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Trade and Environmental Sustainability in Cambodia: A Case Study of Rice, Cassava, and Fish

By

MINISTRY OF COMMERCE and UNDP CAMBODIA TRADE PROJECT

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Acronyms/Abbreviations

ARTNeT	–	Asia-Pacific Research and Training Network on Trade
CARDI	_	Cambodia Agricultural Research and Development Institute
CDRI	–	Cambodia Development Resource Institute
CTIS	–	Cambodia Trade Integration Study
GTZ	–	Gesellschaft für Technische Zusammenarbeit
IFPRI	–	International Food Policy Research Institute
JICA	–	Japanese International Cooperation Agency
MAFF	–	Ministry of Agriculture, Forestry and Fisheries
MoC	–	Ministry of Commerce
RSA	–	Royal School of Administration
RULE	–	Royal University of Law and Economics
SWAp	–	Sector Wide Approach
TRADE	–	Trade-Related Assistance for Development and Equity
UNDP	–	United Nations Development Programme
UNESCAP	–	UN Economic and Social Commission for Asia and the Pacific
WTO	–	World Trade Organization

Executive Summary

This report, prepared by a team of young Cambodian researchers assembled under the Trade-Related Assistance for Development and Equity (TRADE) project,[1] examines the possible environmental impact to result from intensified production and international trade in rice, cassava, and fish.

The team's key findings include:

- The application of chemical fertilizers is widespread in rice farming, with farmers using it to increase the yields of their second (and sometimes third) yearly plantings. Farmers understand that its use has negative consequences for the long-term sustainability of their land (overwhelmingly, their most valuable asset), and also feel that chemically fertilized rice is qualitatively inferior to organically grown rice, but they continue to use the artificial inputs.

  The literature survey indicates that farming using chemical fertilizers is only marginally profitable (owing in large part to the high cost of the fertilizers themselves) and that environmentally sustainable "biodynamic" methods could greatly increase the activity's profit margin. However, the field interviews showed that farmers either do not know about these methods or perceive them to be too complex to undertake.

- Cassava production can be environmentally sound if remediation measures are undertaken in tandem with harvesting. The field research shows that many of the largest growers understand this and are taking appropriate action to protect their land's vitality (e.g., avoiding mono-cropping, using natural fertilizers, changing seed varieties, etc.). However, the nation's small landholders do not understand or are not aware of these remediation measures and, as a result, continue to utilize a system in which they abandon their land when yield falls, moving their farms to unclaimed plots on which to repeat the cycle.

- The report finds that previous studies on agricultural production and trade in Cambodia overlook several ways in which farmers – especially small farmers – can utilize integrated approaches to farming to generate greater income and also safeguard the future productivity of their land. By promoting rice field fisheries, to use one example from the study, rice fields are fertilized naturally and farmers enjoy the revenues generated by the sale of their fish, which, the research shows, can eclipse that which they earn from the sale of rice.

[1] The Research Team included Prof. Adam Fforde (University of Melbourne and Victoria University, Australia), Mr. Bell Oudamketya (RULE), Mr. Kheang Praneth (RULE), Mrs Menh Vuthisokunna (RULE), and Mr. Om Macthearith (RSA). This Research Brief is based on a draft version submitted by the research team in September 2010.

Introduction

The study focuses on the interplay between trade development and environmental impact in three products that generate, or have the potential to generate, significant export revenue: rice, cassava, and freshwater fish. The focus on environmental impact was selected both because it is a critical component of sustainable development and the Millennium Development Goals, and because it is inextricably linked with the production of agricultural goods, which have the potential to significantly increase the Cambodian export base.

The research had two components:

- A review of the existing literature on the three sectors, linking trade sector development with the resulting environmental implications generated; and,

- Field research, which entailed the newly formed research team applying its skills to the task of understanding how the linkages outlined in the literature were supported by primary data collected in the field

Literature Review

Before conducting field research, the team assessed the body of existing literature and the extent to which it might provide explanations about the roots and determinants of fast economic growth over the last decade in Cambodia. The team's main conclusion is that a large portion of existing research tends to overlook the micro-level dynamics that promote change in the Cambodian context.

While many authors and reports focus on governance problems and policy-related constraints undermining growth potential, the team chose to focus on the process of accumulation of human, social and physical capital at farm level, and on the "flexibility and mutability"[2] of norms and behaviours prevailing among rural Cambodian households. Against this background, farmers' livelihood strategies thus become the vectors through which trade and environment dynamics take shape.

Rice

The use of chemical fertilizers and pesticides is the central issue covered by most studies that examine the environmental impact of modern rice production. Most studies also examine the link between the application of chemical fertilizers, the profitability of using these inputs for farmers, and the production of rice for export purposes.

