

## RESEARCHING THE GATHERING ENVIRONMENTAL CRISIS IN CAMBODIAN AGRICULTURE – RICE

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### **Abstract**

The paper reports on fieldwork and analysis of Cambodian farmers' stated reasons for selection of farming practices believed by them to be potentially damaging to the environment. Based upon reflective and step-by-step methods that are highly cost-effective, it concludes that soil-damaging practices in rice farming are part of farmers' accepted beliefs, and justified as 'soil-mining' to support livelihood shifts given pessimistic views of the long-term relative profitability of rice-farming, and as such quite rational. This picture contrasts with national policy and certain expert arguments that assert that the long-term net profitability of rice farming is far higher than farmers seem to think it is.

Keywords: Cambodia, environment, rice farming, development, policy

### **Introduction**

#### *Motivation, context and overview*

This paper is intended to work at two levels. First, it shows how important elements of the gathering environmental crisis facing Cambodia agriculture are constructed, and often ignored, in the relevant literature; second it shows how, deploying rather cheap research assets, this crisis can be discovered and understood. As such, these two levels act as two sides of the same coin, and the paper can be read both as an analysis of knowledge-construction and as an empirical study.

Its core conclusions are, first, that a major environmental crisis is likely coming, manifest in steep soil degradation caused by chemical fertiliser use largely caused by farmers' rational views of future economic development in the country, themselves generated by their perceptions of national development strategy, and, second, that this crisis is obscured by the rules and incentives governing relevant knowledge-construction practices, specifically those in important parts of the donor community.

Cambodia has long been viewed as one of the significant rice-based cultures of Asia. Unlike many of her neighbours, however, rice cultivation has for centuries focussed upon a single wet-season crop. Lacking scope for easy intensification, it is likely that this basic technological barrier to increases in land yields has played a powerful role in Cambodian history, not least by reducing the capacity to generate over time those large populations in relatively fixed geographical spaces seen in her

neighbours, Vietnam and Thailand [Chandler 2008].<sup>1</sup> Historically, the Cambodian court appears to have largely enriched itself through trade rather than conquest, with as one result the loss of control of the lower Mekong to Vietnam having major effects. In this light the intensive hydrology and religious architecture of Angkor Wat appears as a major and risky effort to move away from historical patterns, eventually unsustainably. Or so history may teach us. Such accounts make it easier to understand why, to this day, Cambodian rice-farmers often secure high shares of their income from fish and other non-agricultural activities, and also why contemporary attempts to generate large increases in rice output seem to involve major shifts away from historical patterns. One may note that, as world market demand soared before WWII, it was areas showing apparently low ratios of population to rice land, such as the Mekong, the Irrawaddy and areas of Thailand, not – until the past decade – Cambodia, that have been the sites of rapid increases in production of rice for export.

At present, the rapid pace of urbanisation in China and elsewhere appears to be improving the medium-term viability of agricultural export strategies. The Government of Cambodia refers to rice as ‘gold’, and points to the very rapid increases in rice output, and rice exports, as signs of a successful national development strategy.

Donors and others form views of the sources, costs and benefits of rice production. These views may be in turn informed by relevant literatures – consultancy and other reports, academic studies, donors’ own studies. The research here platformed on a literature survey and was part of a UN consultancy that hired us to report on the impact of foreign trade on the environment in the cases of rice, cassava and fish [Fforde *et al.* 2010]. This paper reports only on the rice component of the consultancy. For the literature survey, in-country, we collected all the materials we could find related to the overall research topic. These are those materials that would be found by a donor or other actor seeking to develop a view of what was happening. They are what their Research Assistants would collate for those preparing background studies, if commissioned. Our full reading of them is discussed elsewhere.<sup>2</sup> We concluded that this literature, especially important parts of the donor literature, both cited selectively and often tended to ignore important depictions of Cambodian realities. Evidence for this is now discussed.

### *Literature*

Parts of the literature offers the seductive idea that rice output gains are possible, will lead to net increases in farmers’ welfare, and imply that chemical fertiliser use as part of a ‘Green Revolution’ package is acceptable and low-cost. As we shall see, studies from powerful institutions maintain this position in part by arguing, implicitly, that in

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- 1 In the case of Vietnam, arguably technical capacity to generate rising land yields in the Red River Delta was crucial in underpinning the drive southwards that saw the non-Vietnamese populations of what is now central Vietnam largely replaced by ethnic Vietnamese. See Bray 1986 for a classic study of interactions between changing land yields and social institutions, and political attempts to deal with the anticipated consequences.
  - 2 This contained 150 items and can be obtained from Fforde. Limited details of the results of the consultancy can be found in Fforde *et al.* 2010. See also Fforde 2016, under review, for a longer discussion and analysis of the literature.

economists' terms Cambodian farmers are irrational, leaving out of their calculations the effects of their choices upon the future productive capacity of their assets (especially land) [Fforde 2013].

