7.4.1.4 Economic analysis of production system interventions

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Summary

The primary aim of this economic analysis was to obtain quantitative information on the net economic impacts of management system interventions on the primary targets i.e. small farm households in eastern Indonesia. In addition, information on the possible financial and social impacts was also obtained. Finally, some scaling issues as well as broader policy and institutional issues were raised. This information is ultimately useful in making more informed future policy and research decisions. A full report has been submitted by Rutherford to ACIAR.

This economic analysis was conducted by constructing two partial budgeting (i.e. gross margin/cash flow) models related to two different production systems on two different islands and analysing their output in relation to the introduction of the strategic interventions described above. The analysis was partial in the sense that only direct cattle related activities were included and other activities that make up the whole farming system were excluded.

A range of options were examined based on detailed biological, social and economic data collected from each of the 4 villages. The summary options presented are:

a) Current system with sale of calf at 12 months.
b) New integrated management system adopted which involves bull supply, weaning at 6 months with 86% weaning rate and modest live weight gain (LWG) based on current village records and sale of calf at 6 months (New management).
c) New integrated management system as above but calf retained after weaning until 12 months old with current LWG.
d) New integrated management system as above with calf retained until 12 months but LWG increased by 50% with and without a 20% price increase.

Outcomes:

- Owner/manager is a better option than being a manager of other people's livestock.
- Introduction of new integrated management package is beneficial especially if calf is not sold until 12 months of age.
- Increasing the LWG of calf after weaning (6-12mths) is extremely beneficial.
- Holding and feeding a calf increases (or saves if wean and sell) labour requirements, mostly for men, by nine hours/month (or 25 percent during wet season) in Kelebuh and two hours/month (or 25 percent during dry season) in Boak.
- Results are sensitive to price and transaction costs which are sensitive to policy and supply and demand of animals. Policy and market analysis is needed.
- Economic benefit is high to retain calf with improved LWG to 12 months but barrier of need for cash and sale would be removed through credit access or some such scheme.

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7.4.1.4.1 Introduction

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7.4.1.4.2 Research method

This economic analysis was conducted by constructing two partial budgeting (i.e. gross margin/cash flow) models related to two different production systems on two different islands and analysing their output in relation to the introduction of the strategic interventions described above. The analysis was partial in the sense that only direct cattle related activities were included and other activities that make up the whole farming system were excluded. Typically, the contribution of large livestock to household income in mixed crop-livestock farming systems in Southeast Asia range from 25 to 40 percent – depending heavily on access to, and ownership of, resources such as arable land and livestock. Estimated annual incomes for Indonesian farmers range from $200 to $500 so relative changes in net returns and risks associated with changes in farming activities are usually significant.

By differentiating between economic and financial costs and returns, gross margin and cash flow estimates respectively were derived. The main difference between the two estimates is that the cash flow included only pecuniary costs/returns whereas the gross margin included pecuniary and non-pecuniary or 'opportunity' costs/returns of activities (i.e. the value of the next best opportunity for the use of a resource). For example, in financial terms, fodder can be gathered by household members from roadsides at no financial cost. However, it has an economic cost that can be estimated as the time spent collecting it by the wage rate of the next best alternative employment opportunity such as in another own farm activity or as hired labour on a neighbouring farm or non-farming activities. If there are no alternatives, the opportunity costs/benefits are zero and gross margin estimates are equivalent to cash flow estimates. The two estimates complement each other as the cash flow indicates the financial information

farmers use when deciding whether or not to undertake particular activities (although it overestimates the benefits where opportunity costs are relevant) whereas the gross margin indicates other information (such as labour requirements) useful in making decisions. Another simpler way to include labour considerations is to analyse only the total time involved rather than estimating its value.

In addition, by specifically considering the gender and age of the labour used in each activity and in which season, another estimate of the total time, and thus the value of the labour input, were obtained. This provided vital information that can be used to indicate some of the social impacts of the different production system scenarios. A basic model was developed in a multidisciplinary way first (and later extended) which significantly adds to the realism and the predictive power of the model while complementing the other outcomes of the project and vice versa.

7.4.1.4.2.1 ***Data and assumptions***

To analyse the impacts of the strategic interventions, the primary unit chosen at the beginning of the time period was a heifer of 18 months of age (based on information from previous studies that this was the earliest possible conception age if the heifer had reached the necessary weight of approximately 160 kg). Therefore the analysis focused primarily on the impacts on a breeding unit in each scenario. Allowances were also made to increase the number of breeding units within a reasonable range which captures some economies of scale (such as occurs in grazing supervision). As indicated previously, some assumptions were changed to analyse a calf fattening scenario as well. Thus limited 'herd' dynamics were captured for the purposes of achieving the objective of this study.

Both of these analyses produced results that are replicable across farm households within and between villages with similar production systems. The assumptions in the model can be also be modified to represent an even wider range of production systems. To achieve research objectives other than those stated here, it may be necessary to capture more complex herd dynamics (that are also more household and cite specific and therefore less replicable). In which case, substantially more resources would have to be devoted to increase the complexity of the model - hopefully with a subsequent increase in the model's accuracy in representing more complex situations and thus, capacity to achieve the desired research objectives.

The time period chosen for this analysis was four years as this represents the minimum period required to capture reaching a 'steady state' in the system with respect to conception and calving and the related costs and returns. Any shorter interval would not have allowed a comparison of the two different systems.

