 Scientific impacts – now and in 5 years

Novel Tongan feed sources fed in diets could generate new information on how to improve digestibility of feed in pigs and poultry. In particular, there is potential for further research to understand the antimicrobial or growth promotion affects of including coconut oil in pig and poultry diets.

8.2 Capacity impacts – now and in 5 years

The development of personnel capacity in this project has improved the sustainability of activities beyond the life of financial support from ACIAR. Capacity building/training activities included the following.

The training of livestock officers from MAFFF and teachers and students at Tupou college in the operation of their demonstration grow-out facilities and how to feed pigs and poultry using local feed resources.

Training of farmers, staff at MAFFF and teachers and students at Tupou College on operation of mini-mills, feed formulation and mixing of diets.

The Tongan delegation who participated in the study tour to PNG and SI in October 2007 received training in the operation of mini mill equipment in Lae.

The project also made suggestions to improve the curriculum content of the Agriculture Diploma Program at the MOTEYS and Tupou College who train students in pig and poultry production.

There is continuing interest in Tonga on how greater amounts of local feed can be used in pig and poultry diets. The project has laid the foundation for a gradual increase in user of local feed in livestock diets.

8.3 Community impacts – now and in 5 years

The main concern in Tonga is the cost of imported meat and feed. We have demonstrated that cheaper feed resources are available and there is potential for expansion of the village livestock sector to reduce the reliance on imported meats. The cheaper feed could have a flow-on effect leading to an expansion of the smallholder egg and chicken meat and pork sectors. The Tongan partners consider the smallholder sector would make a significant contribution to the meat requirements of the community. Around 90% of the pork market is made up of the sale of suckers. Imported pork products make up the rest but this could be local pork if the cheap feeds can be developed. In the poultry sector, 80% of chicken meat and eggs are imported; the local market provides 20%. In addition, the Tongan Government would like to address the problem of roaming pigs. This could be overcome if cheap feed is available as villagers will be able to confine pigs and feed them low cost diets manufactured by mini mill operators.

8.3.1 Economic impacts

Imported pig and poultry feed costs range from 1250-1500 TOP\$/tonne depending on feed type. These costs make it virtually impossible to produce local pork and chicken meat that the community can afford. This has lead to a flood of cheap imports. If 10% of local feed could be used in pig and poultry rations to replace the imported feed this would save Tonga an estimated TOP\$5.75 million/annum in imports.

8.3.2 Social impacts

Four out of five households in Tonga keep livestock. These include cattle, pigs, horses, goats, chickens and ducks. In the pig industry, 13.6% of pigs are consumed by the family, 78.7% are given away and 7.7% are sold. In the poultry industry, 44.1% are consumed by the family, 53.5% are given away and 2.4% are sold. These figures reflect the importance of pigs and poultry for people to fulfil their social obligations to provide for feasts to celebrate first birthdays, weddings and Sunday faka'afes after church. The availability of cheap local feed will make it easier for Tongan families to meet their social obligations.

8.3.3 Environmental impacts

There are no anticipated changes to the environmental status of pig and poultry production in Tonga from this project. Current commercial farms sell manure for use as fertiliser in horticulture and smallholder gardens. The use of local feed sources in rations will not impact on the environment although more land may be utilised for growing of local crops which may have a negative impact on the environment. However, this is likely to be more than offset by the positive environmental impact from smallholders being able to confine their pigs because they can be fed cheaper local feed rather than having to let the pigs forage.

8.4 Communication and dissemination activities

The Tongan delegation attended the project inception workshop at NARI headquarters on 15 August 2007 for ACIAR project ASEM/2005/094 "Improving the profitability of village broiler production in PNG" and met colleagues from NARI, CLTC, Unitech, LDS, Salvation Army and Ok Tedi.

A project inception workshop and final review meetings were held at MAFFF involving all project partners and information exchanged on all aspects of the project.

Phil Glatz and Colin Cargill were interviewed for 15 minutes by Tonga TV on 18 October 2007. The interviewer asked questions about the reasons for the project, how the project was being implemented and the long-term benefits of using local feed resources to feed pigs and poultry. A 2-minute segment was screened on Tonga TV during the local news program.

