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Improving Bali cattle production in mixed crop-livestock systems in eastern Indonesia using an integrated modelling approach.

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Summary

Increased demand for beef in south-east Asia has led to a rapid decline in cattle numbers in eastern Indonesia. A whole farm systems research study was undertaken to identify opportunities for increasing livestock production within the existing smallholder crop-livestock farming system. Preliminary analyses indicate substantial benefits from sown grasses and retaining grain legume crop residues for dry season supplementation of livestock.

Keywords: farming systems, animal production, modelling

Introduction

Eastern Indonesian farming systems are based on growing staple rice crops and cash crops (e.g. maize, cowpea, mucuna and cashews). Livestock provide additional cash with the average household herds of 1-8 animals. However, increased demand for beef has led to dramatically increased slaughter rates and a decline in beef numbers, including breeders. Although this demand provides opportunities to increase farmer welfare, animal production is constrained by limited resources and harsh climatic conditions, especially a short growing season. While Bali cows have potential for high fertility and mature weights of 400kgs plus, most mature cows weigh less than 300kg. While many forages are suitable to overcome the constraints, little use has been made of them, and they must suit the current farming system, social and economic structure, and land and labour resources. This paper describes a farming systems research approach to develop an integrated analysis tool to explore the opportunities and constraints to increasing the animal production of smallholders.

Methods

The existing crop-livestock systems and socio-economic structure were characterised by farmer surveys in a case study village in Sumbawa (SPA kampung, 8°30'S, 118°20'E, av. annual rainfall 1200-1300 mm, 90% in summer) and interviewing extension staff. Data included land area and classes, labour and cash resources, crop species, areas and yields, livestock numbers and sales, material and labour inputs, income, expenses, non-farm income and constraints. Increasing crop and livestock yields. New animal and economic models were combined with the APSIM crop model (McCown *et al.* 1990) in an integrated analysis tool (IAT). New models for rice and Elephant grass (*Pennisetum purpureum*) were developed to complement existing APSIM models for peanuts, stylosanthes, mucuna, lablab, cowpea and mungbean. The animal model was developed from published data and field data for monthly animal liveweight and seasonal forage quality, composition and quantity. The model

predicts liveweight change and calving in Bali cattle under grazing and cut and carry systems. A household socio-economic model identifies economic returns and resource constraints associated with new forage-livestock opportunities.

The models are linked within the IAT (Fig. 1) to enable a whole of system analysis of incorporating new forage and livestock options into the farming system. APSIM operates externally to generate crop stover and forage crop yield and quality data for a range of long-term scenarios (based on historical climate data) that are transferred to the IAT. Animal liveweights, calving numbers, labour requirements, crop yields etc are exchanged directly between the animal, crop and economic models through the IAT linkage. The interface allows users to set up and run a series of scenarios and compare the results with a baseline case. Output is presented in graph or tabular form describing crop and forage yield/biomass, animal liveweights and numbers, labour demands and utilisation, income from crop and animal production, gross margins and cash balances.

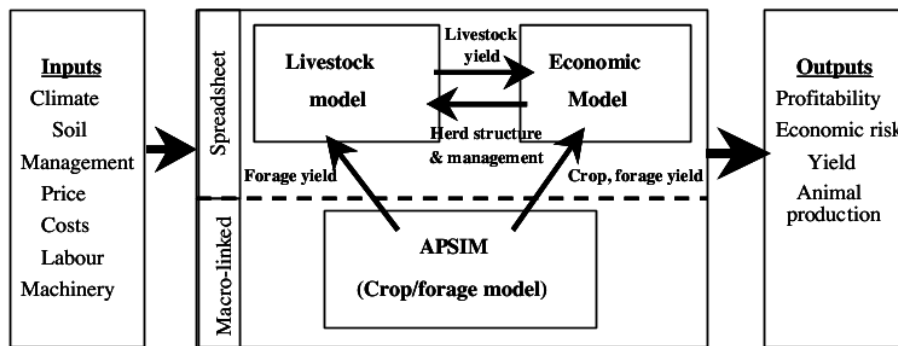


Figure 1. Framework of 'Integrated Analysis Tool'.