In Lombok, there are three types of cattle ownership – owner/managers, owners (who don't manage their own cattle) and managers (who don't own cattle but manage them for owners). For each scenario, this study considered the impacts on two of these types of ownership systems i.e. owner/managers and managers. If a manager is given a heifer, they have rights to the first calf and every second calf thereafter as well as half the increase in the value of the breeder while it is under their care. If a manager is given a cow, they have rights to the second calf and every other calf thereafter as well as half the increase in the value of the breeder while it is under their care. This has important implications in terms of the distribution of risks, costs, and returns (Table 1.). It also has important implications if development can be considered moving from being a manager to an owner/manager (and presumably moving from lower income activities to managing cattle).

Table 1. Distribution of risks, costs, and returns for owner/manager, owner, and manager

Ownership status	Cattle variable costs	Risk breeder capital	Returns -change in value of breeder	Returns from calves	Cattle variable costs
Owner/manager	100	100	100	100	100
Owner only	0	100	50	50	0
Manager only	100	0	50	50	100

The different types of cattle ownership and management increase the complexity in terms of income sharing from calves and increases in breeder values. This latter value was included in the gross margin and cash flow estimates to capture breeder value changes and distribute it more appropriately over the time period. This has the advantage of being able to follow the 'asset' value of the animal which may be important in financial decisions. However, strictly speaking, the net cash flow would not reflect these changes in value this way but rather as the difference between the purchase price and the sale price of an animal when it is traded. Unfortunately both of these estimates are not available if the animal is bred for herd replacement and would have to be estimated in any event. The main characteristics of the three different scenarios (one with two extensions related to different levels of intervention) for Lombok are summarised below (Table 2).

The main characteristics of the two scenarios (with two extensions related to different levels of intervention in a similar manner as for Lombok but specifically for Sumbawa) modelled for the cattle production system on Sumbawa are summarised in Table 3.

The most effective way to capture the major risks in each of the different cattle production systems (i.e. conception rates and calf mortalities as indicated by weaning rates), particularly when working with primary cattle units, is to apply a probability to the major costs and returns. In this analysis, weaning rates were assumed to represent probabilities and were applied to the returns from outputs (calf prices) and the cost of inputs (food, water) to represent their expected or average values.

Finally, to reflect the time preference for money, particularly relevant in developing countries, the present values of the cumulative surpluses derived for the gross margin and cash flow in each year in reaching the steady state were estimated. This provides another estimate of the net benefits by weighting the returns and costs more heavily in the earlier years and also by considering the costs incurred before the significant stream of benefits begin (e.g. time tending a breeder before the first calf). It is important to note that the majority of information used in this analysis is based on actual data from the project's database rather than best estimates. Other specific information required for an economic analysis of this type (i.e. opportunity costs, gender responsibilities for activities) was not readily available from the database but was gathered from other studies undertaken within the project (e.g. social survey) and personal communications with knowledgeable members of the team and their wider contacts.

Table 2. Summary of three major Bali cattle production scenarios for Lombok, Kelebuh

Lombok, Kelebuh Characteristic	Without interventions	With basic interventions	With extended interventions
System overall	During dry season, cattle tethered at pasture during day, tethered in a stall at night. Water and some cut'n'carry fodder given. During wet season, cattle tethered in a stall throughout day and night and fodder cut'n'carried. Cattle collective housing Bull service or AI fee Calf sold at 12 months	As without intervention + Bull selection Controlled seasonal natural mating Strategic weaning (sell calf at weaning at 6 mths) Mating and weaning pens added to housing	1. As with basic interventions but hold calf for extra 6 mths to 12 mths 2. As above but an increase of 50% in live weight gain (LWG) for calf from 6-12 mths
Year 1 - Heifer's weaning %	27 (=30 x 10) (conception % x calf mortality %)	86 (=90 x 5) (conception % x calf mortality %)	As with basic intervention
Year 2+ - Cow's weaning %	54 (=60 x 10) (conception % x calf mortality %)	86 (=90 x 5) (conception % x calf mortality %)	As with basic intervention
Variable costs *	Grazing supervision, grazing fodder and grazing water collection, fodder collection for cow for 12 mths and calf for 6 mths from 6-12 mths Cattle manure collection Cattle bathing in wet season *Cattle collective housing* *Bull service or AI fee* *Selling calf*	As without interventions but no grazing supervision, grazing fodder and water collection, fodder collection for calf.	1. As without interventions 2. As without interventions (assuming feeding costs are the same for the higher productivity feed)
Variable returns	Sale calf at 12 mths old Cattle manure Draught power	Sale calf at 6 mths old Cattle manure Draught power	Sale calf at 12 mths old Cattle manure Draught power
Labour for breeder (hrs/hd/mth, Yr1-4, type)	49 - 57 in dry season 50% men (mostly fodder collection), 30% women (mostly water collection), 20% children (all grazing supervision) 36 - 42 in wet season 90% men (fodder collection) 10% women (all residue collection)	Similar to without intervention	Similar to without intervention
Labour for calf (hrs/hd/mth, % change seas. tot.)	9.3 in dry season (19%) 8.7 in wet season (25%)	Minimal	Similar to without intervention