Yu *et al.* 2009 is a World Bank-supported study from the prestigious IFPRI (International Food Policy Research Institute). It argues that there is a “huge potential” [vi] for rice output expansion in Cambodia, and that “farmers can respond to high prices by increasing their use of inputs such as fertilizers and irrigation” [vi]. They cite a report [ACI & CamConsult 2006] arguing that the reported large yield increase has been caused by “improvements in access to fertilizers and other inputs” [4], focussing upon the dry season crop. The same report is cited as arguing that “a surge in rice productivity could add \$35mn per year to the incomes of Cambodian farmers” [4] and that this would “lift a large number of farmers above the poverty line” [5]. This offers a rosy picture of development, supported by further (but selective) citation of those with the same views:

... a previous multimarket model analysis of Cambodia (Arulpagasam *et al.* 2003) ... found that the Green Revolution Package (including {chemical} fertilizer and irrigation) increased rice production by 4 percent, agricultural income by 1.5 percent, and rice export by 31 percent. Additional investments to improve traditional seed varieties were projected to further increase rice production by 15 percent, agricultural income by 7 percent, and rice export by 228 percent, showing a benefit-cost ratio of 1.7 [Arulpagasam *et al.* 2003: 23]

Neither Yu *et al.* 2009 nor Arulpagasam *et al.* 2003<sup>3</sup> factor into their economic analyses the simple issue of the possible effects of fertilizer use on the capacity of the land, focussing instead solely upon the impact of fertilizer use on yields in the current period. This is, obviously, to assume that farmers' behaviour is irrational, as a rational economic decision-maker should be modelled, using the logic of economic analysis, as considering all costs and benefits involved in their decision-making. However, no justification is given in these studies for assuming that farmers are irrational in this sense and simple short-term analyses are what we find. Factors external to the current time period are ignored ('made invisible by the discourse').

Makara & Sokhom 2000 is a study of less prestige than those just discussed. Under the heading 'Environmental Consequences of fertilizer use', it argues:

The application of fertilizer to rice has potential unintended consequences that are of increasing concern in many parts of the world (e.g. Mishama *et al.*, 1999; Xing and Zhu, 1999). Negative effect on the quality of surface and groundwater are the most common environment impacts (Shrestha and Ladha, 1999).

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3 Arulpagasam *et al.* 2003 is from a World Bank study – Ed Krumm and Kharas 2003. See also Konishi 2003 from Global Development Solutions, a consultancy firm. This second study was published by the World Bank.

Intensification of production by applying high nutrient rate in irrigated areas has been reported of nitrogen accumulation in surface and groundwater ...

In Cambodia, where dry season rice covers only 11% of the total rice production areas and most of this is under receding areas. Moreover, fertilizer rates in this area are generally low compared to other countries. *Although there is no specific study on the impact of fertilizer in this areas*, but used to above -mentioned factors it can be assumed that this effect is probably small. At present, fertilizer rates in the rainfed lowlands are generally low.

*Consequently, Crosson (1995) suggested that negative environmental impacts of fertilizer use in rainfed lowlands were probably minimal.* In rainfed lowlands with access supplementary water from the ground, dry season and early wet season crops cropping is being more common. Villagers usually access stream water or shallow groundwater for daily consumption. Degradation of the quality of these water resources would be a significant concern for public health. In addition artificial and natural wetlands in the rainfed lowlands are often significant food resources for villagers.

*Loss of water quality in these ecosystems needs to be guarded against. Since these problems generally do not yet exist in most parts of rice growing areas in Cambodia, now is an opportune time to set in place strategies to prevent it becoming a concern.* [4-5 – stress added]

This quote flags warnings and risks, but argues that, whilst there is a lack of studies, use of fertilizer in Cambodia has not as yet had negative impacts on the environment and the costs are likely to be in areas such as water quality, not soil degradation. Again, the study ignores the possibility that fertilizer use has negative effects – costs – for the productivity of land in cropping seasons after the one to which it is applied. Farmers are again assumed irrational in economists' standard terms.

It is important to realise (and this paper is written for an academic audience, not donors) that the studies just discussed, for all their use of techniques similar to academic studies (but with different citations practices, at least in principle), originate from a set of epistemic communities very different from those of professional academics. This can easily be seen from their own citations. Thus, by contrast, Fox & Ledgerwood 1999 helps place Cambodian rice farming into a historical perspective – see also Fletcher et al. 2008, Gaughan *et al.* 2009, and Kummu 2009. The latter states:

The results suggest that modern water management concerns, and particularly impacts of different types of human actions such as water diversions and reservoir constructions, on hydrology and sediment transportation – and further on ecosystems and people's livelihoods – should be examined with a much longer-term perspective than is presently employed. At Angkor, for example, human modification of the natural waterways from the 10th–11th centuries changed the natural hydrology of the area permanently and the

decisions made then are still clearly visible in the landscape. The results of the paper also show that even small changes and disturbances in the natural equilibrium might start a chain reaction that over time may alter the whole natural system, as happened in Angkor when one off-take channel gradually evolved into a new river. [1420]

Note also Nesbitt *et al.* 1997, pointing out that prior to WWII, when South Vietnamese and Burmese rice exports boomed – “Cultivating rice for export was often not a profitable activity for Khmer farmers in the colonial period” [3].

The key point here is that the works discussed in the first half of this section are those commissioned by actors such as bilateral donors and multilateral donor agencies (such as the World Bank), with their own interests, and it is not sufficient to retort that there exist academic studies that point in very different directions, for the abundant references that can be found in the donor studies do not usually cite the latter (especially if they disagree).

A key element of the difference, it appears, is the degree to which the local population and its institutions are, perhaps through a notion of cultural or institutional flexibility, treated as active agents that influence historical change or development. For example, Lee 2006, in a study of rural widows, shows how in practice the basic bilateral (rather than ‘patriarchal’ or ‘matriarchal’) patterns of Cambodian society - see also Ledgerwood 1995 also offer flexibility:

Gender role flexibility helped interviewed widows cope with their economic challenges. They had a pragmatic approach to the sexual division of labor and expected family members to do what was needed to feed the family. The survival requirement to produce family food trumped ordinary gender roles. Widows could “trespass” on male gender roles without condemnation or ridicule. Males also “trespassed” on female roles, assisting in transplanting and helping with child care when necessity required. This gender role flexibility was an adaptive feature of Cambodian culture that alleviated the stresses of widowhood. [19]

Such literatures, surely, would not simply assume that farmers maximise incomes ‘for only the current harvest season’ in response to prices, technologies and the here-and-now. The wider literatures offered by academics far more easily, not least as they are meant to cite widely, and to cite views with which they disagree, show interest in farmers’ subjectivities and (often historically informed) socio-cultural resources.