9 Conclusions and recommendations

9.1 Conclusions

There are rich feed resources available for pigs and poultry in Tonga. These resources can be used efficiently if the proper processing and feeding techniques are applied. In this project, staff were trained to operate mini mills and conduct feeding trials for pig and poultry. Staff were able to demonstrate how diets can be prepared using mini and knowledge exchanged between MAFFF, Tupou College, MOTEYS and pig and poultry farmers. A mini-feed mill, comprising a flake mill, drier, hammer mill and mixer was set up on a commercial poultry farm and at Tupou College. The trial result for poultry showed that 30% dilution of a commercial layer diet resulted in similar egg production compared to a commercial diet. This shows there is the potential to use suitable local feed resources to reduce the cost of feeding a commercial imported diet. However, a feed made mainly from local resources resulted in poorer pig production compared to a commercial diet. This was due to the copra meal being spoiled during drying and another batch of copra meal is being made. Adequate processing of feed is important for efficient utilisation of different feed ingredients. The use of cheaper local feed could lead to an expansion of the smallholder egg and chicken meat and pork sectors, with these farmers making a significant contribution to the meat requirements of the country.

9.2 Recommendations

Given the limited time the project has been running, the project team has established a model feed milling facility in Tonga, prepared diets using local feeds and conducted feeding trials with pigs at Tupou College and poultry feeding trials on a commercial egg farm. Staff from MAFFF and from the farmers association travelled to SI and PNG and viewed pig and poultry feeding systems and inspected feed milling equipment which was subsequently established in Tonga. Students supported by the project assisted with feed manufacture and developed the design of pig and poultry housing systems suited to Tonga which has already seen the scale up of operational models from smallholder to semi commercial. Some of these students have subsequently been employed by MAFFF.

At the final review meeting of the ACIAR project partners a number of suggestions were made regarding the next step required to fully establish the livestock feed industry in Tonga. Currently Tonga imports \$20 million of its meat products which accounts for 15% of the total meat consumed. There is an urgent need to reduce the level of imports by at least \$10 million/year by producing more locally grown pork, chicken meat and eggs in Tonga. This will only be possible if the local feed manufacturing Industry is established to compete against the high costs of imported feed.

The ACIAR project has laid the foundation for achieving further development of the livestock industry and the Tongan Government, particularly through its agricultural development and training agencies (MAFFF and MOTEYS), has a high priority for supporting this development. Key areas include improving production efficiency through training current and future farmers in pig and poultry production and developing commercial and small scale feed manufacturing facilities that are compatible with crop production. The Tongan Government and a number of Aid donors are willing to provide capital to support these developments in the livestock industries in partnership with other agencies.

Continued development of the feed milling industries requires further research into available and potential crops to supply nutrients for locally produced sustainable and cost effective diets. For example, while maize is a potential source of pig and poultry feed, there are concerns that sufficient quantities could be supplied on a regular basis for a

large scale commercial feed industry. Alternatively the current project has demonstrated that smaller capacity mills may be more suited to the more diverse and small scale cropping system found in Tonga, where a range of crops can be supplied in smaller quantities on a seasonal basis.

Within the framework of a joint venture including the Tongan Government and a number of other aid donors further development is required of both large and small-scale commercial feed milling businesses (Fafanga Ma'alahi Mill) run in an alliance with commercial and small holder farmers. The venture could be supported by regional feed manufacturing training centres such as Tupou College on Tongatapu and Hango College on the smaller island of 'Eua, under the guidance of MOTEYS and MAFFF through the National Centre of Vocational Studies. The training of students in all aspects of livestock production and feed manufacturing will give them the skills to enter the livestock industry. In addition, attachment training in Australia for MAFFF and MOTEYS staff will be very effective in developing the professional skills required to develop the livestock industry in Tonga.

10 References

10.1 References cited in report

NRC (1994). Nutrient Requirements of Poultry. 9 Revised edition. National Research Council (U.S.), Subcommittee on Poultry. The National Academy of Science, Washington, D. C. USA.

NRC (1998). Nutrient Requirements of Swine. 9 Revised edition. National Research Council (U.S.), Subcommittee on Animal Nutrition. The National Academy of Science, Washington, D. C. USA.

Wilkinson, L., 1996. Systat 6.0 for Windows-Statistics. S P S S Inc., USA.