*Financial costs in italics

Table 3. Summary of three major Bali cattle production systems for Sumbawa, Boak

Sumbawa, Boak village Characteristic	**Without interventions**	**With interventions (+ 2 extensions)**
System overall	Free grazing, rice straw fed in late dry season, no fodder collection, water collected in dry season	As without intervention + Bull selection Controlled seasonal natural mating Strategic weaning Mating and weaning pens
Year 1 - Heifer's weaning %	27 (=30 x 10) (conception % x calf mortality %)	86 (=90 x 5) (conception % x calf mortality %)
Year 2+ - Cow's weaning %	54 (=60 x 10) (conception % x calf mortality %)	86 (=90 x 5) (conception % x calf mortality %)
Variable costs *	*Selling calf* Rice straw Water collection	*Selling calf* *Bull service fee* *Mating and weaning pens* Rice straw Water collection
Variable returns	Sale calf at 12 mths old Draught power	Sale calf at 6 mths old (1. then 12, 2. 12 + fattening) Draught power
Labour for breeder (hrs/hd/mth,Yr 1-4, type)	8 - 16 – women, water in dry season	As without intervention (for all scenarios)
Labour for calf (hrs/hd/mth)	4 – women, water in dry season	None = reduction of 4 in dry season (1. and 2. as without)
Other considerations compared to Lombok	All farmers were owner/managers for the purpose of this analysis No trade restrictions on slaughter cattle, lower cattle prices, higher labour costs, higher literacy	

* Financial costs in italics

7.4.1.4.3 Results

A summary of the major findings and the implications from each of the models and the scenarios are discussed below.

7.4.1.4.3.1 Lombok, Kelebuh Owner/manager – without v's with basic interventions

For a cattle owner in Kelebuh, the economic and financial comparison of the situation without and with the cattle management interventions is summarised below (Table 4). Full details of the models, assumptions, and results are provided in Attachment 1.

Table 4. Summary of results for Bali cattle production system without and with basic intervention, Kelebuh, Lombok, Owner/manager

Kelebuh – Owner/manager **Without intervention** **With basic intervention below** **Gross Margin/Cash Flow ($/hd)**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**PV of 4 Yr Total**
Variable returns	13 13	109 218	198 218	198 218	
Change in cattle value	95 95	41 41	- -	- -	
Variable costs	144 144	178 172	199 183	199 183	
Cash flow surplus	101 101	138 246	**185** **205**	185 205	471 589
Gross margin surplus	(36) (36)	(27) 87	**(1)** **35**	(1) 35	(55) 89

In year one, for both systems (i.e. without and with intervention), variable returns consisted of returns from the sale of cattle manure (financial return) and draft power, the increase in breeder value, and variable costs - both financial (e.g. cattle collective housing fee) and opportunity (e.g. grazing supervision). In financial terms, the cash flow (*financial* variable returns + changes in cattle value - the *financial* variable costs) in year one was a surplus of $101. However, in economic terms, the gross margin (all variable returns + changes in cattle value – all variable costs) was estimated as a deficit of $36. The difference between the cash flow surplus and the gross margin deficit (i.e. $137) represents the total net opportunity costs related to the cattle activities for that year (e.g. the cost of providing fodder, water, grazing supervision).

In year two, variable returns, and hence the cash flow and gross margin surplus, increased as a result of increased returns from the sale of a six month old calf in the case of intervention, and a 12 month old calf without intervention. Note that although the older and therefore heavier calf has a higher value without intervention, this value is tempered by a lower probability of obtaining a calf (estimated via the weaning %) especially in year 2 for the heifer compared to a cow in the subsequent years under this scenario. The change in the value of the breeder was less than in year one as the breeders live weight gains started to taper off. Variable costs (all opportunity costs) fell as a result of the intervention as the calf did not have to be tended for an additional six months – a real advantage in the case of a manager when the calf is eventually given to the owner.

In years three and four, the breeder's weight is assumed to be maintained rather than increased and this is reflected in a zero change in value of the breeder. A 'steady state' is reached in year three whereby the costs and returns are the same thereafter. In economic terms, the gross margin estimate of negative $1 indicates that the farmer in Kelebuh is basically breaking even without interventions. With the interventions, the farmer would be $36 better off which reflects the lower labour requirements with the interventions as a result of disposing of the calf at six months versus holding and tending it for an additional six months. By comparison, holding the calf requires an additional nine hours of labour per month in the dry season (and increase of

19% in this season) and, more importantly, an increase of 8.7 hours per month in the wet season (an increase of 25%), mostly for men, when more labour is needed for cropping activities.

In financial terms, the farmer would be earning approximately $185 per breeder per year in the 'steady state' without intervention but would earn an additional $20 per breeder each year by undertaking the interventions in addition to the labour savings described above. The difference in the present value of the cumulative total of the cash flow surpluses with and without the interventions was estimated to be $118 – significantly less than the non-discounted cumulative total as the major cash flows occur in the later years and costs are approximately the same for each scenario and across time.

7.4.1.4.3.2 Lombok, Kelebuh Manager – without v's with basic interventions

By analysing the returns to a manager under the same assumptions as those for the scenarios above, the most obvious difference in the 'missing' value of a calf in year three (and also the slight drop in variable costs usually involved in selling an animal) as this is the calf that is the property of the owner/manager under the contract (Table 5). The next most obvious difference is a halving of the 'revenue' from the change in cattle value – again reflecting the terms of the managers contract with the owner. These two major differences are captured in the cash flow surplus which falls dramatically in year three and the smaller falls in years one and two related to the two differences described above respectively.