[2] See Ledgerwood, Judy, "Decision-making in rural Khmer villages," in Ed. Ledgerwood, *Cambodia Emerges from the Past – Eight Essays*, Southeast Asia Publications, Center for Southeast Asian Studies, Northern Illinois University, 2002.

Several reports focusing on the rice sector agree that the application of chemical fertilizers – which typically are introduced by market actors – runs counter to traditional practices (e.g., relying on natural fertilizers such as green manure), which are considerably more environment-friendly. However, there is less agreement on the issue of whether this is a positive or negative development.

Although, surprisingly, none of the available studies factor the declining value of the farmers' land holdings into their equations, there are still different views on its benefits to the farmers in terms of income.

For instance, JICA finds in a 2008 study that:

> *If a farmer follows the Cambodia Agricultural Research and Development Institute (CARDI) recommendations for fertilizer applications of urea at 50 kg/ha, and DAP at 75 kg/hectare, this would be an up-front cost of US$102.50 per hectare to a farmer. Simply stated, Cambodian rice farmers would not likely see yield increases high enough to justify the cost of the recommended rates of nitrogen. The continued use of fertilizer seems to be a question of the absolute cost of fertilizer, and not one of adequate supplies in the marketplace, or its recognized efficacy in improving yields.*[3]

A 2004 GTZ study finds that replacing reliance on chemical fertilizers with the use of "biodynamic" techniques, e.g. Systems of Rice Intensification (SRI), that harness biological factors that influence rice tilling and final grain yield (e.g., soil tilth, water management, transplanting practices, early weeding, and seed selection) can be a preferable strategy.[4]

The study finds that, even when the relevant techniques have been adopted only partially by participating farmers, those farmers experience a 40 percent increase in yield. Interestingly, those yield increases are accompanied by a 75 percent increase in net income per hectare, with the difference being due in good part to the farmers' substantial reductions in costs of production – a result of the elimination of expensive fertilizer purchases.

A 2006 Oxfam America study finds that a programme to help farmers change their techniques to "fair-trade", organic practices can result in the farmers producing as much rice as they did while using chemical inputs, and, furthermore, also see their profits more than double.[5]

The picture offered is one where the new techniques, including the use of chemical inputs, are such that farmers' cash costs are seen as relatively "high" compared to expected returns, while for non-chemical techniques input costs are lower and net earnings therefore higher. But the literature does not suggest why non-chemical techniques are not being adopted widely. The main arguments are either because farmers are slow to adopt newer techniques, such as SRI, or that such methods impose "hidden costs", perhaps, for instance, by placing new

[3] JICA, *Sector Analysis and Value Chains, 6.1: Rice*, JICA, July 2008.
[4] GTZ Technical Paper No 3, *Organic Rice Programme*.
[5] Perera, Andrea, *Cambodian Rice Farmers Go Organic*, Oxfam America. 2006.

time-consuming responsibilities upon women at crucial, labour-intensive times, such as transplanting.

However, the benefit of pursuing a "greener" rice industry remains a matter of debate. A 2009 International Food Policy Research Institute (IFPRI) study argues that the output gains recorded by the use of chemical inputs are eventually worth the costs.[6]

Even while acknowledging that these practices lead to only minimal gains in farmer income, the study finds that the increases in rice production help foster the growth of a higher value-added domestic rice sector and also reduce consumers' cost of purchasing rice. Both of these macro-economic national gains, it argues, are sufficiently worthwhile to the Cambodian economy to justify higher costs of production.

In sum, the existing literature is marked by opposing views on the different rice production methods and the income distribution issues associated with them. It also is weak in addressing the long-term effects of modern techniques on the value of the land.

The short-term focus of the surveyed literature indicates an analytical focus on export possibilities, and tends to neglect the positive effects of domestic demand for natural rice. The main conclusions of the literature review include a belief that national targets of increased rice output and land yields may not be consistent with farmers' desires to increase their net incomes, both now and – probably more importantly – over the medium-to-long term.

Cassava

The link between cassava and international markets is indisputable, as the great majority of the local output is exported either raw or semi-processed. Studies examining the impact of trade in cassava on the natural environment typically focus on one of two elements:

1. The way in which growing the root exhausts the soil, depleting its nutrients; and,
2. The air and water pollution that arises from processing the raw commodity.

Most studies examining the sector dedicate limited – if any – attention to cassava's environmental consequences. Although most acknowledge the potential for harm from a large-scale national cassava industry (especially as the use of chemical fertilizers appears to be expanding), the general view is that the activity is presently of a sufficiently small scale not to pose significant threat.

