Australian Government

Australian Centre for International Agricultural Research

Final report

project	**Evaluating strategies to improve calf survival in West Timor villages**
project number	LPS/2006/005
date published	July 2011
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final report number	FR2011-20
ISBN	978 1 921738 99 9
published by	ACIAR GPO Box 1571 Canberra ACT 2601 Australia

Contents

1 Acknowledgments

This project has been implemented entirely on farm. Therefore, first and foremost, we wish to acknowledge the assistance given by farmers. They have mustered their animals when required, fed the animals, collected data, and assisted in many other ways.

This project has involved a lot of field work, including gathering, processing, storing of feed supplies, working with farmers, farmer groups, and district officials. We would like to thank the field staff for their hard work in implementing this project.

We would also like to thank the University of Nusa Cendana, the Rektor, Professor Frans Umbu Datta, his staff for their assistance and support in implementing this project.

The support and assistance of local and state government officials is also gratefully acknowledged.

The Australian partner for this project was the school of Animal Studies, The University of Queensland, and we wish to thank the administration the School of Animal Studies for their support.

2 Executive summary

This project addresses a single, identifiable, fixable issue; that is the high calf mortality in some herds in East Nusa Tenggara Province, Indonesia. However, the successful application and demonstration of this technology in the field has had impacts that have been far reaching and beyond the expectations of the original project. There have been significant impacts on the farmers involved, rural communities, the research team, and particularly government and official bodies.

This project commenced in January 2007 as a two year project. It was extended for a further 2 years in January 2009. The project ended on 31st December 2010, and a summary of the first three years of the project is on the ACIAR website. This report will make reference to the whole 4 years of the project, but particular focus will be given to the results of 2010, and possible future work that could be beneficial to the rural community of Eastern Indonesia. The milestones in section 6 will refer to the 2 years on the extension only (2009 and 2010).

The total numbers of calves supplemented were 256, 242, 173, and 275 for the years 2007, 2008, 2009, and 2010 respectively (giving a grand total of 948 cow calf pairs).

Overall achievement of project objectives.

	Objectives of original project	**Comments on achievement**
1	To evaluate on-farm the effects of confinement and supplementation level on the survival and growth of calves.	This objective has been fully achieved. However, the benefit of supplementation varied with seasonal conditions.
2	To assess the acceptability of this strategy by participating farmers.	This objective has been fully achieved. Farmers needed a lot of support in the first few months of calf supplementation, but once the results became evident, most farmers supported the technology enthusiastically.

	Objectives of extension	**Comments on achievement**
1	To measure the effects of early supplementation of calves on their long term growth and productivity.	This objective has been difficult to fully achieve as many of the supplemented calves were sold early since they were much larger than normal calves. However, this in itself was an achievement as it contributed to the farmers income.
2	To measure the effects of early supplementation of calves on the economic social benefits to farmers.	Supplemented male calves were sold earlier and for a higher price than non supplemented calves. The full impact of supplementation of female calves will not be realized until they have been in the breeding herd for some time. It is probable that supplemented female calves will reach reproductive age (size) earlier than non supplemented calves, and so may produce an extra calf in their breeding life.

3	To facilitate the commercial adoption of the technology developed and evaluated in the original project.	This aspect was fully implemented in the Oefafi village cooperative. However, the experience was mixed when other parties were involved.

3 Background

The Province of Nusa Tenggara Timur (NTT) is one of the poorest regions of Indonesia. The export of live cattle to Java has considerable income generating potential for NTT farmers because the demand for live beef cattle in Java far outstrips supply. However, the combined effects of a low reproduction rate and decreasing body size have meant that NTT cattle producers have not been able to take full advantage of this lucrative live cattle export market. The original project addressed one component of the low reproductive rate; that is high calf mortality (averaging about 30%).

Phase 1 (2007 – 2009) of this project successfully accomplished the following objectives:

1) To evaluate on-farm the effects of temporary confinement (8.00 - 17.00 h) and supplementation level on the survival and growth of calves, and

2) To assess the acceptability of this strategy by participating farmers.