A similar trend occurs in the gross margin estimates as the manager is still bearing all the costs of having the breeder and calf but receiving only half of the revenues and changes in cattle values – hence the extra burden without interventions. This burden is reduced with the interventions if the manager can dispose of a calf that they do not own rather than tend it for an additional six months (as indicated by an increase in the gross margin surplus in year three from $35 in the case of an owner/manager to $160).

Table 5. Summary of results for Bali cattle production system without and with basic intervention, Kelebuh, Lombok, Manager

Kelebuh – Manager **Without intervention** **With basic intervention below** **Gross Margin/Cash Flow ($/hd)**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**PV of 4 Yr Total**
Variable returns	13 13	109 218	21 21	198 218	
Change in cattle value	48 48	20 20	- -	- -	
Variable costs	142 144	178 172	198 181	198 181	
Cash flow surplus	53 53	117 226	**9** **9**	**185** **205**	278 381
Gross margin surplus	(82) (64)	(48) 66	**(177)** **(160)**	**(1)** **35**	(247) (118)

The average of years three and four represent the steady state and the average cash flow surplus under the without and with scenarios is $97 and $107 respectively – approximately half of the above estimates for owner/managers. The same estimate for the average gross margin is negative $89 and $63 under the without and with scenarios respectively – versus negative $1 and $35 for an owner/manager. In summary, being a manager with no interventions is the worst of the given economic and financial positions to be in.

7.4.1.4.3.3 Lombok, Kelebuh Owner/manager – with v's with extended intervention 1

The next scenario, strategic weaning but holding onto the calf for an additional six months for an owner/manager, effectively examined whether the marginal increase in the returns from

holding the calf is proportionately more than the marginal increase in the costs of keeping the calf for the additional time.

The results indicated this was that case in both financial and economic terms (Table 6). For example, the cash flow surplus increased by $84 to $289 (due to the fact that most of the variable costs were not financial). The gross margin surplus increased by $56 to $91 – reflecting the fact that the steady state variable returns increased by approximately $80 (50%) while the net variable costs (mostly opportunity costs) increased by approximately $30 (15%).

Table 6. Summary of results for Bali cattle production system holding calf to 12 months, Kelebuh, Lombok, Owner/manager

Kelebuh – Owner/manager With extended intervention 1 Gross Margin/Cash Flow ($/hd)	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**PV of 4 Yr Total**
Variable returns	13	301	301	301	
Change in cattle value	95	41	-	-	
Variable costs	142	199	210	210	
Cash flow surplus	101	329	**289**	289	777
Gross margin surplus	(34)	143	**91**	91	217

Therefore, assuming sufficient resources are available (i.e. additional labour, feed) this scenario represents and improvement beyond those of the basic interventions. Another issue that deserves particular attention here is the availability of micro-finance. It was reported that most owner/managers sell young animals in response to financial demands. Therefore, if a small amount of bridging credit were available, the possibility of holding the calf for an additional period of time could have more appeal.

7.4.1.4.3.4 Lombok, Kelebuh Owner/manager – with v's with extended intervention 2

Following on from the above scenario, the calf was assumed to be the focus of supplementary feeding with high quality forage – sufficient to increase its live weight gain from six to 12 months by 50 percent. The results are dramatic in terms of both the increases on the yearly financial and economic returns of approximately $100 for both compared to the previous scenario (Table 7). Again, these results reflect the relatively larger increase in marginal benefits (i.e. calf value) compared to the increase in marginal costs (i.e. small additional feed and feeding labour).

Table 7. Summary of results for Bali cattle production system holding calf to 12 months and fattening, Kelebuh, Lombok, Owner/manager

Kelebuh – Owner/manager With extended intervention 2 Gross Margin/Cash Flow ($/hd)	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**PV of 4 Yr Total**
Variable returns	13	409	409	409	
Change in cattle value	95	41	-	-	
Variable costs	142	209	220	220	
Cash flow surplus	101	438	**397**	397	1,022
Gross margin surplus	(34)	241	**189**	189	440

A price premium might also be obtained from this enterprise if fattened male calves are more highly valued or, if the heifer has reached first conception weight earlier and is even potentially in-calf. However, these returns would be received six months later. Therefore, it must then be assumed the household has sufficient wealth or finance available to be able to hold the animal for this additional time.

7.4.1.4.3.5 Sumbawa, Boak Owner/manager – without v's with basic interventions

Given the different production system (lower labour input but lower weaning rates) and lower cattle prices on Sumbawa compared to Lombok, it is not surprising that the expected variable returns and variable costs without interventions are lower - approximately 50 percent and 70 percent lower respectively from year three onwards. Subsequently, the cash flow surplus without intervention was estimated to be $114 in the steady state – 60 percent lower compared to Lombok (Table 8). Due to the relatively low costs of inputs however, the gross margin was a surplus of $65 in the steady state versus breaking even on Lombok.