There are, thus, stark differences between the ways the different stances taken by different lumps of expertise are in play here.<sup>4</sup>

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4 For an in-depth analysis of how this can so easily happen, using international development as a case study of contemporary ‘Western’ policy-government, see Fforde 2017 forthcoming.

### *Implications*

As we planned our research, we found that the idea we had met in the donor literature, that Cambodian farmers were irrational in the sense of paying no attention to the effects of fertilizer use upon anything other than current period production, was highly debatable. The core issue for researching the effects of rice production upon the environment, given the literature review, was to access farmers' thoughts and decision-making. Following the old diplomat's maxim that 'if you want to know what somebody is thinking, go and ask them', this implied fieldwork and interviews. After all, if Cambodian farmers actually were, as the studies just cited assume, irrational, then that would be an interesting research finding, though our prejudice was that the studies were simply seeking arguments to advocate for increases in investments in irrigation (likely requiring heavy Cambodian government international borrowing), associated with an expansion of dry season rice cropping with increased chemical fertilizer use.

### **Analyses and conclusions from fieldwork**

#### *Methodological considerations*

We therefore focussed our fieldwork upon farmers' own perceptions and decisions.

In linking the discussions of the literature to development of research hypotheses the Team took a number of formal steps:

- The Cambodian members of the Team collected the research materials, collated them and prepared notes upon them to a standard format.
- There were extensive face-to-face and email discussions about the materials and methodological issues. These then led to discussions of relevant questions, which were kept rather open and sought to bring out areas of puzzlement and curiosity that could energise the Team. So far as possible these discussions were 'round table', with the Cambodian members of the Team acting as active participants rather than data collectors. This process was aided greatly by some initial scoping-studies, which showed the Cambodian members of the Team what could be done in the field by combining interviews with internal discussions within the Team, and showed Fforde as Team Leader what the Cambodian members could do. This was then followed up by a second scoping mission without Fforde that confirmed that the Cambodian members of the Team could act independently.
- To guide the field work (carried out by the Cambodian members of the Team alone), Fforde and the Cambodian members of the Team prepared 'Questionnaires'. These were mainly to be used to i) provide a framework within which the Cambodian members of the Team could interview; and ii) ensure that certain basic questions were asked and were common to each; and iii) offer possibilities for looking at relationships between basic questions and other data (this was not in the end exploited). These Questionnaires should not therefore be seen as defining the research questions – most of the information noted on

them was not used. Rather, they supported the initially rather inexperienced Cambodian members of the Team in managing their interactions with farmers. One crucial issue here was the importance of the Cambodian members of the Team being able to reach a point where they could trust their own judgement of the reliability of their informants' views of core issues – for rice - Was chemical fertiliser damaging the soil? A little or a lot? What did they do about it, if anything?

- The field work was carried out in a range of sites. This was not a 'sample' in the statistical sense of the term. Rather, discussion within the Team suggested that localities differed and common sense indicated that a range of sites should be visited. Site selection accepted that the results would be more significant if sites varied, and this was interpreted to mean 'persuasive to the Cambodian members of the Team as Cambodians'. This was satisfactory given the nature of the research (more reasons are given below as the fieldwork is reported). Site selection was thus done through internal Team discussion taking according to the following criteria: i) Subjective perceptions of the Cambodian members of the Team about local attitudes, relative to the issues in our research agenda; ii) relevant variations across provinces in terms of socio-economic structures; iii) a feasible number of interviewees to approach; iv) geographical distribution of the targeted sample; and finally, v) time availability of Cambodian members of the Team. It was established early on through discussion, and confirmed in the first scoping mission, that interviewees offered interesting information not only about themselves and their families, but also about the surrounding environment.
- The data collected contain some quantitative indicators for simple descriptive statistics, but the research mainly relies on qualitative analysis techniques, including elements of participant observation. These were interpreted and analysed by the Cambodian members of the Team, who presented their findings orally, and prepared Fieldwork Reports, providing analytical accounts of what they had seen and heard. These were synthesised through interactive discussions highlighting supportive and conflicting analytical results in response to the research questions. The process was facilitated by Fforde to ensure consistency and robustness of the arguments within the research architecture. It should be stressed that the Cambodian members of the Team learnt fast that they would have to defend conclusions reached from field work, and did so well. This is normal 'rapid rural appraisal' methodology. It was decided early to avoid introduction of techniques such as focus groups as this would have added to the organisational burden without adding much value; what was important was to get the Cambodian members of the Team talking to farmers about farmers' issues and to allow them to 'follow their noses' as the situation became clearer to them in the field, and this is what happened. Obviously, part of the reason for this strategy was to see whether they could succeed; they could.

The elements and results of this process are now presented in narrative style, to better capture the focus upon farmers' subjective perceptions.

## Fieldwork

### Introduction

This section is based upon Team-based analysis and fieldwork by Kheang Praneth and Macthearith Om. Quotations in italics are taken verbatim from their reports with minor adjustments for grammar and terminology. Stress (in bold) has been added.