Some studies, however, do focus on the impact of cassava on natural resources. A 2007 analysis of the product, for instance, examines the conventionally held view that cassava is an "exploitative" crop, a term that alludes to its propensity to significantly diminish the fertility of the soil in which it is grown.[7] The report, while acknowledging this possibility, also

[6] Yu, Bingxin and Shenggen Fan, *Rice Production Responses in Cambodia*, IFPRI 2009.
[7] Preston, T.R., *Potential of Cassava in Integrated Farming Systems*, 2007.

demonstrates that cassava farming – which can capture nutrients from animal manure – can be a sustainable activity if the product is grown as part of an integrated crop/livestock system.

Another study suggests that the practical harm done by cassava cultivation in Cambodia arises from a lack of understanding in the small-scale farming community about the optimal techniques for growing it.[8] In particular, if farmers knew about the dangers of mono-cropping, much of the actual harm to future soil viability could be averted.

This research team found that, while the environmental consequences associated with cassava's production are acknowledged and discussed in the literature to varying degrees, the environmental consequences associated with local cassava processing are left unexplored.

Fish

In dealing with fish, the research team sought to analyze the presence of fish *within* farming systems. This choice draws on modern analyses of rural economies, such as those common in Southeast Asia, where sub-systems of production can be closely integrated. This frequently generates environmental benefits, as fish farming creates by-products that can provide natural inputs to such crops as rice and cassava, thereby decreasing the use of chemical inputs.

The research team found that the available literature neglects to focus adequate attention on the role of rice field fisheries, which are a significant source of fish and other aquatic animals and which provide rural Cambodians with important sources of both nutrition and income. As demonstrated by Hortle et al,[9] a lack of quantitative information contributes to rice field fisheries being overlooked by development planners. This oversight often results in promoting growth in rice production to the detriment of the fisheries. What is even more striking in Hortle's findings is that the capture fishery activity can generate even greater revenue for the farmer than the production of paddy rice.[10]

However, the literature does agree on the growth potential of aquaculture-based fish production, which it finds can be exploited in conjunction with raising livestock and the watering of rice or cassava fields, thus contributing to the practice of integrating fish within farming systems.

In gauging the industry's relation with international trade, most of the literature concludes that the great majority of fishing sector output will be consumed domestically. The research team viewed the growth in aquaculture fish output as a means to boost Cambodia's balance of trade, through what amounts to *de facto* import substitution. The growing local production presumably would displace some of the significant amount of fish that is imported from Vietnam for local consumption.

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[8] UNDP Cambodia/Emerging Markets Consulting, *Cassava Industry Study*, Draft Final Report, 2008.

[9] Hortle K.G., Troeung R., and S. Lieng, *Yield and Value of the Wild Fishery of Rice Fields in Battambang Province, near the Tonle Sap Lake, Cambodia*, MRC Technical Paper No 18, Mekong River Commission, 2008.

[10] This is a recurring argument when dealing with the politically sensitive debate over the clearing of flooded forests. This practice allows farmers to increase significantly rice production, thanks to the extremely fertile land, but at the expense of fish stocks spawning in the flooded woodlands.

The literature does not report on the environmental damage arising from aquaculture fish production in Cambodia. The practice is perceived as a pertinent way to ensure the sustainability of fisheries, as well as to supply the growing demand coming from the domestic market.

Findings from the Field Survey of Farmers and Other Stakeholders

Rice

The research team interviewed 18 farmers in each of four provinces – Battambang, Kandal, Kampong Thom, and Takeo – to understand their perception of the environmental risks associated with their farming activities, the fertilizer practices they employ, and the group's observed environmental impacts of these strategies on soil fertility.

The interviews revealed that the farmers principally use chemical fertilizers for their second annual crop (or, in some cases, their third, as certain seed varieties allow for two crops during the wet season). Such fertilizers enable a dramatic increase in yield (from 1-3 tons per hectare on the non-chemical crop to 3-8 tons/ha on the additional crop).[11]

The great majority of farmers indicate that they understand the harm the fertilizers cause their land (and hence the value of their principal economic holding), but feel that they have little choice but to use them. When asked about organic production, they expressed interest, but voiced a belief that implementing those methods would be too expensive and time-consuming.

An interesting point emerging from interviews is that farmers find the quality and taste of the non-organic crop to be markedly inferior to the year's first (and only organic) crop. As a consequence, they make a practice of keeping the first crop for their own consumption and selling the second crop for income. This indicates that farmers understand the benefits of shifting the quality (and possibly health) costs of chemical use to consumers and away from themselves and their family members.