11 Appendixes

11.1 Appendix 1: Small-scale pig production: Background and models used in Vietnam and Indonesia

Husbandry systems for pigs

Aims are 1) to maximise efficiency through greater output of meat and the lowest cost of other inputs such as feed and other costs, 2) provide good welfare and 3) eliminate, control and prevent disease.

Housing for pigs

Aims are to provide an 1) optimal climate (warm dry environment, shelter from cold, rain and direct sun, relatively constant temperature and reduce extremes in temperature) 2) high quality food and water, 3) a safe place for sows to farrow and warm dry environment for piglets and 4) good animal welfare and security.

Requirements for Housing

Free from excess air movement especially important for younger pigs. Good ventilation; increased when it is warm outside to cool pigs and remove ammonia; reduce when it is cold outside to maintain warmth inside the house; wet area for eating and drinking / dry area for sleeping. Sufficient floor and air space (shed volume) for the number of pigs. Clean water supply and enough feeder space.

Why is housing important?

A good environment improves health and production – pigs grow faster.

Husbandry factors

1. Environmental factors include temperature control with good cross ventilation and “flushing” sheds with fresh air. Regular cleaning and disinfecting and dry floors for sleeping and before stocking. Fix leaking water pipes and drinkers. Roof material can be tiles but thatch is the best while iron rooves are the worst. These must be insulated.
2. Housing factors – the width of shed should be 10-12 m maximum for natural ventilation, with width of ridge vent being 10% of width of shed and height of ridge vent about 5% of width of shed. The side wall openings should be a minimum of 20% of the width of shed. There should be good cross ventilation.
3. Critical Factors
Effluent management requires a correct dunging pattern with no cold air at floor level and open dung slots. There should not be any wet floors and fix broken pipes.
4. Farrowing pens
Need two climates. 1) Sows – 18-22°C – shed temperature. Piglets and first few days need 28-30°C with a 1-2°C weekly decline until weaning. The method used to provide a micro climate for pigs is to use a creep box or sleeping box for piglets with a solid floor + 3 or 4 solid walls + solid cover + heat lamp for first week.
5. Weaning pens
Avoid fluctuations of more than 4°C in 24 hour period. In the first 2 weeks maintain 26-30°C and for the remainder: 22-28°C. The way to provide a good weaner

environment is to have 1) a covered warm dry sleeping area, 2) open dunging drinking and feeding area and 3) cover half of the pen with a solid board

6. Recommended shed temperatures

Growers; aim for 20-24°C with fluctuations < 6°C. Older pigs >18°C if fluctuations <6°C.

Dry sows and boars 18-24°C

1. Improving nutrition

Use foraging on high protein pasture and silage production; add fish and snails to diet.

Improving Protein Intake

Wamena #1 diet: 56% cooked sweet potato (SP) vines + 33% cooked SP roots + 11% cooked banana trunk + 0.5% salt

Wamena #2 diet: 33% cooked SP-vines + 22% cooked SP roots + 34% ensilaged SP tubers and vines + 11% cooked banana trunk

Wamena #3 diet: 20% raw SP roots + 9.9% raw SP vines + 60% corn + 10% sundeleka grass + 0.1% salt

Improving Protein Intake

Wamena #4 diet: 50% cooked SP roots + 30% cooked SP-vines + 20% cooked fish internal organs (gill etc)

Wamena #5 diet: 40% cooked SP roots + 30% cooked SP-vines + 10% ensilaged SP tubers and vines* + 20% rice bran

Wamena #6 diet: 33% cooked SP-vines + 22% cooked SP roots + 34% ensilaged SP tubers and vines + 11% cooked banana trunk + 1kg boiled snails

Feeding ensilaged SP roots and vines and cooked SP roots and vines

2. Management factors

Stocking rate (pigs/square metres), 50 kg pig needs >0.50 cubic metres

Stocking density (pigs/cubic metres), 50 kg pig needs >2.0 cubic metres

11.2 Appendix 2: Establishing and running pig feeding demonstration trials

Demonstration protocols

1. Breeding sow herd
2. Dry sow herd (weaning to farrowing)
3. Lactating sows (farrowing to weaning)
4. Growing or fattening herd
5. Weaning to sale (or slaughter)