Supplementing calves at 2% (or 3%) of body weight between 1 and 6 months of age reduced calf mortality to less than 1% and increased calf growth rate (average daily gain) from 0.09 kg/d (control) to 0.18kg/d (supplemented). At the end of the first growth season, control calves weighed 36.5kg and supplemented calves weighed 75.2kg.

Farmers varied in their acceptance of the technology. Some withdrew because they were not prepared to commit the required time, but most persevered and were very pleased with the results.

The aim of phase 2 of this project (the extension, 2008 – 2010) was to maximise the benefit to the rural community of the technology developed in phase 1 of the original project.

The objectives of the extension were:

1) To measure the effects of early supplementation of calves on their long term growth and productivity.

2) To measure the effects of early supplementation of calves on the economic social benefits to farmers.

3) To facilitate the commercial adoption of the technology developed and evaluated in the original project.

There were 2 parts to the extension.

Part A (objectives 1 and 2) of the extension of the project utilised the 2 cohorts of calf-cow pairs produced in the first phase of the project (2007 and 2008). No supplement or treatment was given to these experimental animals, but valuable information was gained by monitoring the calf-cow pairs as the calves grew up and were eventually sold, died, or entered herds as replacements, and the cows continued production in the breeding herd. Observations were biological (including growth, size, survival, and reproduction), economic (including sales, and costs of labour, feed, and infrastructure), and social.

Part B (objective 3). The methodology of the collecting, storing, mixing, and distributing the calf supplement was refined during the original project. However, the team effort by UNDANA staff was not a commercial operation, and was not sustainable long term. Therefore, it was proposed to use the extension to form a partnership with a semi commercial institution (or institutions) to handle the supply and distribution of the calf supplements. Calf supplement was delivered to farmers by the UNDANA team each 14 days in the original project. However, during the extension, farmers collected the supplement from 2 distribution depots. The UNDANA research team trained staff from the partner organisation(s) in the collection, storage, formulation, and administration of the supplement to calves. The role of the UNDANA research team changed to being a source

of advice and technical support, and to ensure that the supplementary ration satisfied quality criteria (17% crude protein), and was administered correctly (2% of calf body weight). A total of 173 and 275 calves were supplemented in the years 2009 and 2010 respectively. One farmer cooperative has saved some of the extra income from the supplemented calves, and will reinvest the money to supplement calves during the 2011 season. In this way the technology becomes self funding.

Data was collected during the monitoring of this process to evaluate the cost / benefit to farmers, and to continuously improve the technology and extension package. This data came principally from the reports farmers make each fortnight when they collect the calf rations, but the research team supplemented this with farmer interviews and direct observations of animals during strategic farm visits.

4 Objectives

The objectives of the extension were:

Part A

1. To measure the effects of early supplementation of calves on their long term growth and productivity.

2. To measure the effects of early supplementation of calves on the economic and social benefits to farmers.

These two objectives will be achieved by monitoring the 2 cohorts of calf-cow pairs produced in the original the project (2007 and 2008). No supplement or treatment was given to these experimental animals.

Part B

3. To facilitate the commercial adoption of the technology developed and evaluated in the original project.

This objective was successfully implemented in one farmer cooperative (The Paku Nalim An Ana group based in the Oefafi village, Kupang Regency). However, an MOU was also signed with PUSKUD (village cooperative Centre), with a view to handing over the routine implementation of the technology. Although there was good cooperation between the ACIAR research team and the PUSKUD team, the full potential of this cooperation was not realized.

5 Methodology

This project was fully implemented on farm, and was therefore entirely dependent on the support, goodwill, and cooperation of farmers.

The technology is described by Jelantik (2008), and consisted of confining calves in pens during the day and feeding them a dry ration containing 17% protein at the rate of 2% body weight. The dams grazed extensively during the day, and were united with their calves for suckling at night. Calves were supplemented from one month of age until there was adequate pasture from the summer rain (usually when the calves were about 6 months old).