#### *The 'abandoned hypothesis'*

It is perhaps useful to remark that early in the research process the rapid increase in rice output, associated with changes in cropping patterns and integration of sub-systems (such as fish, local water control – essentially 'intensification' - was hypothesised by the Team to likely have a positive effect upon the environment. The argument here was that such shifts required better control over water, and would therefore be associated with an intensification of farming techniques. Better access to water, it was thought, would lead to farmers using interactions between sub-systems within their farms, such as relationships between fish ponds, green manure, and so it was thought that this would discourage farmers from using chemical fertiliser, as it would hurt the fish. This hypothesis rapidly proved unsustainable as farmer interviews contradicted it (see below).<sup>5</sup>

The literature survey had focussed our attention on the central issue of the effects of increased output, largely understood as marketed output, upon chemicals use. The reader will recall the lack of attention to the effects of increased rice output upon soil productivity. Through the interviews, we rapidly started to think that adoption of high-yield high-chemical input rice-farming techniques should be seen by farmers as problematic. Whilst significantly increasing current period yields, there were two issues: first, farmers' net incomes did not appear reliably to rise by much: chemical inputs were rather expensive; second, soil seemed to be being 'mined', with declines in long-term productivity caused by the short-term productivity gains strongly believed by farmers, and as such accepted by them. Their rationality, as it emerged to us, did not ignore important costs – centrally, soil productivity – but accepted that they would shift income gains towards the present.

### Sites and data collection

*The rice team has been to four provinces and had opportunities to interview 18 farmers in each province. Firstly, we chose to go to Kampong Thom province, which is one of the provinces bordering the Tonlé Sap Great Lake. As most of the areas are located in the flood-plain of the lake, farmers seem to have far more land than farmers in other provinces. Most of them can produce rice twice a year. Secondly, we decided to go to Takeo province. There, all farmers produce rice as the main crop but for own consumption only as they have very limited land. Thirdly, we went to Kandal province,*

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5 This hypothesis was influenced by Fforde's experience with (Vietnamese) delta rice-farming, thus shown to have very different possibilities for sustainable yield increases [Fforde 1989, 2016].



*which is not productive in rice as the development of industry and commerce has led some farmers to find other activities than rice production, and some of them sell the land to business people. There, farmers have very limited land, but they do not seem to be poor as their main income does not come just from rice, and the province is close to the city. Lastly, we went to Battambang province which is known as the Rice Bowl of Cambodia. It has had a strong agricultural economy with a great production of rice and many other agricultural products for a very long time.*

There was significant variation in conditions between the provinces where we carried out fieldwork. Connections between domestic and foreign trade were, as expected, not significant for farmers, who are though deeply involved in markets:

*In both provinces, farmers report that the number of families growing rice in their village has grown; rice is now both the main staple food and the main income source for farmers. Most of them produce rice for their own consumption and then sell to the local market via middlemen who always wait to buy paddy-rice from them. They report that this means that whilst they don't have difficulties in finding a market, the prices they sell are very volatile and determined mainly by the buyers. Only few farmers have opportunities to export rice directly to Thailand and Vietnam.*

This shows a dynamic situation driven by the market and accumulation at farm level. Farmers are likely to be price takers, as they are not organised in numbers that would influence market price, though there is some notion that traders' margins are 'too high'. As noted above, qualitative research is needed to get further into this. For farmers, there is little difference between domestic and foreign demand.

#### **Chemical fertiliser use: farmers' views and rationality**

Use of chemical fertiliser varied between regions and between different rice crops. Increased output appeared closely bound up with changing cropping patterns, centrally the introduction of a second dry season rice crop.

Field reports showed that the additional rice crop typically gave a much higher yield (from 3 tonnes/ha to 8 tonnes/ha) than the traditional (single) rice crop (only from 1 tonne to 3 tonnes/ha). But farmers reported that for them the second crop rice had 'lower quality' and therefore, was cheaper than the traditional rice crop. The additional crop, they said, had a worse taste than the traditional one as it had to use much more chemical fertilizer. Therefore, most farmers in Kampong Thom tended to sell additional rice on the market, and keep the traditional crop rice for their own consumption. Interviews showed that this was because they cared about both their health and the taste of the rice. This shows clearly that farmers differentiated between what we will call here 'natural' rice and rice grown using chemical fertilisers. There was clearly an 'issue' and the question therefore was what farmers were thinking about it and how it was affecting their behaviour. The table below gives the data, and the reader should bear in mind that farmers were reporting general 'local views' rather than their own.

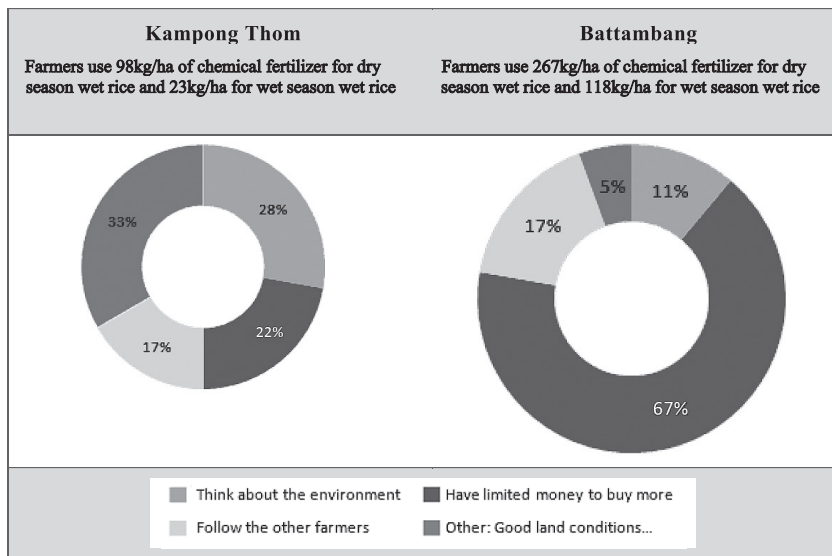


Figure 1: Reasons why farmers use chemical fertilizers.

