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Sustainable Management Practices for Profitable Crop-Livestock Systems in Cambodia and Lao PDR



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This issues brief is based on a pilot study conducted by the University of Adelaide and Murdoch University, on behalf of the Australian Centre for International Agricultural Research (ACIAR).

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Enhancing the resilience and productivity of rainfed systems in Cambodia and Lao PDR is a priority for ACIAR. In these regions there are still large gaps in understanding soil types and their suitability for crop-livestock farming systems. Opportunities to develop new systems and transfer knowledge and technologies to Cambodia and Lao PDR agriculture need to be explored.

Introduction

The agricultural production environment in Cambodia and southern/ central Laos is, in general, harsher than the fertile lowlands of other countries in the region. Soils are generally low in fertility with significant water limitations, and three-quarters of the agriculture is rainfed. The predominance of rice-based farming systems on infertile, poorly structured soils means that current agriculture has rather low productivity on both a labour and a land area basis. Hence, a priority for both Cambodia and southern/ central Laos is to design and implement a sustainable intensification of land use to increase profitability of these farming systems.

There are examples from low fertility soils in south-central coastal Vietnam where livestock intensification has produced significant improvements in household livelihoods (Ba et al. 2013). However, further investigation is needed to determine the relevance and application of livestock intensification across the uplands and lowlands of Cambodia and Lao PDR. The strong demand for beef suggests that intensification involving cattle production will readily link farmers to markets and increased profitability. Increases in profitability and farming systems intensification will contribute to food security which is central to agricultural development in Laos, and Cambodia.

Potential modifications to farming systems that lead to sustainable intensification, according to land and water resources, need to be identified and assessed. These changes in farming systems will need to be socially, culturally, economically aligned and take advantage of new and emerging markets for crops and beef in the region, particularly in Thailand and Vietnam. To capitalise on these market opportunities, substantial changes in current production systems will likely be required for small holder farmers.

Key issues for Cambodian and Laotian food security include research and development that underpins agricultural diversification, particularly into non-rice field and ruminant livestock enterprises. There is also a pressing need to reduce the vulnerability of Cambodian and Laotian agriculture, particularly rainfed cropping, to climate variability and change. The adoption of new crop-livestock farming systems depends on the availability of suitable soil and water resource technologies.

Integrative Farming Systems

Small holder farms in Laos (particularly in central and southern regions) and Cambodia occupy large areas of low fertility sands. Subsistence cropping of rice and other crops, and open grazing of livestock are the main enterprises of these farms. However, these farming systems are changing and under challenge due to labour shortages, which are driving shifts towards direct seeding of rice. Mechanisation and the use of two-wheel tractors, in particular, have changed the reliance on livestock as draft animals and created the opportunity to view livestock as an income-generating production system, rather than a burden or competing enterprise on farms in Laos and Cambodia.

Following a pilot study of the farming systems on low productivity sands in Laos and Cambodia, the resulting strategies were formulated to provide greater diversify in these systems and bring significant benefits to the economic and social fabric of impoverished communities:

Strategy 1: Potential for farming success

Review the current status of cropping and livestock systems in Laos and Cambodia particularly those related to sandy terrain. Identify the potential productivity of crops and forage pasture in these regions through modelling and field experimentation.

Strategy 2: Changing restrictive management practices

Develop solutions to intensify crop and livestock systems in the key regions, incorporating relevant innovations and technologies. Assess the potential to modify farming systems to increase intensification of crop / livestock systems

Strategy 3: Expanding knowledge and promoting uptake

Establish appropriate farming-scale models to test the potential outcomes of interventions. Work in a participatory modality with villages to define rules of participation and management for communal and private land.

Strategy 4: Building new systems

Develop assessment skills to quantify production from intensive crop / livestock farming systems. Improve the design of farming systems and provide training for local research and extension staff.

Strategy 5: Managing socioeconomic impacts

Develop a robust economic model of the potential impact of crop intensification on farm household livelihood. Assess the socioeconomic implications of intensification of crop / livestock systems in Laos and Cambodia, including gender impacts and potential for adoption of technology. Explore strategies for scaling out the project outcomes.

Current agricultural landscape

The poor nature of upland soils in Cambodia and southern/central Laos contributes to decreased productivity, mostly due to low fertility and waterlogging, which is not experienced in the more fertile lowlands. The predominance of rice-based farming systems on these infertile, poorly structured soils means that current agriculture has rather low productivity on both a labour and a land area basis. Soil, land and water resources could play a critical role in increased productivity of farming systems, however the land and water resources of both Cambodia and Lao PRD are still poorly described (Bell et al. 2005; Seng et al. 2005).