The initial phase was to make contact with farmers, and explain the objectives of the project and how the technology would be implemented. This phase utilised the existing relationships between farmers and Dr Jelantik built up through previous research work, as well as through farmer groups, and local government extension staff. After a number of meetings, some farmers signed on and agreed to take part in the project, while others withdrew.

The second phase was a preparation phase which involved the building of a suitable calf pen and some training.

After the calves were born and reached a month of age, the ration was delivered and calf supplementation commenced. This was a period that required intensive support by the research team. Rations were delivered every 14 days when calves were monitored (including body weighing). Over time, a relationship of trust developed between the cooperating farmers and the research team. Both parties learnt from each other.

Implementation was much easier in the second year if farmers repeated the supplementation.

In the first year, supplementation was only implemented in the Kupang regency. However, in the second and subsequent years, the project was extended to include farmers in the TTS (Timor Tengah Selatan) and TTU (Timor Tengah Utara) regencies. Each year, some new farmers joined the project. Farmers who had successfully implemented the technology in previous years worked with the ACIAR research team to help new farmers get started.

Two problems emerged in the first two years of the project:

a) The collection, storage and mixing of the special rations was undertaken entirely by the ACIAR research team. This was considered to be not sustainable long term.

b) As well, the intensive support of farmers by the ACIAR research team consumed a lot of resources.

To overcome these 2 problems, a feed mill was set up at Oefafi Village, and less comprehensive support was offered to farmers.

6 Achievements against activities and outputs/milestones

Objective 1: To measure the effects of early supplementation of calves on their long term growth and productivity

no.	activity	outputs/ milestones	completion date	comments
1.1	Identify cow / calf pairs from the 2007 and 2008 cohorts of the original study	Cow, calf pairs identified. Objective is 50 supplemented and 50 (2% 3% body wt) un-supplemented (control) pairs from each cohort	Year 2, month 9	Approximately half (150) of the required animals were identified with permanent electronic tags (rumen bolus). One problem that emerged was that supplemented calves reached selling weight 6 months early - so were lost to the project. The sale price is being included in the economic data.
1.2	Measure productivity and growth of animals (body weight and body size changes)	Mortality data, reproduction data, and growth data of experimental animals (body size and body weight)	Each third throughout the extension of the project	This data was collected as planned, although a number of animals have been sold.
1.3	Analyse and report productivity and growth data	Report / publication presented	Year 2, month 10	Some of this data has been analysed and presented in a publication (see Mullik et al 2010 in appendix)

PC = partner country, A = Australia

Objective 2: To measure the effects of early supplementation of calves on the economic and social benefits to farmers

no.	activity	outputs/ milestones	completion date	comments
2.1	Collect economic data on cattle sales	Month, age and sex when sold, size and weight when sold, sold by weight or per head, price obtained, marketing chain, sold direct to exporter or to fattening feedlot, sold for domestic or export use.	Each third month throughout the project.	This data has been collected as planned.
2.2	Collect data on socio economic impact of the project on farmers and their families.	Data socio economic impact of project on farmers and their families. How is increased income spent? Effect on health, education of children, housing, nutrition.	Data collected each third month throughout the extension	This data was collected as planned,

2.3	Analyse and report socio economic data	Report / publication presented	Year 2, month 10	Some of this data has been analysed and presented in a publication (see Sogen et al 2010 in appendix), but further analysis may be done in the future.

PC = partner country, A = Australia

Objective 3: To facilitate the commercial adoption of the technology developed and evaluated in the original project