*The survey helped gauge the difference of chemical fertilizer use per hectare between the two crops. The average use of chemical fertilizer in kilograms per hectare in Kampong Thom for the additional rice crop was on average 98kg/ha while the traditional crop was only 23kg/ha. In Battambang, the additional rice crop used 267kg/ha whereas the traditional crop only 118kg/ha. Clearly, farmers in Kampong Thom use much less fertilizer than those in Battambang. According to the interviews results, more than one fourth of farmers (28%) in Kompong Thom say that they worry about the environment, and that is why they don't use chemical fertilizer or use little. The data from Battambang shows a huge difference (compare Figure 1 above).*

#### The perceived effects of chemical fertilizer

The very different levels of chemical use in the two provinces appear to correspond to very different farmers' perceptions of the strength of trends in declining soil fertility. In the high chemical-using Battambang near 95% of farmers thought that fertility was declining; in the lower chemical using Kampong Thom 50% thought it was declining and 30% thought it was improving.

Farmers in Kampong Thom reported that the declining productivity of their land was shown by the soil becoming harder or dried out and then difficult to plough, by the need to change seeds very often, and by the need to use increasing amounts of chemical fertilizers year after year. For those farmers who reported that their soil quality was, by

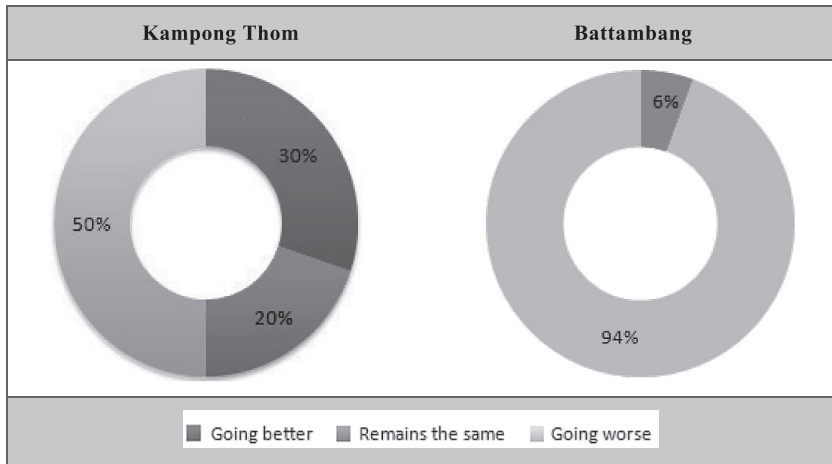
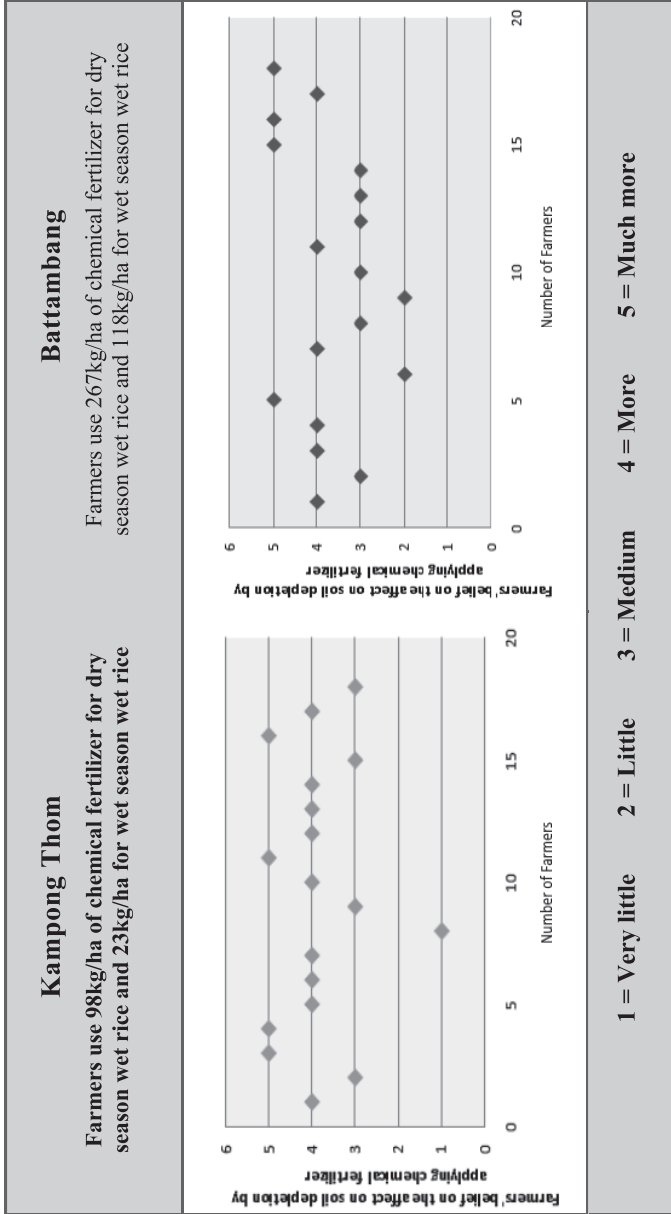


Figure 2: The soil productivity in farmers' opinions.

contrast, improving, reasons given included concerns about the negative impacts from chemical fertilizer, location of rice fields in the floodplain and so already being fertile, and use of natural fertilizer such as manure fertilizer, green fertilizer and organic fertilizer.