At first inspection, the farmers seem to exhibit highly short-term strategic thinking (i.e., sacrificing the long-term viability and value of their principal possession for marginally low short-term economic gains). However, this view fails to consider that their behaviour indicates a possible move away from farming. The field survey indicates a general discontent with farming as a principal means of livelihood (for, among other reasons, the high cost of inputs, notably including chemical fertilizers). With a perception that "farming is for poor people" and against the backdrop of an evolving economy – marked by such factors as urban migration and more non-farm-related employment opportunities – it is possible the farmers are maxing out the income-generation potential of their land before moving on to other activities.

[11] For more on the chapping cropping patterns and increased output, see USDA – Cambodia, *Future Growth Rate of Rice Production Uncertain,* 2010.

Certainly, the great majority of those interviewed indicated that they do not want their children to become farmers. To quote one interviewee: "Rice production is gradually losing its dominant place in farmers' livelihoods."

These strategies have national implications, not least because of the basic economics involved in generating the large increase in rice output needed to produce an exportable surplus. Because the interviews suggest that rice exports may be dependent upon unsustainable "mining of the soil" methods, there is reason to suggest that new investment in a rice export strategy might impose high environmental costs.

Clearly, a national agricultural export strategy that aims at sustainable agricultural exports over the next generation needs to consider these risks and their associated costs. This subject is definitely an area where more research is needed to understand better the nature of these trends and to shape appropriate responses.

Cassava

The research team interviewed 17 cassava farmers in Banteay Meanchey Province, eleven from Battambang Province and five cassava processors (four family based and one starch factory) in Kampong Cham Province.

The field research revealed a farming community that is significantly more committed to protecting its land assets from the negative environmental impacts of the activity than its counterpart community engaged in rice cultivation.

Approximately 90 percent of the farmers expressed an understanding of the toll cassava farming exacts on land fertility and explained the measures they take to counteract it. Some of the procedures they employ include using foliage falls and cassava skins as natural fertilizers, letting the soil lie fallow for a few months, and shifting to other crops when their cassava yields begin to decline. These have all been effective at helping maintain (if not perhaps increase) the land holdings' soil fertility.

There is a divide, however, between the practices employed by the medium- and large-scale farmers and those undertaken by the smallholder cassava growers. The smaller operators tend not to take care of the land, and also do not have access to some of the equipment necessary to undertake the rehabilitation efforts, such as ploughs to till the nutrient-rich skins and leaves back into the ground. As a result, their response to declining yields is often to abandon their land when the soil no longer produces enough cassava, moving on to unclaimed land – which remains relatively abundant elsewhere.

As for large-scale farmers, a case study on a cassava farming development that was managed by an *Okhna*[12] in Banteay Meanchey province was illustrative. The researchers found evidence that the wealthy landowner employed good practices in the management of his large cassava operations. Many farmers explained the role of the *Okhna* in educating them about the

[12] This term refers to leading business people with political connections.

utility of using organic fertilizers and rotating seeds from one variety to another at planting season.

On the processing side, there are two types of operators – small-scale and industrial. The small-scale processors expressed understanding of and concern about the damage their business can cause, especially to the local water sources. They explained that they do take measures to limit the harmful impacts – such as using the by-products of their activity as a fertilizer for the rice fields – but that some contamination still occurs. For instance, in one village, deeper wells had to be dug because the runoff polluted the longstanding community water source.

Industrial-scale processing presents an even less encouraging picture. A 2005-constructed processing factory jointly owned by Vietnamese and Khmer interests has caused significant problems for the surrounding community, even though it is operating at only partial capacity. The manager of the plant allowed that the side-effects of its operation – which include a noxious odour in the air, as well as water pollution that has harmed local rice crops and fish ponds – would get worse if the facility is more heavily subscribed. Locals have expressed frustration at the situation, but, without effective government environmental enforcement mechanisms, there is little the community can do to make the owners more accountable for the environmental – and local livelihood – damage it is causing.

The main conclusion is that, under current conditions, cassava growing does not appear to harm significantly the environment. Thus, foreign trade in raw cassava will not result necessarily in significant damage to the environment through negative effects on soil (although the situation may change for the worse if steep increases in cassava growing follow different patterns of production).

Conversely, cassava processing is associated with concrete environmental risks. These risks are exacerbated because mechanisms to make processors responsible for negative externalities are weak. Accordingly, foreign trade in semi-processed cassava has a negative environmental impact, mainly through its effects upon ground water. Local mechanisms for dealing with these negative externalities are inadequate, though the negative consequences of this effect are declining currently, as the market is encouraging export of unprocessed cassava rather than processed. To be sure, exporting raw as opposed to processed material may not be desirable either as the opportunity for value addition is lost. Clearly, for Cambodia to move up the value chain and go further into cassava processing, mechanisms to address negative externalities must be introduced.