No.	Activity	Outputs/ milestones	Completion date	Comments
3.1	Identify cooperating parties who will form partner-ships with the project	Partners are identified.	Y1, M 8	This was achieved as planned.
3.2	Develop a memorandum of understanding (MOU) with each partner	MOU signed between project and cooperating parties	Y2, M 10	A MOU has been signed with PUSKUD (Pusat Koperasi Unit Desa, or Central Village cooperative unit), a local cooperative in 2010. However, a more productive relationship has been formed with the farmer cooperative at Oefafi village.
3.3	Train staff from these partners in the methodology used	Staff trained	Y2, M5	Initially, PUSKUD staff did accompany ACIAR project staff in the obtaining, mixing, and distribution of calf feed. However, this involvement was intermittent. On the other hand, farmers and their families from local village cooperatives (especially Oefafi village) did actively participate in the whole project.
3.4	Work with partners to set up 2 or more calf ration distribution centres	Distribution centres established	Y2, M5	Two distribution centres were established as planned.
3.5	Recruit farmers who will participate in this part of the extension	Farmers owning 300 cow calf pairs recruited each year (approximately 40 - 50 farmers each year) .	Y2, M6,	173 cow-calf pairs were recruited in the 2009 season, and 275 were recruited in the 2010 year. In 2009, some new farmers were hesitant at first to come to the depots and collect the rations. The protocol was revised in 2010 to give farmers more help in the first month, visiting them 3 times.
3.6	Develop a reporting system for farmers. Refine the extension package.	Reporting system developed. Simplified extension package published.	Y2, M5	This was achieved and used during the 2009 and 2010 seasons.
3.7	Collect data on the sources and real costs of supplementary rations	Collection of data on ration costs	Y2, M6	Data was collected as planned.
3.8	Perform a cost benefit analysis on the benefit of supplementing calves	Costs and benefits calculated.	Y2, M12	This has been achieved, and the results are shown in the economic impact section.

3.9	Collect data from participating farmers to determine what factors facilitate or hinder technology transfer and adoption	Data concerning perception of farmers.	Y2, M8	This data was collected at the end of the 2009 calving season (May - August), and was repeated during the 2010 calving season.
3.10	Analyse and report data on supplementary feeding calves	Report / publication presented	Year 2, month 10	Some of the data from the 2009 calving season has been published. Analysis of the 2010 has been done, but further work could be done.

PC = partner country, A = Australia

7 Key results and discussion

Supplementary feeding of calves during daylight hours between 1 and 6 months of age reduced normal calf mortality from about 30% to less than 3% and increased growth rate by up to 100% (compared to non supplemented control calves). These results were consistent over the first 3 years of the project, but the extraordinarily high rainfall during 2010 may have eroded some of the advantages of supplementation in that year.

Initially, it was expected that the compensatory growth would occur in the non supplemented calves during the following wet season when feed supply was plentiful. However, this did not occur, as can be seen from the 2007/2008 results (see figure 1).

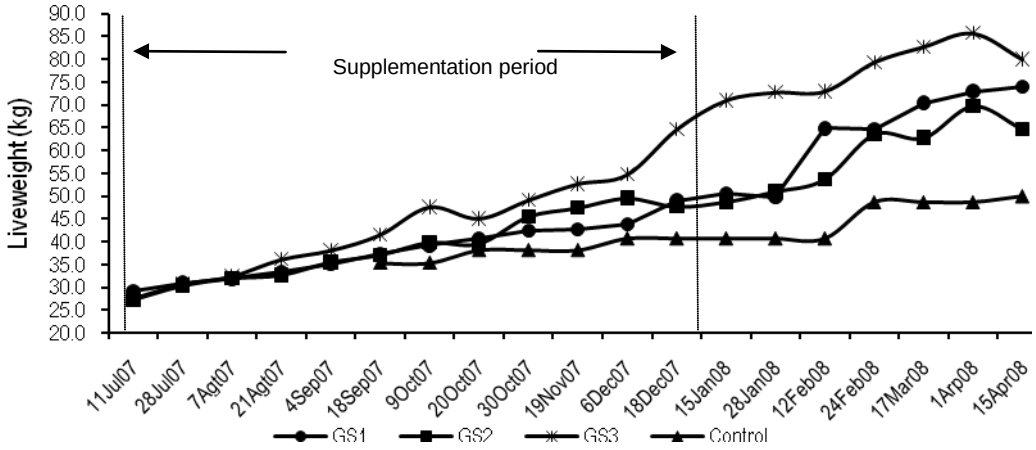

Figure 1. Calves supplemented from the age of 1 to 6 months at the rate 1% (GS1), 2% (GS2) and 3% (GS3) of body weight.

