Australian Government

Australian Centre for International Agricultural Research

RESEARCH BRIEF

Forage options for improved crop–livestock systems for Cambodia and Laos

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This research brief summarises

This research brief summarises the activities, findings and recommendations of a project commissioned by the Australian Centre for International Agricultural Research (ACIAR) - 'Management practices for profitable crop-livestock systems for Cambodia and Laos' (SMCN/2012/075).

Opportunities to greatly increase the productivity of forages have been identified by the research project. Additionally, some threats to the sustainable production of forages have been determined. The project also has explored a range of dissemination methods to increase the capacity of farmers and agricultural extension workers to promote improved practices.

The project conducted research in areas of Cambodia and Laos that have infertile, sandy soils and challenging seasonal conditions such as flooding and drought. The aim of the project was to identify and extend management practices that can increase the productivity, profitability and sustainability of forage production in these areas.

Background of the research

The livestock sector in Cambodia and Laos is crucial to sustainable rural livelihoods and food security, and it offers many opportunities for smallholder farmers, including women, and small- and medium-sized agribusinesses. Nearly all cattle and buffaloes in these countries are owned by smallholder farmers.

The intensification of livestock production by rural households has the potential to improve farm profitability and resilience by enabling smallholder farmers to access high-growth markets. Market growth has been brought about by increasing meat consumption resulting from economic growth, urbanisation and population expansion.

However, inadequate feed quality and quantity for livestock has consistently been identified as a major constraint to production. A solution to this problem is for smallholder farmers to grow perennial forage grasses to feed their own animals. This has been widely researched and demonstrated to improve the supply of feed for supporting increased livestock production in South-East Asia, including in Cambodia and Laos.

The development of forage grass systems in rice-based farming regions is closely aligned with priorities agreed by ACIAR and the Royal Government of Cambodia and the Government of the Lao People's Democratic Republic, in research strategies developed between the parties for 2019 to 2029. The specific priorities are:

- Sustainable intensification of market-oriented smallholder livestock production systems.
- Sustainable intensification and diversification of agriculture, focusing on non-rice crops in traditional crop-rice systems and alternative cropping systems.

The ACIAR project 'Management practices for profitable crop–livestock systems for Cambodia and Laos' (SMCN/2012/075) has conducted research in areas of Cambodia and Laos that have infertile, sandy soils and challenging seasonal conditions such as flooding and drought.

The project has built a partnership among a diverse group of stakeholders from Australia, Cambodia and Laos to research forage production to identify and extend management practices that increase productivity, profitability and sustainability.

In Cambodia, the project was primarily active in Takeo Province, which has a history of growing forage grasses, and Kampong Speu, where forages have recently been introduced by the project. In Laos, work was undertaken primarily in Salavan and Champasak provinces.

Research activities included surveys of forage growers and supply chain actors, on-farm research trials, the production of information posters and videos, and dissemination events in villages to share findings with farmers and extensionists.

"I previously spent an entire day to collect grasses far from home and had to buy rice bran to feed the cows, so it was costly and time-consuming. The forage production brings my family many benefits. The cows grow fast and we can earn money by selling them faster."

Mrs Chum Chanthorn, participating farmer from Samrith village, Tang Krouch commune, Samraong Tong district, Kompong Speu province of Cambodia.

Benefits of growing forage grasses

The benefits of growing forages in the context of smallholder farming systems are numerous and well-documented.

Income generation

Growing forage grasses provides households with an increase in the quantity and quality of livestock feeds, which can generate greater income from livestock – animals that are well fed and in good condition can achieve higher prices. Additionally, through silage making, irrigation and the selection of drought-tolerant varieties, forages can provide nutritious feed into the dry season when feed is scarce and livestock are typically fed low-quality roughages such as rice straw. Farmers who are able to supply better feeds to their animals in the dry season have a market advantage because the general quality of livestock in markets is in decline.

Labour saving

Intensive time and labour requirements of traditional livestock feeding practices can be reduced by growing forages. Perennial forages can be planted to provide feed in accessible locations. Varieties with traits that increase the ease of harvesting compared with uncultivated grasslands can be planted, significantly reducing the labour required to feed livestock. Labour savings are more pronounced after initial establishment because planting is unnecessary in subsequent years. Typical labour savings of 2 hours per day for each household have been reported in studies from Cambodia and Laos.