Case study: Increasing the animal herd of a smallholder farm in, Sumbawa, (a) utilising crop residue and (b) introducing Elephant grass

The SPA Kampung case study household had 3 parcels of land: a house lot of 0.25 ha, crop land of 0.75ha (land 1), and lower quality estate-crop land of 1ha (land 2). The household consists of 5 people, and has 2 cows and 2 calves. Rice is grown on land 1 and some groundnut on land 2 in the wet season, followed by cowpea and groundnut in the dry season. There are no legume fences and no crop retention. The model is run over 5 years, with a goal to increase the breeding cows from 2 to 4. The feeding system is very flexible; involving cut and carry, or grazing or a combination of both with switches between systems depending on feed supply, other farming activities and available labour.

Results

The baseline scenario indicates a forage shortfall of 5000 kg by year 5 (Fig.2a) and a labour shortfall of some 135 days. The quality of available forage remains quite high during the early dry season with crude protein ranging from 7 to 12% and dry matter digestibility ranging from 45 to 55%. Pasture yields were low at 1500-2500 kg/ha. Mature cows have 4 calves over the 5 years, and are in poor condition (Fig. 2b). The household sells 6-7 animals, and has 5-6 on hand at the end. Revenue from cattle in year 5 is Rp1.0M (Fig. 2c). There is a low cash balance (gross income less all other expenses) of Rp2.7M in the final year.

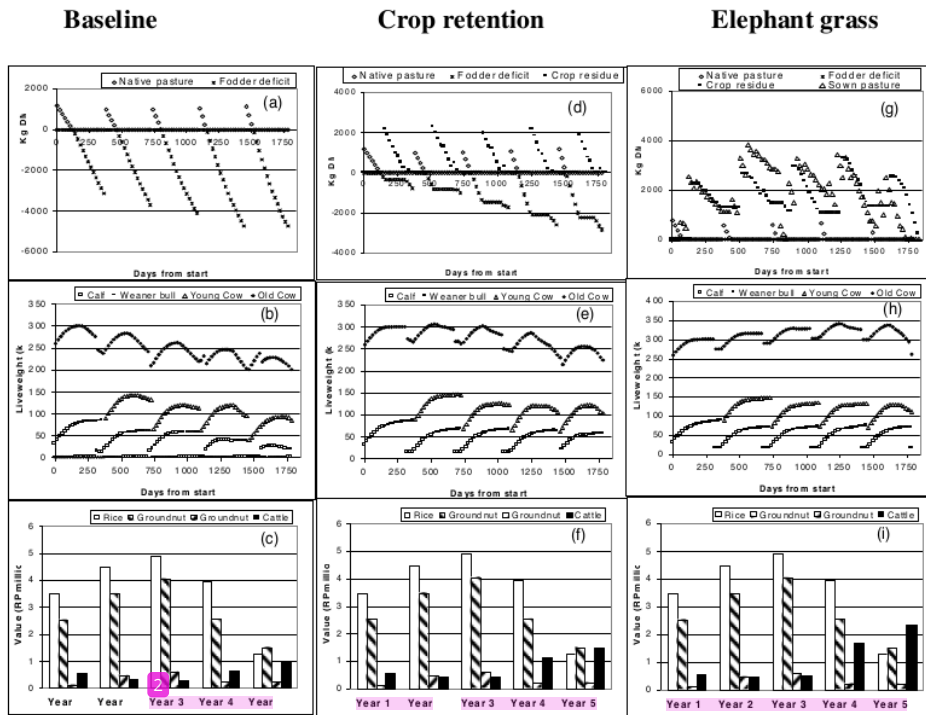


Figure 2. Graphic output for baseline, crop retention and sown pasture scenarios.

Retention of crop residue reduces the forage shortfall to 3500 kg in year 5 (Fig. 2d), with a labour shortfall of 60 days. Mature cows have 5 calves and animals are in reasonable condition (Fig. 2e). The household sells 7-8 animals over the 5 years, with 5-6 on hand at the end. Cattle revenue in year 5 is Rp1.5M (Fig. 2f), and the cash balance is Rp4.6M. Planting 0.3 ha of elephant grass on land 2 eliminates the shortfall in forage (Fig. 2g) and labour. Mature cows have 5 calves and animals are in good condition (Fig. 2h). The household sells 8-9 animals over 5 years with 9-10 on hand at the end. Cattle revenue in year 5 is Rp2.4M (Fig. 2i), with an increased cash balance of Rp6.2M.

Conclusion

A farming systems analysis approach has identified many possible options to improve livestock production and household welfare. Sowing a small area of improved pasture can greatly improve the profitability of a smallholding and allow it to increase herd size.

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Acknowledgement

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