With intervention, the variable returns are only higher in year two – reflecting the higher weaning percentage expected from the heifer. The lower cash flow surplus and gross margin surplus in the steady state for with interventions versus without interventions ($91 and $41 respectively) indicates that unless the calf can be held for an additional six months then the farmers are best to use the interventions for the heifer only. This conclusion would change if the economic social or cultural value of the labour saved from disposing of the calf early is undervalued in this analysis.

Table 8. Summary of results for Bali cattle production system without and with basic intervention, Boak, Sumbawa, Owner/manager

Boak – Owner/manager **Without intervention** **With basic intervention below** **Gross Margin/Cash Flow ($/hd)**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**PV of 4 Yr Total**
Variable returns	0 0	64 103	122 103	122 103	
Change in cattle value	78 78	131 131	- -	- -	
Variable costs	28 34	39 46	57 62	57 62	
Cash flow surplus	78 74	188 222	114 91	114 91	390 380
Gross margin surplus	50 44	156 188	65 41	65 41	268 254

7.4.1.4.3.6 Sumbawa, Boak Owner/manager – with basic interventions v's with extended intervention 1

Again, by strategic weaning and holding onto the calf for an additional six months to sell at 12 months of age, the results indicate the farmer's net economic and financial returns increase significantly – triple gross margin values in the steady state and double the cash flow values - compared to those achieved with the basic interventions (Table 9). This is the result of an addition of a relatively small cost of labour – particularly compared to the increase in the value of the calf.

Table 9. Summary of results for Bali cattle production system holding calf to 12 months Boak, Sumbawa, Owner/manager

Boak – Owner/manager **With extended intervention 1** **Gross Margin/Cash Flow ($/hd)**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**PV of 4 Yr Total**
Variable returns	-	188	188	188	
Change in cattle value	78	131	-	-	
Variable costs	34	49	65	65	
Cash flow surplus	74	308	177	177	574
Gross margin surplus	45	271	123	123	441

7.4.1.4.3.7 Sumbawa, Boak Owner/manager – with basic interventions v's with extended intervention 2

The final extension of the model for Sumbawa involved estimating the economic and financial returns from holding and fattening the calf (Table 10). Again, the dramatic increase in economic and financial returns of approximately $90 per breeder per year reflects the large increase in marginal returns versus marginal costs. However, this is still $130 below the yearly cash flow for Kelebuh for the same scenario indicating that cattle breeding on Lombok is much more profitable in financial terms – mostly due to higher cattle prices.

Conversely, the Sumbawa estimate for the gross margin surplus is $20 above the estimate for the same scenario on Lombok which highlights the fact that significantly less labour is used in Bali cattle breeding activities in the Sumbawa Bali cattle production system. The higher wage rates on Sumbawa reinforce the fact that the labour is 'more valuable' on Sumbawa so that the economic and financial gains at least from activities that require more labour are more carefully weighed against their costs.

Table 10. Summary of results for Bali cattle production system holding calf to 12 months and fattening, Boak, Sumbawa, Owner/manager

Boak – Owner/manager With extended intervention 2 Gross Margin/Cash Flow ($/hd)	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**PV of 4 Yr Total**
Variable returns	-	278	278	278	
Change in cattle value	78	131	-	-	
Variable costs	34	50	66	66	
Cash flow surplus	74	398	267	267	778
Gross margin surplus	45	359	212	212	642

7.4.1.4.3.8 Cattle price sensitivity analysis

Currently, the method of cattle price determination in Indonesia's eastern islands is relatively unknown. For example, from a regression analysis of the prices versus their live weights for all cattle sold and recorded in the database (albeit relatively limited in number) in the larger project, the resulting regression equation for Kelebuh and Boak were different in both intercept and slope.

The positive intercept value for Kelebuh suggests the price determination is non-linear below the range of values but remarkably linear within the given range of values. The regression equation for Boak prices had no intercept but the value of the slope was lower – indicating higher prices were received for cattle on Kelebuh, ex farm-gate.

It was also hypothesised that the prices of male cattle were higher than those for female cattle. This was subsequently tested by this author who found that the differences between the means and variances of the two samples were statistically insignificant (at 5%). However, this is an area that needs further study.

As a start, the sensitivity of the results with respect to cattle price changes was estimated by assuming some change in the system resulted in a 20 percent increase in the intercept and slope of the regression equation estimated from the database for Kelebuh. Not surprisingly, this price increase translated into an approximate $80 or 20% increases in variable returns and cash flow surplus and a 40 percent increase in the gross margin surplus (Table 11).

Table 11. Summary of results for Bali cattle production system increasing cattle prices by 20%, holding calf to 12 months and fattening, Kelebuh, Lombok, Owner/manager

Kelebuh – Owner/manager With extended intervention 2 Price increase - 20% increase slope and intercept value Gross Margin/Cash Flow ($/hd)	Yr 1	Yr 2	Yr 3 (% change)	Yr 4	PV of 4 Yr Total
Variable returns	13	487	487 (19)	487	
Change in cattle value	114	49	-	-	
Variable costs	142	209	220 (0)	220	
Cash flow surplus	120	524	475 (20)	475	1,222
Gross margin surplus	(15)	327	267 (41)	267	640

7.4.1.4.3.9 Summary

This analysis utilised partial budgeting models to estimate the economic, financial, (and social) costs and returns related to breeders and calf fattening in two different Bali cattle production systems on Lombok and Sumbawa – two of Indonesia's eastern islands. Based on the characteristics of the systems and the assumptions in the model, the introduction of basic, and then extended, interventions in an integrated management system (i.e. bull selection; controlled seasonal natural mating; strategic weaning -typically at six months instead of 12; and tactical diet supplementation of the calf) has a significant positive impact on the economic (gross margin), financial (cash flow), and perhaps social status (suggested via changes in labour requirements) of farm households with Bali cattle breeding operations, *ceteris paribus* (Table 12).