Environmental benefits

Increased soil organic matter accumulation and carbon sequestration through forage root growth, litter fall and biomass accumulation have the potential to improve the system benefits. Deep-rooted perennial forages limit soil erosion and can sequester an estimated 4 to 14 tonnes of carbon per hectare per year in the top metre of the soil profile – noting that there will be an upper limit to carbon accumulation over time. Perennial crops reduce the need for tillage and recycle residues, both of which can improve the physical, chemical and biological properties of soils.

Options

It may be possible to grow forage grass in locations and years where producing a grain crop is not possible, such as sandy soils prone to both flooding and drought. Identification of the correct place in the landscape and associated hydrology is an important consideration.

Climate variability adaptation

Because perennial forage grasses can last for many seasons after they are planted, there are reduced risks associated with planting inputs once established. Furthermore, the risk of crop failure due to environmental conditions is reduced because the product is biomass rather than a grain, which is less sensitive to climate shocks. Once established, forage grasses are present in the field and available to take advantage of out-of-season rainfall, without the farmer having to take additional planting risks.

Key findings and lessons learned

Species selection, preferred planting sites, availability of planting material

Several broadly adapted perennial tropical grasses have been evaluated in challenging conditions of South-East Asia, including on infertile sandy soils in Cambodia and Laos. Some varieties have been introduced to farmers as part of development projects. Broadly adapted species adopted by farmers include *Urochloa* hybrid 'Mulato II', *Megathyrus maximus* cultivars 'Simuang' and 'Mombassa', and *Paspalum atratum* cultivar 'Terenos'. Most of these varieties are typically tolerant of either flooding or drought, but not both.

Variations in landscape at the farm scale affect the suitability of forage varieties. *Urochloa* hybrid and *Megathyrus maximus* cultivars are recommended for drought-prone, acidic sands that have less risk of flooding. At sites lower in the landscape that are prone to temporary flooding in the early wet season and hold residual water later in the year, the best varieties are those that are tolerant of flooding but have higher water demands such as *Paspalum* and locally available paragrass (*Urochloa mutica*). These varieties may require supplementary irrigation in the dry season.

Farmers who have an awareness of forage grasses and a desire to grow and manage them report difficulty acquiring seeds or planting material. Farmers who are beneficiaries of development projects often become epicentres of scaling out by providing or selling live planting material to other farmers, however the trade of live planting material is limited by distance and interpersonal relationships. Often the farmer cannot maintain a perennial pasture for more than a few years, and then availability decreases. The purchase of seeds often occurs at the end of segmented, cross-border value chains with little customer choice or quality assurance.

There is a need to strengthen the availability of forage grass planting materials in Cambodia and Laos.

Soil nutrition for forage grasses

Nutrient management for continuous forage grass production is different to grain production for crops like rice or maize. When growing crops for grains, farmers typically aim to ensure there is adequate fertility for their crops to produce a single harvest of grain each year. Accordingly, recommendations to farmers for producing grain crops can be simplified as target amounts of inputs.

By contrast, production from perennial forage grasses is continuous and harvests are made repeatedly in a single year, depending on productivity and need. Each harvest removes nutrients from the system that must be replaced. Fast growth and high production in the wet season, due to high temperature and moisture, can quickly deplete soil reserves of nutrients until one or more nutrient deficiencies occur, unless nutrient outputs are matched with inputs. Conversely, applying nutrients to reach a target when water is too low to increase plant growth could result in waste, because even when well nourished, the forage grass cannot grow without water.

The research team found that most farmers and extension staff in Cambodia and Laos are not accustomed to managing perennial grasses and have very limited understanding of responsive fertiliser application. Local farmers do not think of soil fertility in terms of providing specific nutrients to plants, and do not comprehend the quantitative aspects of soil nutrition at the levels required to make informed and efficient decisions about fertilisers. There is little knowledge of specific nutrient deficiencies and associated plant symptoms. Furthermore, although farmers preferred rigid guidelines, good management requires that they be prepared to respond to seasonal conditions with flexible and appropriate nutrient management.

Guidelines for forage nutrition are uncommon and generally do not account for the high concentration of potassium removed in leaf tissue or the seasonal variability in nutrient use by plants. Results showed that even at the very high nutrient rates provided by various livestock development agencies in the Mekong region, a further 9 tonnes/hectare of feed dry matter per year (50% increase, equivalent to roughly 45 tonnes of fresh grass) can be produced with potassium supplementation in a wet year.

