Management strategies to increase calf numbers of small-holder farmers in eastern Indonesia

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Abstract

This paper describes several areas of work relevant to Indonesia's program of self sufficiency in beef cattle production. The successful implementation of an integrated village management system involving natural mating during a restricted period and early weaning to improve reproductive efficiency is described. The results of a range of studies conducted to develop feeding strategies to increase growth of early weaned Bali cattle across eastern Indonesia are reviewed. Finally, the potential use of crop residues, including rice straw, as a basal diet for reproducing females is also introduced.

Introduction

The Indonesian government, through the Program Percepatan Swasembada Daging Sapi (P2SDS), has placed a high priority on self sufficiency in beef cattle production. Domestic beef consumption is presently increasing at approximately 4% per annum (Indonesia Department of Agriculture, 2007) while national cattle numbers increased at 1.1% per annum between 2003 and 2006 (Indonesia Directorate General of Livestock, 2007). Domestic demand for beef is currently unable to be met from local supply alone under the present beef cattle production systems. It is predicted that under the present beef cattle production systems, meat imports will continue to increase and by 2010 will account for approximately 37% of the Indonesian beef market (Indonesia Department of Agriculture, 2007).

Increased reproductive efficiency, through strategic management of breeders, and changes in the forage resource base at the small-holder level will result in a more efficient beef cattle production system and increased farmer cash flows but will only result in a moderate increase in cattle numbers. A large increase in the Indonesian cattle population will only result from a large increase in the number of breeding females, which will require a significant expansion of the biomass available for cattle feeding. Both strategies will require changes in cattle management practices, particularly the use of available feed, land and labour resources. The

main constraint to increasing the cattle population in Indonesia is the availability and use of suitable feed resources.

The eastern islands of Indonesia have been identified as having potential to meet this increased local demand for beef, with Bali (*Bos sondaicus*) cattle the predominant breed in this area. Bali cattle are well suited to the cropping-livestock systems of eastern Indonesia. They are popular amongst small-holder farmers due to their apparent adaptability to the regional conditions; ease of handling, lower feed requirements compared to larger genotypes, tolerance to high ambient temperatures, ability to reproduce annually under poor environmental conditions and ability to recover condition quickly after exposure to periods of inadequate nutrient supply or heavy draught loads (Toelihere, 2003). However, their growth rates are low. Panjaitan *et al.* (2008) found average live weight gain of yearling animals was 0.2 kg/day in villages.

Early weaning

Cattle, in any part of the world, which face random mating and poor weaning practices inevitably have low calving percentages and high calf mortality. This is due to a lack of synergy between the available nutrition and the nutrient demands of the animal. Generally, supplements are advocated to overcome this lack of synchronisation. However, farmers do not always have the financial resources available to provide supplements. A simple and cost-effective management system, adopted in temperate and tropical systems, is to control the mating period and to conduct weaning such that times of peak nutritional demand (largely lactation) match the supply of available nutrients.

Early weaning is one management strategy available to increase the reproductive efficiency of cows. It has been successfully implemented under extensive grazing conditions of northern Australia (Holroyd and Fordyce, 2001) and in the cropping-livestock systems of eastern Indonesia (Panjaitan *et al.*, 2008). Early weaning removes nutrient demands of lactation from the pregnant cow, allowing her to maintain or recover body reserves prior to her subsequent calving and lactation. Further, dry cows will gain body condition quicker than lactating cows when feed quality improves. These maintained body reserves will facilitate a quick return to oestrus after calving. The combined feed requirements of an early weaned calf and dry cow are significantly less than the lactating cow-calf unit. The early weaned calf has relatively low requirements (kg DM/day) of high quality feeds, so less abundant high quality feeds can be allocated to the early weaned calf to promote good growth while more abundant, lower quality feeds and crop residues can be directed to the dry cow to maintain or increase body condition. Similarly, the combined water requirements of an early weaned calf and dry cow are significantly less than the lactating cow-calf unit. The decreased feed and water requirements associated with early weaning will result in reduced labour requirements of the small-holder farmer.