Table 12. Summary of major economic, financial, and social impacts for Bali cattle production systems in Kelebuh, Lombok and Boak, Sumbawa

Village	Production System	Gross Margin in steady state ($/breeder/yr)	Cash Flow in steady state ($/breeder/yr)	Labour requirement change from base (hrs/hd/mth)
Kelebuh, Lombok	Current system – owner/m	-1	185	Base = 0
	Current system – manager*	-89	97	Base = 0
	Basic mgt - owner/m	35	205	-9 x 6 mths
	Basic mgt - manager*	-63	107	-9 x 6 mths
	Extension 1 – hold calf to 12	91	289	0
	Extension 2 – hold + LWG	189	397	0
	Extension 2 + 20% price rise	267	475	0
Boak, Sumbawa	Current system	65	114	Base = 0
	Basic mgt	41	91	- av. 2 x 6 mths
	Extension 1 – hold calf to 12	123	177	0
	Extension 2 – hold + LWG	212	267	0

* Average of year 3 and 4 due to calf and breeder value sharing

These major results and their implications are summarised below in the following points:

- Without intervention, due to the differences in the current systems of Bali cattle production on each island, financial returns in Kelebuh are substantially higher than those on Boak ($185 v's $114/breeder/year in the steady state).
- However, in economic terms, when the opportunity cost of labour is taken into account, the situation is reversed – reflecting the low labour input in the production system in Boak and its higher value. This is a feature that, on its own, would make the basic interventions more attractive as they reduce the labour requirements.
- In Kelebuh, approximately 30 percent of the total number of farmers who manage cattle do not own the animals themselves but manage them under contract. This arrangement has a

significant impact on the distribution of costs, returns and risks and therefore the adoption and impact of Bali cattle production system interventions – even as relatively low in actual (versus perceived) risk and low cost as the interventions are in this project.
- Basic interventions increased the financial returns in Kelebuh. These returns were increased substantially by extending the interventions to included strategic weaning *and* holding the calf for an additional six months *with* tactical diet supplementation.
- The same is not as true for a manager as there are no economic or financial gains for every second calf that effectively represents a burden under the current contract situation.
- The extended interventions are more likely to be adopted by owner/managers and managers particularly if they have access to credit to enable them to hold onto their calves for additional time periods. In the case of a manager, this may lead to more wealth generation and eventually becoming an owner/manager - improving their wealth generating capacity even more.
- In terms of the possible social implications, strategic early weaning reduces the labour requirement by 20 percent per head per month in the dry season and by 25 percent per head in the wet season – the majority of which is saved by men. Therefore, depending on which season the additional six months fall, the amount of labour saved ranges between 20 to 25 hours per head per month for six months. How this labour would be reallocated and what impact it would have requires further investigation.
- Also in terms of social implications, the impact of an increase in wealth also requires further investigation. For example, an increase in wealth might mean that more animals could be owned, herd sizes could increase, and/or crop activities extended – all of which have social implications.

Finally, in addition to the micro-production issues discussed above, bigger picture issues are likely to have impacts on economic, financial, and social development related to Bali cattle production systems via their impacts on returns, costs, and risks that equal, if not rival, those already investigated. These issues require further consideration – particularly when contemplating practical scaling up of the positive impacts of these interventions.

7.4.1.4.4 Other considerations

7.4.1.4.4.1 Structural changes in beef production and consumption

The nutrition transition, documented in the early 1990s, encompasses and pre-dates the more highly publicised 'livestock revolution' and draws on the earlier work documented under the 'epidemiological transition' – changes in human diseases that usually accompany structural changes in nutrition. In essence, the nutrition transition refers to the changes in nutrition that follow structural changes in consumption - the latter being a phenomenon known as Bennett's Law (1941) (i.e. as disposable income increases, the demand for certain foods increases – namely livestock products, sweets, alcohol etc.). Indonesia is no different – increasing wealth is driving an increased demand for livestock products – particularly in urban centres like Jakarta. This implies that there are opportunities for domestic (and foreign) beef cattle industries to meet the increasing demand. The potential impacts (i.e. who gains/loses and by how much) as a result of these opportunities depends to a large degree on the global, national, regional and local policy and institutional settings ('rules of the game' e.g. land rights).

7.4.1.4.4.2 Policies and institutions – impact on costs and returns, profit and marketing margins

Prior to 1998, beef import licences were required in Indonesia and tariffs of 27.5 and 22.5 percent applied to imports of chilled and frozen beef respectively while live cattle imports were controlled by tariffs (15% on slaughter cattle), permits, quarantine requirements, and quotas. As live cattle imports account for the majority (approx. 2/3rds) of Indonesia's 'beef equivalent' imports, tariffs on imports of slaughter cattle provided artificial market incentives for domestic slaughter cattle raising industries. The potential beneficiaries under this scenario included cattle

raisers (primary beneficiaries), cattle traders, cattle transporters and meat workers (secondary beneficiaries) with urban consumers being primary losers as a result of higher beef prices.