This increase in body weight was also reflected in an increase in body size. Even though calves were supplemented for only about 5 months, this short period of supplementation appears to increase adult body size.

Not only did more calves survive from the supplemented group (98% vs approximately 70% in controls), but the supplemented calves were more valuable as yearlings ($AUD 260 for supplemented calves vs $AUD 200 for control calves).

8 Impacts

8.1 Scientific impacts – now and in 5 years

The major scientific impact has been to demonstrate to stake holders that the most important problems limiting beef production in West Timor (lack of feeder cattle for fattening and small adult body size) can be economically overcome by supplementing calves from 1 to 6 months of age.

There are 2 scientific theories that account for the small (and reducing) body size of cattle in West Timor;

a) negative genetic selection (the largest animals are exported), and

b) lack of nutrition (especially during the first year).

Results of this project indicate that most of the reduction in body size is due to severe undernutrition in the first 6 months, and this can be alleviated through supplementing calves. The scientific focus therefore will be on improving growth of cattle in the first year. This will lead to a more rapid increase in productivity, and a better return on investment (than genetic selection, although genetic selection should also be implemented).

The cooperating farmers in this project were encouraged to sell the extra calves that had been saved through supplementation when they were weaned (except those needed for replacements). This was to prevent an unsustainable build up of numbers and to generate extra income for farmers. The long term scientific impact will be a focus on efficiency of the whole herd. This may involve selling older cows and even reducing the overall herd size. What is the optimum age profile of the breeding herd? What is the ideal age to sell old cows? How can these cast for age cows be profitably sold. Preliminary research by Dr Jelantik (pers com) indicates that these old cows may be profitably fattened and sold for meat, thus producing another income stream for farmers.

SCIENTIFIC IMPACT OF PROJECT ACCORDING TO FARMER'S PERCEPTION

A survey of farmer's perception of supplementing calves was conducted between 2008 and 2010. This survey consisted of the following 3 major parts:

1. Perceptions of the appropriateness of form, amount, and composition of supplement
2. Perceptions on the beneficial effects of supplement to calves and cows
3. Perception on the commercial use of the supplement

Result of Survey of Farmer Perception 2008-2010

1. Most farmer agreed that the form, amount, feed composition of the supplement was appropriate: 100% farmers agree that the supplement was appropriate to calves, 61% farmers agree that the raw materials of supplement were easy to find, 100% of farmers agree to the ammount of supplement that was gived by farmers (2%), but jonly 18% farmers agreed that they could make the supplement themselves.
2. Farmer's perception of the effect of supplement showed: 100% farmers agree that the supplement was beneficial to calves, 97% agree that the supplement reduced the calf mortality rate, 81% agree that the supplement increased calves sale value, and 97% farmers agree that supplemented calves were ready for sale younger. Most (97%) of farmers agree that supplementation of calves caused cows to cycle

earlier and 92% of farmers agreed that supplementation of calves increased the birth rate in next year.

3. Based on the results of supplementing calves, 100% farmers indicated they would pay for the supplement themselves if the program loaned them first and will be payback after sale the cattle

Based on the perception of farmers, the future scientific impacts will probably include:

1. Technically, the supplementation technology is now ready for wide commercial use.
2. When the supplement is used by farmers, productivity of Bali cattle will be increased which will result in increased farmer income.
3. As adoption rate increases commercially, it will induce changes to the animal feed industries. This will benefit all farmers.

8.2 Capacity impacts – now and in 5 years

This project has led to an increased capacity of the research team, and participating farmers.

The research team has gained in the capacity to;

a) Identify problems,

b) Be more confident in their teaching as well as to conduct presentation to stakeholders (since they are speaking from personal experience)

c) Data collection and analysis,

d) paper writing and English,

e) experimental design,

f) Communication with farmers (listening and gaining trust),

g) Work with stake holders and other funding bodies increase the application and impact of the technology developed in this project.

g) Ability to train others, and

h) In the use of information technology.