A previous ACIAR initiative (AS2 2000 103) successfully introduced an "Integrated Village Management System (IVMS)' in Kelebuh village, Nusa Tenggara Barat (Panjaitan *et al.*, 2008). Weaning was not previously practiced in Kelebuh and mating was ad hoc, with low success rates with artificial insemination and limited bull access. The IVMS matched feed supply with animal demand and was based on natural mating of Bali cows over a restricted period of time and early weaning of the calf at 5 to 6 months of age, to markedly increase

conception rates, calf output and farmer cash flow. The key to the IVMS was early weaning of the calf to remove the increased nutrient demands imposed on the cow during lactation. Weaning occurred when the calves were five to six months of age, usually between September and March, each year. Calves were placed in a communal weaning pen, constructed of locally available materials, with cows tethered and fed nearby for the first week of the weaning process. Weaned calves were maintained in the weaning pen for a further 3 to 4 and fed locally available green forages.

The IVMS was introduced in Kelebuh in late 2001 and early 2002 and resulted in increased pregnancy rate (80%), decreased calving to conception interval (70 days), increased weaning rate (83%) and decreased calf mortality (2-4%) (Panjaitan *et al.*, 2008). The timing of calving, and subsequent weaning, was shifted to better match seasonal conditions, in terms of feed availability, risk of disease and draught requirements (Figure 1). Under the IVMS all new-management calves were weaned immediately prior to, or during, the early wet season, whereas, previously, weaning continued for several months beyond this time. With peak calving occurring between March and June, under the IVMS, the anoestrus period was shortened compared to when calves were born between July and October. This rapid return to oestrus and high rates of conception were facilitated by the process of weaning, which removed the lactational nutrient demands from the cow during mid-gestation, allowing her to recover sufficient body condition for the subsequent lactation and mating period.

The benefits to small-holders in eastern Indonesia include increased reproductive rates, more efficient feed resource use, reduced labour requirements and increased farmer cash flow. The social benefits of the high reproductive performance, included a concentrated calving period (the large number of calves born and surviving over a short time had a clear affect on village morale), ease of management of a large group of animals of similar age and greater bargaining power with traders. However, early weaning can be a difficult concept to introduce to farmers and requires intensive engagement with small-holder farmers to change their perceptions and management practices. The IVMS was so successful it is now a component of Australian Centre for International Agricultural Research (ACIAR) initiatives currently being scales out across Nusa Tenggara Barat and South Sulawesi to improve the efficiency of beef cattle production systems.