Seasonal variations and soil factors affect production

Large areas of Cambodia and Laos are covered by acid infertile sands (MRC report- soil map), in both uplands that are susceptible to erosion, and lowlands where seasonal waterlogging occurs annually. Small holder farms in Laos (particularly in central and southern regions) and Cambodia occupy large areas of these low fertility acid sands. Subsistence rainfed rice and open grazing of livestock are key enterprises of these farms. However, these farming systems are changing, with labour shortages driving shifts towards direct seeding of rice and an associated decrease in dependence on livestock for draft purposes.

The agricultural areas of relevance in Cambodia and Laos have a semi-arid tropical savannah climate with annual rainfall varying from 1100-2200 mm. A long dry season from November to



April limits crop and livestock productivity during this period unless irrigation is available for forage production or fodder reserves produced in the wet season can be held over for dry season feeding. The early wet season (April- July) varies in intensity and reliability of rainfall. It may produce valuable feed for livestock and opportunity cropping, but

waterlogging risks in the lowlands are high. On the other hand, there may be missed opportunities to use early wet season soil water because planting of rice is delayed until ponded water has accumulated in fields. Wet season rainfall between July and October may be intense and cause waterlogging depending on relief and soil type. The duration of wet season rainfall and amounts vary from year to year and spatially within toposequences¹.

¹ In the lowlands and gently undulating landscapes of southern/central Laos and Cambodia, toposequences typically have a relief of 1-30 m and extend along an axis of 100-500 m. Along the toposequence, there is a gradient in hydrology and soil texture which substantially affects water balance and crop productivity. Hence the toposequence is proposed as the appropriate unit of landscape in these study areas

Intensifying and diversifying farming systems

Agriculture is the most significant contributor to GDP in the rural regions of Laos and Cambodia. Around 80 % of households in Laos and Cambodia are involved in agricultural production. Agricultural production and food security has increased in Laos and Cambodia in the last decade (Mainuddin & Kirby 2009), much of which is related to increased rice yields. At present, there are 0.783 and 2.3 million farms across Laos and Cambodia respectively (Penh 2010), a third of which have some sandy soils. An increase of 10% in productivity in only 10% of these farms on these soils is predicted to increase annual production by US\$0.4 billion for Laos and close to US\$1.2 billion for Cambodian impoverished farming communities.



To achieve this increase in productivity, diversification and sustainable intensification of crop / livestock systems has promise for increased profit from agricultural production. Improved production in livestock systems can build on the legacy of forage breeding and selection in the region that has identified a range of well-adapted, productive pasture and forage species for sandy soils in Laos and Cambodia. Increased production has been approached in the past through the additional incremental selection of suitable forage genotypes, or management of livestock (Bush et al. 2014; Nampanya et al. 2014). It is also important to consider water use in these systems, as this will assist in defining the key opportunities that can be readily implemented within current farming systems. However, the key to increasing total farming system productivity in the defined regions of Cambodia and Laos is to focus on the whole-farm system change rather than on components.

Diversification of agriculture is already showing some uptake, with increased production of upland crops like maize, soybean and cassava. There are also regions of crop intensification where irrigation is available. Livestock intensification and integration with cropping represent an additional, largely untapped, opportunity for increased farm productivity. The adoption of integrated crop-livestock farming systems depends on the availability of suitable soil and water resources, or technologies to overcome soil and water limitations. Overcoming these limitations will greatly improve national food security and household income, but requires significant changes to the current farming systems. Capitalising on emerging domestic and international market availabilities, particularly for beef, will also be an integral part of the intensification of current farming systems.

Community engagement

It is suggested that appropriate community-based participatory extension models be applied to designing and implementing farming systems change. Participatory Land Use Planning (PLUP) is a decision support tool aimed at identifying land use change opportunities and addressing them at the farming system scale. Although there have been a number of weaknesses associated with the precursor policy (LUP), PLUP is a policy method designed to change land use to more productive and sustainable solutions (Bourgoin et al. 2011). The success of PLUP as an agent for land use change requires active involvement from members of village land management committees, to promote adoption of new land uses, land management techniques and to improve understanding of long-term sustainability (Bourgoin & Castella 2011).

For Cambodia and Laos, PLUP committees should consist of key personnel from representative sectors (government, private, NGOs etc) and focus on delivering crop/livestock systems that are suitable for upland and lowland areas with low fertility sands, particularly through the optimal use of available soil moisture and alleviation of soil fertility constraints. The challenge is to identify workable solutions that will result in sustainable agricultural intensification and greater profitability for farmers on the extensive areas of sandy soils in southern Laos and southeast Cambodia.