Whole herd production

1. Breeding and growing herd

Measuring INPUTS

1. Inputs – feed

Main economic indicator

- Cost of feed / kg (or tonne)
- Amount feed used (kg) / kg meat produced
- Herd feed conversion efficiency (HFCE)
- The lower the HFCE the greater the profit

2. Inputs – labour

- Milling feed
- Feeding pigs
- Maintenance
- Cleaning
- Labour

3. Measuring outputs

- Breeding herd
- Dry sow herd (weaning to farrowing)
- Farrowing to farrowing interval (FtF)
- As FtF interval increases / profit drops

Number of non-productive days good economic indicator

1. Use FtF to assess sow feeding and production model for economic efficiency
 - Breeding herd
 - Farrowing sows (farrowing to weaning)
 - Main economic indicators
 - Pigs born/sow
 - Pigs born alive/sow
 - Pigs weaned/sow

- Pigs weaned/sow/year (whole herd – pigs sold/sow/year)

Other economic indicators

- Birth weight
- Weaning weight
- Growing herd
- Average daily gain (ADG)
- Weaning wt (A)
- Sale wt (B)
- Days weaning to sale (C)
- $ADG=(B-A)/C$
- Feed conversion ratio (FCR)
- Feed used from weaning to sale (D) including wastage
- $FCR=D/(B-A)$

Village model – existing low input system-involves feeding coconuts, manioke, sweet potato, scraps, foraging

Mini-mill model – medium input system-involves using formulated diet using locally sourced ingredients

Diets are based on cassava or corn + protein and minerals

Commercial imported diet – high input system

Village model

- Diet varies with availability
- Irregular feeding
- Pigs often underfed
- Low energy intake
- Protein deficient

Mini-mill model

- Formulated diet using local ingredients
- Improved nutritional balance
- Energy – manioke, corn
- Protein – fish, copra meal, meat meal, high protein pasture (fresh or dried)
- Vitamins and Minerals (local or commercial source)
- Medium inputs

Commercial imported diet

- Well balanced nutrient intake
- High energy and protein intake
- Adequate vitamin and minerals

- Diets formulated for age
- Weaner/grower/dry sow/lactating sow

On site demonstration

- Established piggery
- Two or three groups growing pigs (5+/group)
- Feed from weaning to sale
- Weigh pigs at weaning
- Weigh amount of feed daily (plus weigh backs)
- Weigh pigs at sale
- Sale price LESS cost of feed

11.3 Appendix 3: Demonstration protocols for establishing a poultry feeding trial

- Select sites where demonstrations will be conducted
- Choose a minimum of six pens (blocks of cages) to establish feeding trial
- Randomise the pens for allocation of animals to groups (current feeding system) and treatment group (new feeding system)
- Measure daily maximum and minimum temperatures and any observations on animals (health and behaviour)
- Allocate birds and pigs to cages or pen and weigh before starting trial to ensure weights are similar in each pen
- Record daily feed given and weekly feed residue
- Measure weekly weights of birds
- Trial can last for 6-8 weeks and repeated pending results
- Record of following data; feed in/feed residue sheet for each week; weekly body weight; max/min temperature and observations
- Developing cost of production models for scale up of poultry farms in Tonga

11.4 Appendix 4: Pig and poultry production models – Tonga

Outline of presentation by Fatuimoana Langilangi (MOTÉYS)

Background

The Kingdom of Tonga is an archipelago of 172 coral and volcanic islands. Only 36 islands inhabited with the islands spread over 360,000 km² with a total land area is 747 km². The total land area is divided into five major groups: Tongatapu, 'Eua, Ha'apai, Vava'u and the two Niua's. Mean annual temperature ranges from 23-28°C, mean annual rainfall is 1,700 mm and total population 101,000.

Importance of pig/poultry in Tonga

- Source of protein
- Production of manure to maintain and improve the fertility of the soil
- Jobs
- Social and cultural importance

Objectives of developing pig and poultry production

- Increase livestock production to cope with domestic demand
- Ensure wider job opportunities
- To provide better farm incomes to rural farmers
- To help maintain and take benefit of land resources still available in abundance
- Existing Models of pig and poultry production in Tonga

Models 1: Traditional/extensive

Pigs/poultry are allowed to scavenge. Majority of farmers raise 1-4 sows. They require limited hand feeding. Little shelter is provided and pigs are free to walk around the village.