On February 1, 1998, import tariffs on all food items were reduced to a maximum of 5 percent as part of the IMF's assistance package requirements following the Asian currency crisis. Thus beef imports were subjected to a five percent tariff. Beef import licences and quarantine requirements still exist and imported beef must have halal certificates (AUSTRADE website). Similarly, import permits for live cattle are still required (and cattle must come from foot and mouth disease free areas) and quarantine requirements must be fulfilled, but quotas and specific tariffs on live cattle imports no longer exist.

On January 1, 2001, the Indonesian Government introduced a 10 percent Value-Added Tax (VAT) on all imported agricultural products (including meat and livestock). This policy instrument was obviously designed to raise import tax revenue while protecting domestic industries. However, given its 'bluntness' as a policy instrument, some sectors of some industries will benefit while others will be disadvantaged (e.g. domestic intensive *and* industrialised livestock industries relying on imported feed grain and imported mechanical production and processing equipment). Record numbers of live cattle were imported in 2002 - the majority now being heavier cattle (MLA website). In a new move, Indonesia has banned the importation of beef and cattle produced with the use of growth promoting hormones. It is worth noting that the Indonesian Government places a high priority on establishing and promoting export industries as a driving factor in its economic development. Although minor by comparison, Indonesia does export some beef and veal – presumably to high value markets in neighbouring countries.

Whether Bali cattle raisers on Indonesia's eastern islands have benefited, or will benefit, from increased cattle prices (artificially created or otherwise) depends to a large degree on their receiving accurate and timely market signals (complicated by the large number of 'middle-men') as much as their *ability* and *willingness* to respond. A wide range of domestic cattle marketing and processing taxes also exist and many levels of governance. Institutional changes that lead to reduced taxes and transaction costs and increased availability of accurate and timely market signals, possibly via a reduction in the number of middle-men, should result in higher profit margins for farmers. Evidence that the farmer's ability and/or willingness to respond beyond the immediate short-term is constrained would include falling herd numbers – particularly the proportion of older and larger cattle.

In 2000, approximately 80,000 head of cattle were turned off from Lombok herds. Approximately half of these were slaughter cattle shipped live to Java. Another 30,000 head were slaughter cattle slaughtered locally on Lombok via the new slaughterhouse (established with the assistance of the Asian Development Bank with higher health and phytosanitary arrangements than the older slaughterhouses) with most of the resulting beef exported to Java. The remaining 10,000 head were breeders transported to other areas of Indonesia and exported to neighbouring countries such as Malaysia (which took 2,000 breeders in 2002). In 2001, the Government introduced a ban on live slaughter cattle exports from Lombok (not Sumbawa) with the exception of unproductive females. The aim was to stop the drain on bull numbers as younger and younger cattle were being sought. However, in 2002, approximately 3,000 slaughter cattle sourced from Lombok, Sumbawa, and W/Timor were exported to East Timor (pers. comm. Tanda, May 2003).

Table 12. Summary of market price information, Kelebuh and Jakarta

Market Information				Average
Kelebuh farm-gate				
Cattle age (months)	24	36	48	
Cattle weight (kg)	221	245	281	
Cattle value (Rp/hd)			3,267,492	
Cattle value (Rp/kg)				11,796
($/kg)				2.56
Cattle value (Rp/kg CWE+)				23,592
($/kg CWE)	5.20	5.13	5.06	5.13
Meat equivalent (Rp/kg				32,767
($/kg ME)				7.12
Wholesaler middle-men 1-10				
Meat equivalent (Rp/kg				???
Jakarta retail markets				
Low value beef* (Rp/kg)				32,300
($/kg)				7.02
Medium value beef*				35,200
($/kg)				7.65
High value beef* (Rp/kg)				41,750
($/kg)				9.08

+ Carcase weight equivalent estimate based on 50% conversion from live weight
# Meat equivalent estimate based on 72% conversion from carcase weight
* These figures only sourced and modified from: Improving Indonesia's Beef Industry, CIE & CASE, 2003?

What impact these policies and trade activities are having on local cattle numbers and prices, particularly for bulls, is unclear at this stage. However, it could be expected that a ban on slaughter cattle exports from Lombok would lower cattle prices as a closure of export markets for slaughter cattle would lower demand. The increased demand for slaughter cattle from the new abattoir however, should at least maintain, or possibly result in higher, cattle prices if it is assumed that the resulting beef is entering the high quality, high price markets and/or there is a premium for beef from Bali cattle in Jakarta *and* that these returns are being passed back through to farmers. Therefore, any significant increases in cattle productivity as a result of interventions on Lombok should not dampen prices, despite this export ban due to the increased demand from the new abattoir. The longer term nature of breeding operations as opposed to opportunistic cattle fattening operations, could dampen the demand and price of female cattle unless the domestic or export markets for breeders improves.

As a first attempt to gain some understanding of the process of price determination, the following information relating to Bali cattle and beef prices was collected, mostly from the project database, as summarised below (Table 12). Due to gaps in this type of marketing information, no real conclusions could be drawn about marketing and profit margins other than that this area requires further investigation.