*Regarding the organic rice, very few farmers know what it is and for those who do, they never plant it. In the farmers' opinion, organic rice is rice of very high quality and hundred percent natural. Organic rice is costly, very good for taste and health, and can never affect soil fertility. However, the process of planting the organic rice is hardly to be achieved because we have to purify the land, use organic seeds, and use organic fertilizers. In fact, they recognize that organic rice farming is very complex. Some would shift to organic rice cultivation method with only a 10% price premium, while others with 20%-30% and 30%-50%. The reason is that it's difficult to plan and requires at least 2 years before rice of this quality can be harvested (the fields have to be cleaned up and this takes time). For them, to make organic rice a success in Cambodia farmers will have to follow organic farming methods carefully. But this requires more and better training on how to apply these techniques and the government has to ensure stable markets and price for organic rice.*

Farmers' opinions were thus rather clear, as can be seen from the figures above that show their opinions on the effects upon soil fertility of chemical fertilizer use in each of the two provinces. Despite the large differences in practice, opinion was not very different. Farmers believed that they were reducing the productivity of their soil by using chemical fertilisers.



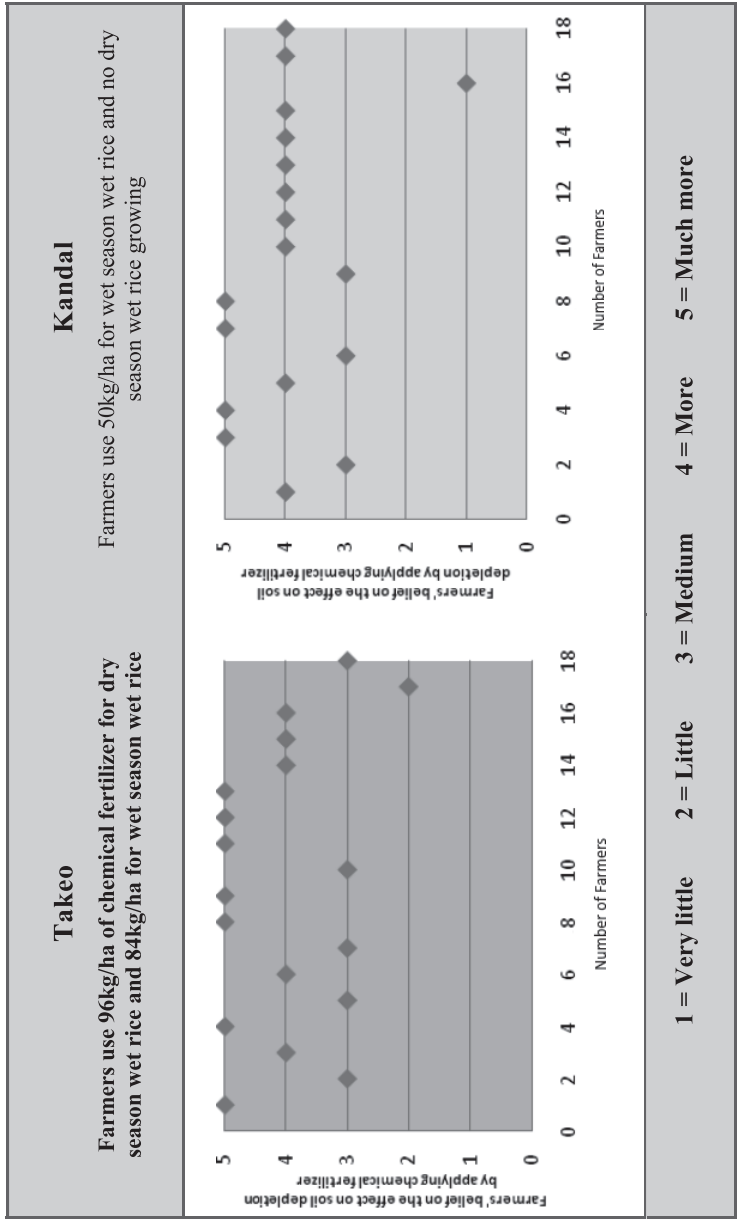


Figure 3: Soil depletion by applying chemical fertilizers (farmers' opinion).

*This shows that they understand the problem. However, they still have to use chemical fertilizer in addition to natural fertilizer. The question is: why do they still use it if they know that it's bad for soil fertility? The common answer, especially from farmers in Battambang, can be summarised by this statement "I have no other better solutions than using it.<sup>6</sup> In order to get the yield, I have to use it, and it's the same for the other farmers in the village". **Farmers realize the environmental impacts of chemical fertilizer use but, for them, this problem does not influence their actual behaviour.** They think more of how to get higher yield in order to have enough rice for own consumption and sell to the markets. Their primary concern is how to feed their family and their children now. If the situation remains the same, the future of farmers in the next generation will be much more difficult than that of today.*

The tensions in this quote are understandable. The Cambodian Team member – the interviewer - has a national, long-term perspective, and is worried that the farmer is mining the soil through their use of chemical fertiliser. They see this behaviour as irrational, in the sense that it reaches the wrong conclusions as it is short-sighted. The farmers – the interviewees – who we can recall were facing a dynamic situation where livelihood options were evolving, urban migration a perceived option, and so on, appear to have been thinking differently, and for them the best solution was rather to use more chemical fertiliser and accept that it was damaging the soil. In common sense terms, different world views, each rational, lead to different conclusions. Yet, though this may be the case, what is not reasonable is to assume, as the literature cited above does, that farmers in standard economic terms were deeply irrational, ignoring any effects of fertilizer use on long-term soil productivity.