There is a need to better educate farmers on how to recognise and respond to nutrient deficiencies in forages.

Implications and recommendations

Strengthening local knowledge of plant nutrient management

Forage grass production requires effective nutrient management to maintain yields over the long term. Education and training of extension staff and farmers is required. Specifically, forage producers require an awareness of what nutrients are required by forages, and which products on the market contain these nutrients.

The significance of potassium as a nutrient for high-performing forages should be emphasised. Farmers require training to understand that nutrient deficiencies are more likely to occur after forage grasses have been highly productive, because more nutrients have been absorbed from the soil and removed through harvest to feed livestock.

To enable farmers to efficiently supply nutrients, they need to be able to recognise and respond to specific nutrient deficiencies.

Recognize and Respond is therefore the theme of a series of posters created by the project and shared amongst project participants for wider display. These posters also contain QR code links to a series of video guidelines on five different aspects of forage grass management.

The research team recommends widespread dissemination of these posters and videos.

***Recognize and Respond* poster series**	***Recognize and Respond* poster series**	**Forage production video series**
Khmer language	Lao language	Khmer language

Investing in stronger forage value chains

Harnessing the benefits of growing forage grass in Cambodia and Laos requires investments that bring about stronger forage value chains. Specifically:

- improving access to a range of forage seeds and planting materials
- developing agribusiness services options to improve fodder markets and implement silage making from forage grasses
- building on existing, high-potential sites of forage adoption for scaling out and linking them to new sites through farmer-to-farmer learning, facilitated cross-site visits and farmer field days.

Further reading

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ACIAR project

Management practices for profitable crop–livestock systems for Cambodia and Laos (SMCN/2012/075)

Commissioned organisation

The University of Adelaide

Partner organisations

Murdoch University; Cambodian Agricultural Research and Development Institute (CARDI); Royal University of Agriculture, Cambodia (RUA); Livestock Development for Community Livelihood Organization (LDC); Lao PDR National Agriculture and Forestry Research Institute (NAFRI); National University of Laos (NUoL)

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Recogonize and Respond to Macronutrients Deficiency in Forages

Scan here forView information online

Project SMCN/2012/075 Management practices for profitable crop livestock systems for Cambodia and Lao PDR

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Recogonize and Respond to Macronutrients Deficiency in Forages

Recognize and Respond to Sulfur (S) Deficiency in Forages

Forages require small amounts of sulfur (S) to grow. When there is not enough sulfur in the soil, they grow poorly. The colour of the plant changes from green to yellow, starting with the youngest leaves. This is different nitrogen deficiency which causes oldest leaves to become yellow first. Nitrogen limitation is more common than sulfur.

Sulfur is sometimes found in compound fertilizers, however it is not as common as other nutrients. If a fertilizer contains sulfur, it should say so clearly on the bag, for example 16–16–8+13S.

Recognize and Respond to Phosphorus (P) Deficiency in Forages

Forages require phosphorus (P) to grow. When there is not enough phosphorus in the soil, they grow poorly. Red lines become visible leaves, starting from the edges, like in the photos.

If you apply lots of cow manure to your forages, phosphorus deficiency should be uncommon. If a Phosphorus deficiency is identified, Diammonium Phosphate, also called DAP or 18–46–0 contains a relatively high concentration of Phosphorus. It is also included in lesser quantities in other blended fertilizers, like 15–15–15.

Recognize and Respond to Nitrogen (N) Deficiency in Forages

Forages require Nitrogen (N) to grow. When there is not enough nitrogen in the soil, they grow poorly. The colour of the plant changes from green to yellow, starting with the oldest leaves, like in the photos.

Most farmers apply Urea, which is a good source of nitrogen. Manure also contains nitrogen, but not high amounts. Other fertilizers might also include nitrogen. If forages are not growing well even when there is enough water and nitrogen, look for the signs of other deficiencies in the field.

Recognize and Respond to Potassium (K) Deficiency in Forages

Forages require potassium (K) to grow. When there is not enough potassium in the soil, they grow poorly. Yellow lines become visible on the leaves and the edges may appear burned like in the photos.

Sandy soils are more likely to have low potassium. If potassium deficiency is suspected in your forages, apply the same amount of 0–0–60 (potash) to your field as you do urea each time you apply fertilizer. 0–0–60 is the most economical form of potassium fertilizer.