The project has had a considerable impact on the research team. Three Junior scientists have gained scholarships as follows:

a) Johanis Jermias has gained a Ford Foundation Scholarship and is studying in the Netherlands.

b) Cardial Leo Penu has been granted a John Allwright Scholarship and will go to James Cook University in June 2011

c) Immanuel Benu has gained a John Allwright and will go to James Cook University in 2012.

Involvement in this ACIAR project has provided an opportunity for three academic staff to gain sufficient publications to apply for a professorship. They are:

a) Professor Henni Belli

b) Dr Gusti Jelantik, and

c) Dr Marthen Mullik

Participating farmers have gained in the capacity to;

a) Trust technical support and be more open to new ideas,

b) Evaluate the results of changed management practices, and

c) Adopt a more professional / businesslike approach to raising cattle.

d) produce proposals for development of their business.

Farmers who have adopted the calf supplementation technology have enjoyed the benefit of the extra income. They will be reluctant to go back to the way things were before the project. Some farmers will have learnt the general lesson that a small increase in input may result in considerable benefits, and they may be willing to try improving other aspects of agricultural production. It is hoped this application of technology will continue, even without external support.

8.3 Community impacts – now and in 5 years

The community impacts are related to the length of time a village (cattle group) has been involved with the project, and the closeness of the association between the community and the research team. In the case of the cattle group PAKU NALIM AN ANA in Oefafi village, Kupang regency of West Timor, community impacts have included the following aspects:

a) Use of the hammer mill and other ACIAR funded equipment to manufacture calf rations for sale to other farmers,

b) The use of manure waste and Siam weed (*Chromolaena odorata*) to produce organic compost for sale to the general public.

c) The implementation of the project has used local groups of farmers. This has enhanced the ability of groups to work together, and has increased the capacity of the group to adopt new income generating ventures.

The extra income has enabled some participating farmers to send their children to school, or tertiary education in some cases (see appendix 2 – a success story).

The long term impact on participating groups is a change in their attitude to cattle production. They have a more business approach to cattle raising, and have the confidence to implement appropriate technology.

8.3.1 Economic impacts

Marketing and Economic Impact

The number of cattle sold per farmer in 2009 ranged from 1 to 5 head, with an average of 3.25 head. Most of the cattle (84.6%) sold were males, and were aged from 7 to 12 months (average 9.1 months) at the time of sale. The main destination of cattle sold was for fattening, while females were used for herd replacements. There was a strong linkage between the breeding and fattening components of the beef production chain.

In most areas of West Timor, the lack of cattle weighing scales at the farmer level means that transactions are based on estimated weight and appearance of animals rather than

objective measurements. Respondent farmers indicated that applied especially to the marketing of weaner cattle which weighed between 68kg and 135 kg (average 80.0 kg) at time of sale. There is a need for knowledge and experience for both farmers and traders so that cattle can be sold for a fair price, based on accepted objective criteria.

Under the present pricing system, the selling price does not always reflect the quality of cattle, since the common basis for price (body weight) is not always used. The average price received for the weaner cattle was IDR 2,159,091 ($277 AUD), with a range from IDR 1,500,000 to IDR 3,750,00 ($192 to $482 AUD). Sales occurred throughout the year, but the majority took place in October, December, and August.

Money received from sales of animals was utilized according to need as follows: children's education (23.5%), housing (23.5%), family health (11.8%), cultural activities such as marriage (35.3%), and debt repayment 5.9%. Money from cattle sales is not reinvested in cattle or used for savings in the form of cash in the bank. Farmers sell animals when money is needed; cattle are used as a "living bank"

Livestock sales transactions between farmers and middlemen occur on the farm where animals are bred. The middlemen traders pay for transport and other marketing costs as well as the cost of risk. However, these practices put the farmer in a weak bargaining position, especially if the farmer is in urgent need of cash. This situation may be overcome by better knowledge and understanding on the part of farmers so they can more accurately estimate the value of their sale animals using objective criteria.