7.4.1.4.4.3 Scaling

Having 'found' an intervention that has a net positive impact on an individual unit like a household, two questions arise: how can the net positive impact be maximised for the individual unit? And how can the number of units be increased to maximise the total net positive impact? These are important questions. For example, in his classic paper in 1993, the World Bank's Alan Berg stated that is was a "scandal that we [in development] have done so little in *applying* our scientific knowledge" and gave the reason as the devotion of more than 5

percent of research efforts to answering the 'how' question, as opposed to the 95 percent of research effort devoted to the 'why, who, where and what' questions. Therefore, the 'how' questions are examined in this section from a practical and theoretical view – drawing on documented case studies to introduce the concept of scaling i.e. how to extend net positive impacts to get the biggest development bang per research and extension buck.

Human nutrition programs in Haiti – the Hearth program (G. Berggren et al., 1999)
Many programs had been instigated in Haiti to improve the nutrition of moderately and severely malnourished children. The latest program, the Hearth program, aimed to reduce the cost of the antecedent programs while maintaining or increasing the effectiveness so that it could be *quantitatively* scaled up i.e. expanded from a sustainable village level program to a sustainable district-level program. The main difference between Hearth and the antecedent programs is the increase in community participation and responsibility designed into the program – especially by community mothers. The program scaled down *functionally* before it scaled up i.e. scaling down from: a few large permanent mothercraft centres serving several communities to many small hearths of local mothers each serving a few families; paid staff to volunteer mothers; 3 months of demonstration feeding to 12 days; and several demonstration meals per day to one per day.

This scaling down not only reduced the cost but also made the program more accessible and apparent to the local families. Responsibilities for analysis and problem-solving in relation to nutrition moved closer to the community: the positive deviance approach incorporated local practice/wisdom from mothers of similar circumstance but with optimally nourished children to convince other mothers that they could do the same thing; and the teaching/learning strategy shifted from demonstrations by knowledgeable persons to self-discovery by the mothers themselves in a partially structured environment. By scaling down in this way, the program staff was able to focus on scaling up issues such as implementing the program throughout the entire district. Program staff were then able to *functionally* scale up i.e. identify new problems and introduce new activities in the fledgling network such as micro-enterprises. Results to date have been encouraging and the work into this complex issue is on-going.

Poverty alleviation and nutrition program in Vietnam (Sternin et al., 1999)
The positive deviance approach was also the basis of a program in Vietnam designed to change behaviour rather than to transfer knowledge to alleviate poverty and improve nutrition. The project was developed in 1991 and in seven years, the population positively affected by the project's interventions grew from 20,000 to 1.2 million.

Human nutrition and blindness prevention in Bangladesh (Greiner and Mannan, 1999)
A program was instigated in Bangladesh in 1984 to educate and motivate two target groups, the rural poor, and the general population, to take preventative measures available to them in order to reduce the number of nutritional blindness cases among children. The methods chosen included using groups of traditional folk singers to give free performances in villages, weaving messages about nutrition into their songs, chants, and playful debates. They also utilised women volunteers who became temporary paid staff, chosen for their interest in serving the community, and secondary school students via gardening projects.

The program began with a large scale pilot study that ran for two years, reached approximately 240,000 people. The pilot program covered the "three stages required for quantitative scaling up to be successful i.e. the *process* stage (testing whether the proposed intervention will be effective under field conditions), the *feasibility* stage (determining the likelihood of achieving accepted output/outcome levels) and the *efficiency* stage (establishing optimum costs and effectiveness relationships)." Quantitative scaling up to achieve the projects objective among 4 million people was achieved in 3 years and then 9 million people in ten years from the start of the project. The methods described above proved to be a very cost effective way of achieving the project's objective, as were many subsequent methods - designed and introduced into the

program as a result of constant project *evaluation and feedback*. Reinforcing the scaling down of responsibilities to the community, the program found that "when adequate knowledge, changes in dietary patterns, and the desire to grow nutritious crops have been achieved, the people themselves, supported mainly by commercial markets (but also to some extent the educational system and agricultural extension) will sustain the necessary behaviours."

Theoretical principles underlying the North Karelia project (Peska et al., 1996)
The North Karelia project applied a community based strategy to address human health problems prevalent in eastern Finland. The type of approach used and the positive impacts achieved have made it prominent in development literature as a powerful demonstration of the net positive impacts possible from project interventions at a community level, with lessons for projects at the national level.

The key feature of this community based strategy is that it simultaneously applied multidisciplinary knowledge to identify the community problems, to prioritise the community objectives in relation to these problems, and then design the actual program contents and activities to achieve these objectives. In particular, this approach recognised the physical, social, and cultural environments in which individuals make behavioural decisions. Researchers combined relevant aspects of four basic theoretical frameworks for behavioural change (i.e. behaviour-change, communication-behaviour change, innovation-diffusion, and community organisation) into a unified model of community intervention most relevant to achieving the project objectives.

7.4.1.4.4.4 Summary
The discussion above provided a brief consideration of other issues relevant to Bali cattle production and development in Indonesia's eastern islands including: the possible impact of structural changes in beef production and consumption and policies and institutions on costs, returns, profits and marketing margins; as well as some practical and theoretical ideas related to the opportunities for, and constraints to, scaling up the net positive impacts from Bali cattle production system interventions.