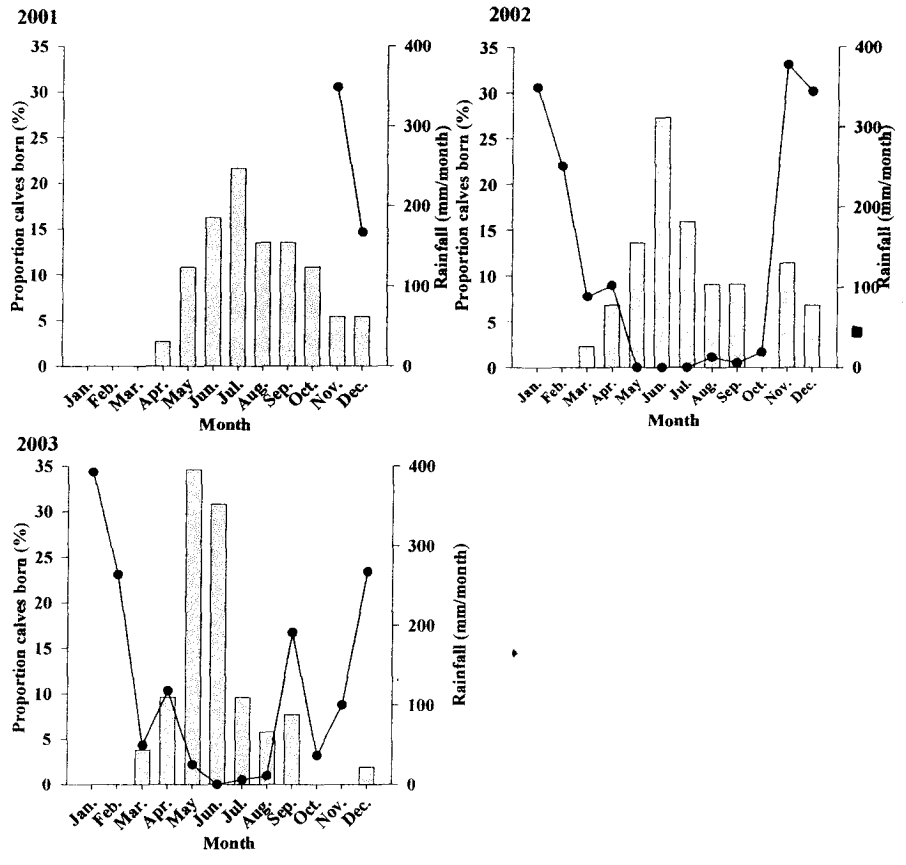

Figure 1. The distribution of calving (▭) and rainfall (-●-) in the years 2001, 2002 and 2003 under the integrated village management system implemented at Kelebuh village, Lombok, Indonesia (From Panjaitan *et al.*, 2008).

Feeding strategies to increase growth of the early weaned Bali calf

Presently little is known about the specific nutritional requirements of early weaned Bali calves and feeding and management strategies to enhance their growth. A recent review of Bali cattle feeding and growth reported a large variation in growth rates across a range of experiments (Marsetyo *et al.*, 2006). However, these experiments rarely investigated responses of early weaned Bali calves and were rarely conducted over a long duration with intensive measures of live weight change, feed intake and the nutritive value of the feedstuffs. It is anticipated that the scale out initiatives in progress in South Sulawesi and Nusa Tenggara Barat will result in increased calf numbers and financial benefits to farmers to retain, and increase growth rates of, these calves. Therefore, there is a need for information regarding how best to manage and feed these calves to enhance their growth rates from 6 to 12 months of age.

A current ACIAR project (LPS 2004 023) is examining strategies to increase growth of weaned Bali cattle. This project specifically aimed to investigate feeding strategies which would increase growth rates of early weaned Bali calves from less than 200 g/day, under normal village management practices, to over 360 g/day. A total of 14 feeding and live weight gain studies were conducted at Sulawesi Tengah (Central Sulawesi), Jawa Timur (East Java), Nusa Tenggara Barat (NTB; West Nusa Tenggara) and Nusa Tenggara Timur (NTT; East

Nusa Tenggara) in 2006 and 2007. The four sites were chosen as they varied significantly in terms of environmental conditions, types of feed resources available and prevailing cattle management systems. All studies used early weaned, male Bali calves, approximately 70 kg live weight and six months of age for the studies. The suitability of a range of feedstuffs and combinations of feedstuffs to enhance the growth of these calves were evaluated. Feedstuffs evaluated included grasses (native grass, king grass, elephant grass, *Brachiaria mulato*), forage legumes (*Centrosema pascuorum*, *Stylosanthes hamata* cv. Verano, *Clitoria ternatea*), tree legumes (*Leucaena leucocephala*, *Sesbania grandiflora*, *Moringa oleifera*, *Gliricidia sepium*), crop residues (corn stover, mung bean stover) and agricultural industry by-products (rice bran, copra meal) and commercially available concentrates (maize grain, prima feed, soybean meal). All experiments measured live weight gain over a minimum of 10 weeks, with feed intake measured daily and digestibility, nutritive value of the feedstuffs and water intake measured over 7 consecutive days on three occasions during each experiment. Across all experiments a total of 49 feeding strategies have been evaluated, with a live weight gain response for each strategy under similar experimental conditions determined. It is now possible to relate the live weight gain response to the nutritive composition, digestibility or intake of each diet to build an overall picture of nutritional requirements of young growing Bali cattle (for example, see Figure 2).