Advantages of this system

This system is cheap and the farmers have little work to do. There are minimal provisions for shelter, reproduction and feed and water and no management skills are required.

Disadvantages

Slow growth due to energy and protein deficiency. Problems include internal and external parasites such as kidney worms and stomach worms, large round worms and mange mites. Pigs damage nearby cropping farm. Stealing of pigs and being killed by dogs is a concern. Pigs can also be injured by farmers during cropping. The pigs also create a hygiene problem in the villages rooting around structures and foul the environment with faeces and urine.

Model 2: Semi-intensive system

In this system sows and young pigs live in small pens with good houses, while dry sows and boars live in the paddocks. Pigs live in small pens/house and then go outside to graze pastures and crops.

Boars and sows with litters live in the house and the weaners and dry sows live in the paddocks.

Farmers use moveable pens to control pigs which are grazing pastures.

Model 3: Intensive system

Pigs/poultry are fully raised indoors. Farmers need considerable funds to establish and run an intensive pig/poultry unit. It is a full time job and good food and water and housing space (e.g. sow needs 1.3–1.6 m²) is required. Maintaining health of animals is important.

Advantages

- High production
- Disadvantages
- High cost
- High management skills
- Planning a pig and poultry enterprise

Anyone considering establishing a pig or poultry enterprise must consider the following:

1. Capital Investment
 - Money
 - Labour
 - Land
 - Stock
2. Production costs
 - Feed and water
 - Housing
 - Cleaning
 - Labour
 - Health improvement
 - Confinement
 - Pens/paddock
 - Market
 - Access
 - Methods of marketing

11.5 Appendix 5: Determining the cost of production of running a poultry farm

The following infrastructure and equipment need to be considered when setting up an egg farm:

- Land: site preparation; laying sheds; cages and fittings; egg room and store; cool room; egg washer and cart; feed cart; knapsack-spray; trailer-1 tonne, two wheel; station wagon; tools and sundries; disposal pit; tractor and access; equipment shed.

The following costs will be incurred when operating an egg farm:

- Electricity/light globes; hardgrit; shellgrit; egg wash powder; medication, cleaning, sanitation; packaging; petrol/fuel; accountancy fees; bank charges; phone/postage; council/water rates; repairs; vehicle registration; vehicle insurance; asset insurance; work and personal insurance and casual labour.
- Determining the cost of establishing a mini mill in Tonga:
- Capital: land; sheds; mini mill; flaker; hammer mill; mixer; pelleter; scales; dryer; vehicles; office equipment; capital set-up costs; labour; materials; fuel; fencing; concrete; operating costs; labour; manual labour; casual; foreman; office staff; managerial; repairs and maintenance; fuel; fuel depot cost; petrol.

11.6 Appendix 6: Travel report by Tongan Government and industry staff

Three livestock farmers and a government officer were able to undertake a study tour to Solomon Islands and Papua New Guinea (10-20 August 2008). The group included Christopher Mafi, Metotisi Vete, Lathu Vehikite from Industry and Otenili Pifeleti from the Ministry of Agriculture and Food, Forest and Fisheries. They spent two days in Solomon Islands and six days in Papua New Guinea.

Objectives of the study tour

The study tour was undertaken to train the group about profitable pig and poultry feeding systems developed in Solomon Islands and Papua New Guinea. They also learnt about the operation of mini mills and received instruction on how to feed pig and poultry using the local available resources.

The objectives of the pig and poultry project were:

1. To develop potential suitable feeding systems for pigs and poultry in Tonga based on information and examples in Papua New Guinea and Solomon Islands.
2. To demonstrate on-station to farmers the most profitable feeding systems that incorporate local feeds.
3. To promote the wide-spread adoption of profitable feeding systems for pigs and poultry.

During the time the delegation were at NARI in Papua New Guinea, they were able to observe research undertaken on sheep, duck, pigs, rabbit and chicken and methods to make silage from sweet potato to feed the pigs. The delegation also inspected research being undertaken on feeding of village chickens in Solomon Islands.

They observed the feeding of layers (local chicken) with locally available ingredients, including corn, fresh cassava, coconut-graded fresh, ripe pawpaw, mung-bean, fish meal lime, salt. The trials were being conducted at Solomon Islands College of High Education to encourage students to raise chickens when they returned home to their village.