The accounts reported thus suggest that many if not most farmers were quite deliberately trading-off exploitation of enhanced short-term possibilities against long-term costs. Whether these makes sense will depend, of course, upon what is happening to them in, say, 10 years time. Further, and in contrast to the enthusiasm of the studies cited above, short-term returns from the dry-season rice crop were not high (most certainly not huge), as can be seen from interviews reporting what they perceived as the problems facing them and their communities (recall again that they are reporting what was normal local opinion, rather than simply their own views):

*In both provinces {Kampong Thom and Battambang}, the top 3 concerns of the farmers are the same. The # 1 problem for them is the lack of irrigation system. The # 2 problem is natural disaster, such as drought, flood, storm and insects. The # 3 problem are the high production costs, which include transportation, electricity, fuel, and all inputs. This is a big burden for them. They complained that the cost of fuel and chemical fertilizer is very high and they also complain that the price they get for rice on markets is low and fluctuating, and this makes rice production not so profitable.*

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6 Recall that the opinions here are those of farmers *about common opinions around them.*

This again shows coherent opinions. For farmers, the perception was that rice was not very profitable in the short-term (season-by-season), mainly because input costs were high. They appreciated that if expected rice prices were higher things would, year-by-year, feel different. This was their view (see Figure 3 over page), and it is consistent with the behaviour they reported, which accepted techniques that used chemical fertiliser and damaged their soil. It would be possible to calculate economists' models to establish the parameters of such decisions, but the key issue is what they think, and they were not using algebra.

The fieldwork data from these two provinces was confirmed by that from the other two. In Takeo province:

*... most of the farmers have showed that chemical fertilizer has caused a big problem to soil fertility ... {only} one out of the 17 rice farmers interviewed does not acknowledge that chemical fertilizer is harmful to soil fertility. With this outlier, with a very different answer from the others, I tried to look at his land size and other related issues. It appears that he owns a relatively small plot of land and is poor so he cannot buy much chemical fertiliser. 14 of the rice farmers said they were very concerned about soil depletion caused by chemical fertiliser, while the 3 others said that the extent of the depletion depends on how the chemical is applied. They argued that if it was applied properly, it did not reduce soil fertility.*

Thus, here as in Battambang and Kampong Thom, we obtain the same overall view: farmers knew that chemical fertiliser was damaging the soil, yet they used it anyway. Again, it was the additional dry season rice crop that was attracting more chemicals. The interviewers dug more deeply into the reasons farmers gave for the situation:

*Despite awareness of soil depletion by applying chemical fertilizer, most farmers use chemical fertilizer to support rice growth. However, the amount applied by farmers varies {by crop}. The reason they give is that an additional rice crop needs more nutrition to grow and greater care since it's not insect-tolerant and is also water-consuming.*

The overall result is robust and interviews in the fourth province, Kandal, supported the same conclusions.

#### **Iterating the emerging analysis**

As this point in the fieldwork and evolving analysis we needed to start to re-consider the pointers to families' strategies that we were getting from interviews. Clearly, farmers' strategies were changing, and it seemed likely that we needed to explore the extent to which farmers' longer-term thinking included a shift in focus away from farming. As was often put to us, farmers often think that 'nobody makes money in rice or fish'. In such a view, rational calculation will suggest 'using up' fixed capital in farming that cannot be moved into new livelihood strategies, freeing up resources that may also be used to support the transition. This explains why farmers should decide on strategies

that they expect will ‘mine’ their soil, one of their key assets. One would expect that what economists would call ‘imperfect’ land markets would be incapable of allowing farmers to realise land value in other ways, and in any case it is not clear how a perfectly operating land market would value rice land with such expectations.<sup>7</sup>

The ‘soil mining’ option was associated in so many of our interviews with the use of chemical fertiliser to get a second rice crop. These strategies have their national implications, not least in the basic economics behind the large increase in rice output and creation of an exportable surplus. Whilst we hear often that ‘Cambodia has a comparative advantage in rice’ and this is revealed by the rapid increase in rice output, these farmers can be understood to have been saying that they believed that the underlying situation denied this: rice exports were to a large extent based upon an unsustainable mining of the soil. We may note that farmers were generally aware of ‘natural’ rice farming techniques but there is little ‘yes but’ that could have involved them arguing to the Cambodian members of the Team that they would change techniques and allow the soil to recover after a period implementing these short-term strategies. This suggests that their medium-term goals were to leave farming and that they did not worry that the sales value of their land, when they finally left, might be very low.