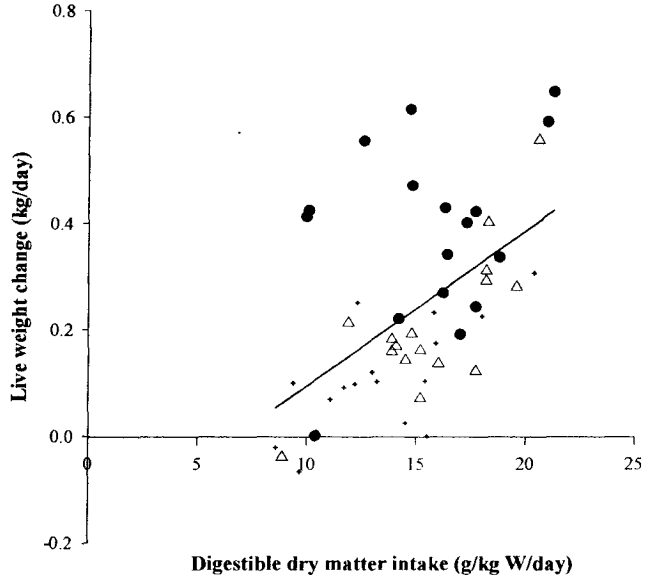

Figure 2 Relationship between average daily live weight gain and digestible dry matter intake of early weaned Bali calves fed a range of diets. Diets were grouped as <10% (·), 10 to 18% (▵) and >18% (•) estimated crude protein content in the feed offered.

The results of these studies demonstrate that six month old weaned Bali calves have a requirement for high crude protein diets (160g crude protein/kg DM) to achieve maximum growth rates. The maximum growth rates achieved in the current suite of experiments was approximately 0.6 kg/day for calves fed a concentrate ration with greater than 16% crude protein and for calves fed 10g maize grain or rice bran DM/kg W/day plus leuceana ad libitum. Feeding diets such as native grass, commonly fed in villages, resulted in live weight gains of 0.05 to 0.15 kg/day; while feeding diets of 100% leucaena or sesbania ad libitum resulted in average daily live weight gains of approximately 0.4 kg/day. The general recommendation from these studies is that high protein feeds should be included in the diet of

early weaned Bali calves at 10g DM/kg W/day. This will increase calf growth rates, promote more efficient feed resource use, in that the supply of high quality feeds will last longer, and provide small-holder farmers with greater flexibility when it comes to the marketing of their cattle.

The likely adoption of such feeding strategies requires implementation, monitoring, modification and demonstration under the constraints faced by small-holder farmers in the cropping-livestock system. To achieve this, best-bet options were implemented, monitored, adapted and demonstrated in villages at each of the four sites for at least 6 months in 2007 and 2008. The preliminary results indicate that the feeding strategies can be successfully implemented by small-holder farmers, resulting in significant increases in average daily live weight gain of early weaned Bali calves (Figure 3).