Papua New Guinea

At NARI, the delegation group obtained information on diets being formulated for chickens, ducks, goats and pigs. The delegation attended an ACIAR poultry project inception meeting where most of the stakeholders discussed and shared their ideas about the ACIAR projects in Papua New Guinea.

Below are different rations the delegation obtained for pig formulated by NARI.

Pig Ration 1							
This is a simple ration used at NARI for both young and mature pigs							
Ingredient	Ratio n mix	Crude	Crude	Ash	Crude	Energy	Cost
	(%)	Protein (%)	Fibre (%)	(%)	Fat (%)	(Kj/kg)	(K/kg)
Copra meal	20	4.16	3.5	1.4	1.26	3.46	1.25
Wheat							
Millrun	54	8.21	5.4	2.92	2.21	8.75	0.2
Pig							
Concentrate	10	4	0	0	0	0	2.89
Waste							
Noodles	15	1.76	0	0.08	0.18	2.42	0.29

Salt	1	0	0	0	0	0	2
Total	100	18.12	8.9	4.39	3.65	14.62	
Pig Ration 2							
Ingredient	Ratio n mix	Crude	Crude	Ash	Crude	Energy	Cost
	(%)	Protein (%)	Fibre (%)	(%)	Fat (%)	(Kj/kg)	(K/kg)
Copra meal	40	8.32	7	2.8	2.52	6.92	1.25
Wheat							
Millrun	34	5.17	3.4	1.84	1.39	5.51	0.2
Fishmeal	10	5.9	0.1	2.19	0.69	1.75	1.67
Waste							
Noodles	15	1.76	0	0.08	0.18	2.42	0.29
Salt	1	0	0	0	0	0	2
Total	100	21.14	10.5	6.9	4.78	16.59	
Pig Ration 3							
Ingredients	Ratio n	Crude	Crude	Ash	Crude	Energy	Cost
	mix (%)	Protein (%)	Fibre (%)	(%)	Fat (%)	(KJ/kg)	(K/kg)
Cassava							
Meal	25	0.53	0	0.55	0.13	3.68	0.57
Sweet							
Potato	29	1.22	0	1.84	0.38	8.05	0.5
Pig							
Concentrate	16	6.4	0	0	0	0	2.89
Waste							
Noodles	40	4.68	0	0.08	0.18	2.42	0.29
Salt	1	0	0	0	0	0	2
Total	111	12.82	0	2.46	0.68	14.14	

The ingredients for the pig and chicken diets are produced locally and poultry products are much cheaper than in Tonga.

Project Support Services Limited (PSS Ltd)

The delegation visited PSS Ltd which distributes feed milling equipment throughout the South Pacific and Papua New Guinea. The Tongan delegation was particularly keen on buying a flake mill, drier and hammer mill to utilise the large amounts of cassava produced locally in Tonga.

Recommendations

At the end of the tour the Tonga delegation resolved to use ACIAR funds from the project install a mill on a commercial farm and involve all interested farmers.

11.7 Appendix 7: Pig pen construction as a nursery and model for sustainable development

Applicant: Fine Pese

Title: Student

Section/Department: National Centre for Vocational Studies

Address: Puke, Tongatapu

Phone: 76 745

Fax: N/A

E-mail: pesenurseries@gmail.com

Project background

The Kingdom of Tonga consists of 171 islands divided into four major island groups, the southern group (Tongatapu and 'Eua), the central group (Ha'apai), the northern group (Vava'u) and the far northern group (Niua's).

Our natural resources (although slowly fading) is still one of our most prized possession. As a small island developing state, there is an urgent need to promote sustainable development. By this communities reap the benefits of nature conservation (such as income and good health) and have as little impact on the environment as possible.

Pigs have a cultural significance to Tongans. They have been used as offerings at weddings, funerals, royal celebrations, family functions and more even before Captain Cook's excursions to the Friendly Isles. They were also indicative of one's wealth!

Today, a large amount of subsistence piggeries have been established. With the increase in population size the demand for pigs has increased. The demand for pigs has emerged because more reasons for celebrations have arisen. This includes engagements, bridal and baby showers, Halloween, Valentine's Day etc.

Inflation has recently hit hard and yet people are still willing to pay money for pigs raised in piggeries. So the question is – what can I do to generate income for myself yet cater to others' needs with regards to pig farming?