In the system used by CIRAD researchers in northern Laos (Bourgoin & Castella 2011), farmers are engaged to understand if there are opportunities for village groups to more effectively use their land resources, provide community-based forage for animals and to create a system in which to effectively use and limit exploitation of the communal forage supply. A key outcome of the implementation of PLUP is to apply options to make substantial improvements to agricultural systems through technological innovations and land use change. This process can be used to provide new integrated opportunities to the farming communities

The economic and social implications of re-designing crop and livestock systems in Laos and Cambodia also need to be addressed, as a component of implementing step change impacts in food production. It is also important to disseminate information through a variety of formats, for example booklets, meetings, factsheets and workshops conducted in the native language, to ensure adequate extension of key processes to farmers. This integrative approach to the dissemination of information on a village scale has also been shown to be more effective than the original method, which focused on individual beneficiaries (Bourgoin et al. 2011).

The economic and social issue

Agricultural products account for only a quarter of Laos and Cambodian farmer's income, with many seeking off-farm work and income from other sources (Tong, Lun & Sry 2013). As mentioned earlier, a 10% increase in productivity in just 10% of these farms on these land forms will result in a significant economic gain for Lao and Cambodian smallholders in generally impoverished farming communities.



Since farming households make up 80 % of households in Laos and Cambodia, changes to the farming system will have direct impacts on the farming households and communities. Farming communities in Laos and Cambodia are already dealing with the consequences of increases in labour costs, increased urbanization, increased farm mechanization and potential changes to farm sizes. Given that women also undertake most of the manual farming labour in Lao (Penh 2010), it is important to consider the implications of farming system changes when proposing increases in intensification and alterations in farm management. Changes in production systems may also potentially lead to the creation of new markets and products, but again, will depend on the exact nature of the changes to farming systems.

Increasing intensification has the potential to provide an increase in value of over US\$1.6 billion to Laos and Cambodian farmers. The successful intensification of agriculture in parts of Thailand serves as a useful model for Laos and Cambodia to emulate. However, there are some drawbacks to this model, for example the requirement for accessible farm labour and water availability (Fukai & Ouk 2012). Therefore, research is essential to adapt models of intensification

to meet market, cultural, social, economic, labour, and farm management requirements in Southern Laos and Cambodia. Furthermore, a focus on the opportunities in sandy soil environments provides a clear target for research that benefits the farming communities.

Questions for further research

How can a sustainable intensification of crop and livestock farming systems on sands be achieved in Cambodia and Laos?

The current agricultural climate in Lao PDR and Cambodia offers a large scope for change and improvement. Drawing on previous studies into cropping constraints in the upland areas, there are still many issues that need to be resolved as outlined below.

- What is the water-limited potential for crop and forage production on the sandy landscapes in Cambodia and Laos?
- What current constraints and what management practices can be developed to increase crop, forage and crop residue production?
- Can crop / livestock systems be better designed for greater integration and resilience?
- What farming systems solutions can be developed through participatory land use planning?
- What are the economic and socio-economic implications and benefits from intensifying both crop and livestock systems for farmers and communities?

These questions could be addressed through a comprehensive analysis of the productivity potential for integrated crop / livestock systems in sandy terrain, and the definition of management practices (soil-based, rotations/sequences, crop management) that can alleviate limitations (e.g. seasonal conditions of drought or waterlogging). Other factors that must be considered are the evaluation of the socioeconomic impacts of changing crop / livestock intensification for communities and the development of a robust model of the potential economic impact of crop intensification on household livelihood. The adoption of a participatory methodology (PLUP), to identify communities or villages to work with in establishing a farm-scale model of intensification may assist with the successful implementation of newly devised farming systems.

Conclusions

Upland farms in Cambodia and Laos are often unproductive due to low fertility soils and water constraints, both drought and waterlogging. The farming systems currently consist of rainfed cropping and open grazing, but due to reduced dependence on livestock for draft and to labour shortages, there is a need to intensify and diversify these systems. Greater integration of livestock production systems into cropping systems is a significant opportunity to increase agricultural productivity and profitability, which will have a major impact on rural communities and national GDP. This strategy must be approached carefully, however, to identify and assess solutions that are environmentally, economically, culturally and sociologically aligned. Suggested changes need to be implemented through appropriate and effective dissemination and uptake pathways.



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