Investment opportunities

Recently, the Indonesian Government provided a one of grant of 750 million IDR (AUD $80,645) to the PAKU NALIM AN ANA farmer cooperative. This money was used to purchase 160 breeding cows. However, this money could have been used to supplement 1,600 calves. The two scenarios are compared in table 1 below. Purchasing cows is not increasing the overall cattle population or production; it is moving animals from one place to another. However, using the same money to supplement young calves could potentially produce an extra 371 animals.

Table 1. COMPARISON OF PURCHASING BREEDING COWS WITH SUPPLEMENTING YOUNG CALVES

Row	ASSUMPTIONS			
	INITIAL GRANT (IDR) (One off)			750,000,000
	EXCHANGE RATE (IDR/$AUD)			9,300
a	$AUD EQUIVELANT			$80,645.16
b	PREGNANCY / CALVING RATE (%)			80
	SURVIVAL RATE OF CALVES TO WEANING (100 - MORTALITY) (%)			
c	* NON SUPPLEMENTED (25% mortality)			75
d	* SUPPLEMENTED (2% mortality)			98
	VALUE OF CALVES AT WEANING			
e	* NON SUPPLEMENTED			$200.00
f	* SUPPLEMENTED			$260.00
g	COST OF FEEDING A CALF FROM 1 TO 6 MONTHS			$50.00

PURCHASE BREEDING COWS SCENARIO (FIRST YEAR ONLY)

h	NUMBER OF COWS PURCHASED ($500) (a/$500)			160
i	CALVES WEANED (h x b/100 x c/100)	160	0.6	96
j	**VALUE OF CALVES WEANED (i x e)**	96	$200.00	**$19,200.00**
k	**VALUE OF CALVES (MALES) SOLD** *(females used as replacements)* (j/2)			**$9,600.00**

SUPPLEMENTING CALVES SCENARIO (FIRST YEAR ONLY)

l	NUMBER OF CALVES THAT COULD HAVE BEEN SUPPLEMENTED (a/g)	$80,645	$50.00	1,613
	OF THESE CALVES, THOSE SURVIVING TO WEANING			
m	* NON SUPPLEMENTED (l x c/100)	1,613	0.75	1210
n	* SUPPLEMENTED (l x d/100)	1,613	0.98	1581
o	EXTRA CALVES DUE TO SUPPLEMENT (n - m)			371
	VALUE AT WEANING OF THESE CALVES			
p	* NON SUPPLEMENTED (e x m)	$200.00	1210	$241,935
q	* SUPPLEMENTED (f x n)	$260.00	1581	$410,968
r	EXTRA VALUE OF CALVES AT WEANING DUE TO SUPPLEMENT (q - p)			$169,032
s	**EXTRA VALUE OF MALE CALVES SOLD AS WEANERS** *(females used as replacements)* (r/2)	$169,032	2	**$84,516**

Notes:

*** Rows b, c, d, e, g and f.** These are estimates based on project results and reported findings

Rows k and s. It is not permitted to fatten young females for meat - but they can be sold as replacement breeders

8.3.2 Social impacts

The cattle groups are located within close knit communities. All members of the community (women, men, and children) have participated in or observed the implementation of the project. The implementation of the project has facilitated the interaction between the ACIAR team members and farmers (including family members). Socially, village members have become more confident and outward looking through this contact with the research team. In some cases this contact has raised the enthusiasm of children for education. The social prestige of some farmer groups has been enhanced through their hosting training sessions for other farmer groups.

Rural communities that have been involved in the project have been changed. It is hoped that this changed attitude to cattle production will reduce the trend of young people migrating to the city; that they will remain in the rural area because it is a better place to live.

8.3.3 Environmental impacts

The environmental impacts of this project are minimal. Cattle / calf pens enable the concentration of animal faeces which are more readily collected for making compost and fertilizer. One village makes and sells an organic compost fertilizer from cattle faeces and chromolena weed. Reducing calf mortality and increasing growth will potentially increase productivity and income from the same number of animals (or maintain productivity with less animals). In addition, calves were sold earlier i.e. 6 mo as compared to 12 mo in the unsupplemented group. This will tend to reduce grazing pressure and thus minimize land degradation.