This proposed project acts on the saying "think big, act small". The community will have access to cheaper pigs that will be raised in environmentally sound conditions. The project shall start on a small scale then build on from here.

Project budget and total amount requested

Total budget = 4,500.00 (in Tongan Pa'anga (TOP))

Amount requested = 5,000.00(TOP)*

Other sources of funding (cash or in kind) = Nil

*An overestimate for unforeseen expenses such as inflation of materials.

Project duration

12 months

Responsibility and management

All activities, data reporting and financial management will be solely managed by me, the principal applicant – Fine Pese. Contact details have been given.

Project description

A 6 m x 6 m pig pen is to be built on the residential compound. This would require laborious work in terms of construction. Existing and/or stray piglets will be recruited into the pen and raised. Contracts will be drafted and signed by successful contractor(s).

Nutrition will be in the form of organic waste and kitchen scrap. Chemical-containing feed will not be allowed unless unforeseen circumstances arise. Monitoring of health is imminent and would require assistance from the Department of Environment.

Project objectives

This proposed small-scale project aims to:

1. Raise pigs in an environmentally sound manner
2. Be used as a model for future pig farm establishment
3. Provide for unforeseen occasions
4. Generate income.

Work plan and evaluation plan

Activities	Duration (week)	Performance Indicators	Costing (TOP)	Resources Required
1. Hire contractor(s)	2	- Accredited contractor(s) employed	300.00	- Transportation - Contractor(s)
2. Draft contractor(s)	3	- Legally binding contractor(s) in place	100.00	- Transportation - Legal adviser (pro bono)
3. Construct pig pen	4	- Establishment of pig pen	3,500.00	- Materials (invoices attached) - Transportation
4. Assess pen	1	- Environmentally sound pig pen - Approval from Environment Department	100.00	- Individual time - Environment Department Officer
5. Recruit pigs	1	- Number of pigs recruited	-	Individual time
6. Monitor health and wellbeing of pigs	12	- Number and size of pigs	500.00	- Individual time - Environment Department Officer
TOTAL			4,500.00	

Small-scale piggery project for training purposes by Simote Moala

Objectives

- To strengthen the practical skills of students and encourage pig farming
- To set up a Trial Research Unit to promote food security and income generation for diploma students
- For students who trained at the Community Development and Training Centre of the Ministry of Education to take part in a practical training unit, increasing awareness of pig breeding and ensuring a sustainable project that benefits all students

Project goal

The goal of this venture is for students to be familiarised with pig husbandry in order to set up their own piggery at the close of their formal schooling

Piggery location

The piggery will be established and located in Nuku'alofa or in another central district of Tongatapu to be accessible to the project manager.

The piggery location also needs to be accessible to students during regular working hours.

Location should also be close to feed and water supply sources.

Background

It is important for any training program, especially the diploma in Agriculture Training Program, to have its own Practical Training Unit for students. Students are able to substantially improve their practical skills and knowledge when given the opportunity to learn in a hands-on environment. Currently, the CDTC offers nothing for students to gain this type of practical training. It is critical that a program is developed in order to ensure that student's graduations from these programs are equipped with relevant skills that translate into real world activities. By establishing a piggery training unit will be able to adequately prepare students with hands-on knowledge.

Project description

A small piggery unit of roughly 10 x 20 feet that contain two sows and one boar. The pen will be divided into four smaller consisting of:

- Boar pen
- Farrowing pen
- Weaned pen
- Breeding pen

The building materials can consist of some previously used items, such as roofing iron or local timber.

Materials for Construction

- Bricks
- Cement
- Coconut timber
- Nails
- Sand and gravel
- Corrugated roofing iron (can be previously used)
- Miscellaneous

Project Inputs

There is sufficient land for the establishment of the piggery, voluntarily provided by one of the students and a private land owner. The size of the land area is approximately 200-240 square feet. The agreement allows for the student to visit and work at the piggery.

Students are responsible for labour and providing pig feed using local products, ensuring the pigs are well fed.

Project Output

Students gain practical skills on pig farming and maintenance.

Revenue from the sale of resulting piglets can be used for replacement of stock and feed, contributing to the sustainability of the project.

Cull sows can be sold and funds can be used in a revolving account.

11.8 Appendix 8: The diet fact sheets