Fish

The research team visited Kampong Chhnang and Kandal provinces to assess the behaviour of professional fish harvesters.

The interviewers found that the producers in Kandal maintain fishponds for commercial sale, while those in Kampong Chhnang rely less on ponds, which are principally used to raise fish for personal consumption. The latter group is more active in the use of river-based fish cages and pens (which, incidentally, are less likely to cause environmental damage).

The most important observations came from the fish farmers of Kandal, who understand the environmental damages their livelihood is capable of producing. They identify polluted water and malodorous air caused by it (an effect that is magnified by the remnants of uneaten fish feed) as among the leading negative impacts of their activity.

Some of the producers indicated that they make a practice of using only organic products, with a goal of limiting the negative impacts of their activity. They also suggested that there is scope for "greener" fish-raising, including by enforcing a regime of frequent changing of the pond water (the dirty water can then be used as an organic fertilizer for rice fields).

However, even with these possible mitigation strategies, the producers are concerned about the environmental impacts of the aquaculture sector in future. Several registered their fears that the combination of limited government oversight and the low level of importance most Cambodians attach to the environment will mean a potentially polluting sector, especially as increasing numbers of people practice aquaculture in the country.

As noted earlier, the literature tends to overlook the potential benefits of integrating fishing within a more complex farming system. Still, the field work, tends to support the view that Cambodian farmers, at this stage, are either unaware of the benefits from or do not appear to be interested in exploiting sub-system interactions, including integrating aquaculture into paddy farming, within their overall livelihood strategies.

Still, a significant expansion of pond aquaculture is under way. While this expansion is not expected to generate significant export revenue, it will have impacts on the balance of trade, as it will reduce the current high level of fresh fish imports, mainly from Vietnam. This is not expected to have negative effects upon the environment, provided that Government's oversight of illegal practices is vigilant and effective. The consequences may indeed be positive, as pond-based aquaculture improves farmers' access to water, as well as opportunities to develop cultivation techniques that avoid use of chemicals, for example through exploitation of links between local farm sub-systems (i.e., the recycling of used pond water as an organic fertilizer for rice fields). But this eventuality will require increased and coordinated support actions.

Conclusions and Policy Implications

A main line of argument in the literature is that the rapid increase in rice output, associated with significant changes in cropping patterns, will have a *positive* effect upon the environment. The argument is that such changes requires better control over water and will result in an *intensification* of farming techniques.

Better access to water, it is thought, should lead to farmers exploiting complementarities between sub-systems *within* their farms, such as relationships between fish ponds, green manure, paddy fields, and livestock, among others. Therefore, this interdependence should discourage farmers from using chemical fertiliser, because of the negative consequences on soil fertility and fish stocks. However, the fieldwork shows little evidence of such behaviour, and, in fact,

suggests that expected positive environmental returns might be missing, resulting in significant sustainability concerns.

In comparing the results from the field research to the literature surveyed, the research team suggests that any investigation of the environmental impacts of rural production motivated by trade opportunities must truly understand farmer behaviour and farmers' views on their present and future livelihoods.

If, for instance, rice farmers believe that the economics of their profession is becoming unsustainable, this belief could result – and perhaps already has resulted – in actions that deliver short-term economic gains, but at tremendous long-term cost to Cambodia's agricultural output potential. A regular survey of farmers' perceptions, strategies, and evolving behaviour is highly recommended, especially as cassava and aquaculture outputs are likely to increase in the future, and this may have negative environmental repercussions.

Moreover, further primary research is needed to shed light on the sustainability of rice exports. If farmers do not believe that rice production will be profitable for them in the long term, they will be unlikely to expand the efforts and resources needed to make their farming practices more environmentally sound, leading, in the short term, to an unsustainable path of export-led rice production.

Converting farmers' beliefs about rice production's long-term profitability will require several specially tailored interventions. Based on findings, this Study recommends that the RGC:

1. Promotes integrated farming systems practices rather than mono-cropping, with the latter likely to result in the promotion of cash crops to the detriment of other more sustainable income-generation activities (e.g., inland freshwater fisheries);

2. Coordinates closely between agencies in charge of agricultural development (firstly, MAFF) and those in charge of defining trade development strategies (MoC), both at the policy and at the regional/community level. This is a major prerequisite to define the interventions that are most likely to be sustainable; and,

3. Produces a range of interventions to support farmers at the local level, via technology, small-scale infrastructure, agricultural extension services, training in modern farm management techniques, and capacity building programs.

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