In attempting a synthesis of their interviews, one Cambodian Team member reported the following, clearly trying to see whether farmers were adopting an ‘export’ strategy – an indicator of strategic behaviour:

*Regardless of their land size, all of the farmers grow rice to meet their own consumption and the leftover is for selling either to rice miller or local market. {This} ... selling is done to pay off the loan of chemical fertilizer, the loan of seed, to earn money. There are no farms who export rice on their own. {About half of farmers sell rice} ... and the local market takes ... this to cater to domestic demand. So does the rice miller, but the miller further exports rice to Vietnam and Thailand. Farmers tend to the view that rice production is not so popular ... Daughters of farmers go to garment, footwear manufacturing or act as cashier at transportation booth. Sons of farmers go to animal food factory or work as security guards. Importantly, there is a stereotype that rice farming is done by poor people. Since there are job opportunities, **rice production is gradually losing its dominance on farmers' livelihood.***

This suggests once more that a very common view amongst farmers was that they should mine their soil to pay for strategies that would allow them to change livelihood strategies away from farming. They were using the profits chemical fertilizer liberated from their soil to invest in their children, hoping they would leave farming. This rational calculation also fits with the arguments given for retention of ‘natural’ rice for own-consumption, investing, thus, in family members’ strength and health:

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7 See Fforde and Seidel 2015 for a study of knowledge construction and development politics related to land titling aid projects in Cambodia.



*Farmers said they limited their use of chemical fertiliser because they want to keep rice for their consumption. It is not tasty if you use chemical fertilizer to increase rice ability to grow fast. For their consumption, they prefer rice grown using natural fertilizer rather than chemical fertilizer.*

Although not conclusive, these views suggest that farmers' were deliberating seeking to shift any health costs associated with chemicals use to consumers and away from family members.

## Conclusions

### *Cambodian farmers and the origins of the crisis*

The interview data helped the Team produce an analysis that is rather clear, so far as it goes, for the sample is very small in terms of numbers of interviewees, though of course far larger in terms of their reporting of mainstream opinion around them. These conclusions suggested, especially when read in the context of the literature survey, that there was an urgent need for extensive fieldwork to confirm or deny what our research was suggesting.

- First, the farmers we accessed through our interviews had clear beliefs about the effects upon their soil's fertility of the use of chemical fertiliser. Contrary to implicit assumptions of the studies reported above, they are not irrational, ignoring such effects. Further, their views were that these effects were negative, and significantly so. *The origins of the crisis, if farmers know what they are about, are therefore to be found in the combination of farmers' views of the long-term relative attractiveness of farming with the particular technical conditions of Cambodian rice-farming, which seem to come down to the high costs of sustainable intensification, where farm sub-system interactions encourage soil preservation.*
- Second, it is rather likely that what we were observing was a rational farmer strategy, where farmers, anticipating that the future lay outside farming, were shifting farming costs into the future by 'mining' their soil through application of chemical fertiliser, and by shifting the health costs associated with chemicals away from the family by avoiding use of chemicals on rice kept for own consumption. It is not possible to state what percentage of farmers actually thought this, for our interviews were as much to do with asking about 'local opinion' as about farmers' own personal views. But the results are as significant as any series of conversations with reasonable informants across a range of sites: that is, that it would be unwise to reject them, but, before acting on them, more research is needed. *The solutions to the crisis are not, therefore, likely to be easy to think-through or to implement.*

This farmer strategy (of soil-mining) may well be successful for them. Much depends upon what happens. If Cambodia were to spend the next 10-15 years relying upon such strategies as a core part of rice export strategy, then substantial investments would have been made by others – in areas such as rice-milling, transport etc. This would then influence decisions taken, perhaps confronting rural poverty and rapidly declining

land yields, when facing steeply rising costs at farm level, in large part due to poor soil quality and declining returns to chemical fertiliser inputs. It is likely that offsetting these, and maintaining the value of investments above the farm in the rice exports strategy, would be very high. It would probably require expensive outlays, such as development of an extension system to support sustainable techniques, subsidised irrigation and other infrastructure (for example rural electrification) and so on. To the extent that this apparent strategy is not viable or implemented too late, those left on the farm may exert considerable political pressure as they see rising costs and falling rice yields hit their livelihoods. This will probably also be influenced by the nature of employment opportunities 'off-farm', which are hard to predict, but the risk is there. Clearly, a national agricultural export strategy that aims at sustainable agricultural exports over the next generation needs to consider these issues.

### *Methodology*

The resources deployed by this study were tiny compared with those research activities cited earlier in the paper in the literature survey. Yet the research seems to show that those studies are misleading and based upon strong implicit assumptions about farmer rationality – specifically, that they are irrational in ignoring changes in soil quality – that are easily shown to be false, or at least highly dubious. Two conclusions follow:

First, the clarity of our research results suggests that the cited literature's unreliability should not be attributed to any problems of access or the inherent complexities of the research subject. Rather, theories of knowledge production that focus upon factors external to the research subject (here farmers), seeing no risk to simply assuming a certain rationality, explain the powerful influence of other factors: perhaps a desire to fit with extant generalised theory, to support profitable agendas, to secure dominance over competitors or to avoid egregious behaviour, and so offer better explanations of the knowledge produced [Fforde 2017].

Second, in terms of better understanding of farmer behaviour our methodology used is extremely cost-effective, and perhaps successful for that reason. The picture obtained through interviews suggests clearly that farmers are pessimistic about the long-term relative returns to farming, especially of rice, and are therefore quite rationally believing in (and so pretty certainly acting upon) strategies of 'mining' their land by adding a second rice crop that requires expensive and soil-damaging chemical fertiliser. It is not possible to access such important issues without use of something like the research methodology used here, which respects subjectivity and therefore accesses it. This may be because it is very cheap to do so.

Third, the implications of soil-mining for the rice push of Cambodian national development policy are possibly very serious. As in some developed countries, such as Australia's problems with soil salinization, investments to restore damaged land can be very expensive and such costs could greatly reduce the value of both public and private sunk costs in investments associated with the rice push, in, say, a decade's time. This is quite apart from the cultural and social invisible costs associated with the effective destruction of rice land in a very old society for whom, as in other countries, rice has a wide range of cultural values.

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