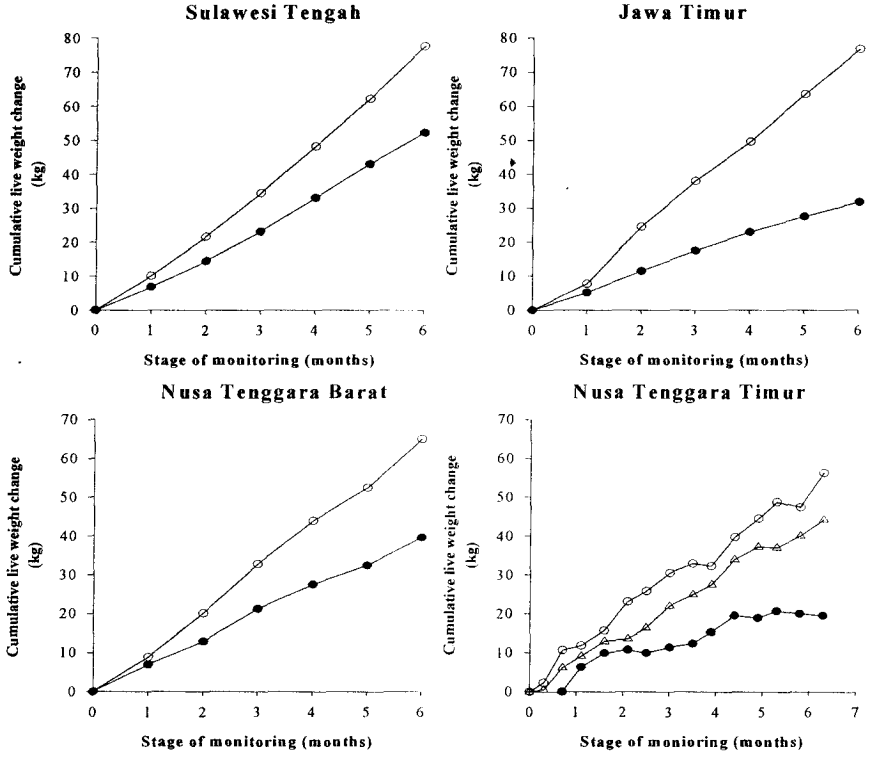

Figure 3 Change in live weight of control and treatment Bali calves aged 6 to 12 months in villages in Sulawesi Tengah, Jawa Timur, Nusa Tenggara Barat and Nusa Tenggara Timur. Control calves (•) were unweaned, with no nutritional intervention. All treatment calves were weaned at approximately 6 months of age, 70-100 kg live weight and fed approximately 10g DM/kg W/day of copra meal mixed with rice bran (○ , Sulawesi Tengah), leucaena (○ , Jawa Timur), sesbania (○ , Nusa Tenggara Barat) and leucaena (○) or forage legume (△ Nusa Tenggara Timur).

Feeding strategies to support a national increase in herd numbers.

Strategies such as the IVMS and changes in the forage resource base increase beef cattle production efficiency, through improved reproduction rate and increased live weight gain, and will increase the cash flow of small-holder farmers. However, these will not lead to large increases in the cattle population across Indonesia. The major constraints to an increase in the national cattle population are the quantity of feed and land available at a regional or national level and the labour inputs required to manage additional cattle. Presently, cattle numbers fit well within the current crop-livestock system and the available feed and labour resources. However, no new feed options are on the horizon which would potentially double biomass production whilst maintaining the status quo for staple and cash crops, such as rice, peanut, corn, mungbean and soybean. For a significant increase in the regional cattle population to occur a large biomass of an as to now unutilised feed resource must be available with no additional labour requirements.

Rice straw and other crop by-products are largely unutilised feed resources which exist in large quantities across much of Indonesia. Rice straw, in particular, is often simply burnt, contributing to air pollution. Potential exists to utilise these crop by-products as cattle feed resources, resulting in a more efficient system where the crop residues are fed to animals, converted to faeces and composted for fertiliser and biogas production, whilst maintaining or increasing animal production, rather than been wasted or burnt. There have been many attempts to use rice straw within animal feeding systems and they have largely failed. The main reason for this is that rice straw has been directed towards fattening cattle and, to do this, expensive straw treatment processes and supplements have been required. These can work but farmers stop using them because they are expensive, time consuming or require too much technical knowledge. Small-holder farmers generally want to keep inputs in cattle production systems to very low levels.

Based on the biological principals of early weaning and targeted supplementation it is possible to utilise the large quantities of these lower quality crop residues as a basal feed to meet the maintenance requirements of the non-lactating cow. This model has a strong biological basis and there is a good example of cow-calf production systems in northern Australia based on low crude protein (<4.0%) forages successfully weaning greater than 80% calves each year. This model uses the key features of the IVMS (early weaning, controlled seasonal mating, matching the quality of the feed resource to the requirements of the class of animal), where the calf is weaned at 5 to 6 months of age and fed less abundant high quality feed resources, such as newly introduced forages or tree legumes, while the non-lactating cow is fed untreated crop residues, such as rice straw, to meet maintenance requirements. Bali cattle are well suited to this system due to their lower feed requirements and their ability to recover body condition quickly after lactation on low to moderate quality feedstuffs. The use of crop residues in such a system would require no treatment or additional labour requirements, apart from removing from the field, drying and storing. It is likely that labour inputs would be reduced allowing labour inputs to be directed to other income generating activities or to the management of more cattle.

Conclusions

To support the proposed increase in cattle numbers across Indonesia a greater quantity of feed resources is required. This will require a change in feeding management where early weaned calves are preferentially fed less abundant high quality materials, such as new forages and tree legumes, at a fixed proportion of live weight while lower quality materials and crop residues, such as rice straw, are directed to the non-lactating cow for maintenance of body condition. The use of crop residues as a basal feed resource for non-lactating cows combined with early weaning, new forages and strategic supplementation of the early weaned calf have the potential to increase cattle numbers and the efficiency of cattle production systems across Indonesia. Such an initiative would go some way to meeting the Indonesian government's aim of achieving self sufficiency in beef cattle production.

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