8.4 Communication and dissemination activities

At the local level, project staff have worked with the Department of Animal Husbandry staff to identify cattle groups. The technology has then been discussed with these local farmer groups. In some cases, farmers who have participated in the past have explained to new farmers how the technology works, and what the costs and benefits are.

At the provincial level, a number of training courses have been run at Oefafi village, which has functioned as an informal training centre. Farmers from Flores and other areas have undertaken training at Oefafi.

Students have also received information about the technology through practicals.

A field day / exhibition was held at Oefafi on 28/4/2010. Some 400 participants attended. They saw displays of the project results, and shared experience with farmers who had collaborated with the project (see appendix 6).

The impact of the technology developed by the project was explained to decision makers such as government officials, business managers, bankers, teachers, lecturers, and community leaders.

Public media was also used (newspaper articles, TV) to disseminate project results.

Nationally and internationally, the results have been disseminated through national cattle seminars, meetings, and publication of books and articles (see publications in appendix).

A list of published papers is given in section 10.2

However, the following team members have published at least one paper through the project:

H.L. Belli,

P. Kune,

I. Benu

R.S. Copland

I.G.N. Jelantik

Mullik

C. Leo-Penu,

J. Jeremias and R. Copland (2008)

J.G. Sogen,

A.A. Nalle,

F. L. Benu,

9 Conclusions and recommendations

9.1 Conclusions

1. Calf mortality and small body size are major problems limiting the efficient production of beef cattle in NTT.
2. However, the scale and importance of these problems are closely related to climatic conditions (which mediate the feed supply) and the livestock production system.
3. These problems can be overcome by supplementing calves between the ages of 1 and 6 months.
4. A reduction in calf mortality must be part of an overall cattle management plan so that total cattle numbers are kept to sustainable levels and income for farmers is maximised.
5. Approximately 150,000 calves are born in NTT each year. As many as 50,000 of these may die, depending on the season. The application of the technology out lined in this project could prevent most of these calf deaths.
6. However, to scale up from supplementing 300 calves a year (as in this project) to over 100, 000 would require a large investment in:
    a. Capacity building and training of advisory staff
    b. Infrastructure such as fodder production, harvesting facilities, feed mill and mixing facilities, as well as storage and distribution capability.

9.2 Recommendations

1. The overall efficiency of the beef production system could be improved by allocating segments of the production chain to appropriate environmental conditions as follows:
    a. Breeding and production of young weaners feeder animals in the drier areas that are not suitable for other agricultural pursuits.
    b. Growing and fattening could take place in the flatter, more fertile areas where there may be access to agricultural by products or fodder trees.
2. The total sustainable cattle carrying capacity of each particular farm, area or district should be estimated. These may be tabulated as Livestock Units (LU – an animal weighing 250kg) as outlined in ACIAR monograph 19.
3. Once the total sustainable number of LUs have been estimated, then the herd profile can be optimised to maximise efficient productivity for each particular farm or district.
4. In particular, non productive or old animals (maybe over 10 years of age) should be removed from the breeding herd, fattened, and sold. This would generate another income steam for farmers.
5. Since the resources to supplement calves are not widely available, regions and districts with the highest calf mortality should be targeted first.
6. There is the potential to develop an investment package for investors. Investors could loan farmers $50 AUD per calf for supplementation, then share the profit when the calf is sold as a weaner.

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10.2 List of publications produced by project

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A paper presented the National Bali Cattle Seminar, held at the University of Mataram, October 2009 (these proceedings will be published).

Dr Gusti Jelantik, Dr Marthen Mullik, and Dr Richard Copland (2009) **Cara Praktis** - A book on supplementing Bali Cattle Calves, published by UNDANA UNIVERSITY PRESS, ISBN 978602 8547 11 6. 79 pages (see appendix 4).

PETUNJUK SUPLEMENTASI PADA PEDET (An advisory leaflet on supplementing calves)

11 Appendixes

11.1 Appendix 1:

Complete papers published from project (see separate file)

11.2 Appendix 2:

Extension manual (see separate file)