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# Agrofuels – A boost of energy for the Mekong region?

A Report for Focus on the Global South

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## Preface

This background paper seeks to brief readers on the extent of the development, production and consumption of agrofuels, particularly liquid fuels for transport, in the Mekong region. The area of focus comprises the countries of the Mekong River Basin, that is, flowing downstream north to south, the southernmost prefectures of China (Yunnan and Guangxi), Lao PDR, Burma, Thailand, Cambodia and Vietnam. The varied political, economic, and social contexts of this region make it difficult to present general conclusions. Equally the many levels, aspects and questions concerning the development, impacts and ethics of the agrofuel industry in the region, can only be touched upon. Hopefully, however, the very different ways in which this sector has been developed in this region, may illustrate some instructive as well as the many cautionary lessons for farmers, their networks and other policy analysts working in the region.

This paper is based mainly on a desk study of publicly available literature. The section on community level renewable energy schemes was supplemented with interviews of key informants in Thailand. The first section covers the main features of the boom in agrofuel development in the Mekong Region, providing a contextual base and examining some of the impacts and critiques of the expansion of the ethanol and biodiesel industries. A note is made on some community level bio-energy initiatives and examines some of the challenges facing small-scale alternative fuel development. The final section presents a summary synthesising these findings and drawing together the different strands of analysis in the context of geopolitical developments in the region.

## Main features of the agrofuels boom in the Mekong Region

### Introduction

Fossil fuels are rising in cost, increasingly limited in availability, and their use is hazardous to the earth's climate on which we all depend. At the same time, liquid fuel demands for freight and passenger transport are still rising (see table), and in the Mekong Region these demands are projected to increase substantially in the coming years[1]. In this context, two responses could be put forward: the first to find ways to reduce fuel use sensibly and justly, and the second is to find viable, renewable fuels to meet the demands.

It is not a question of either one or the other; the first response must be pursued. The need for less energy-intense pathways for development is now virtually undisputed. However, shying away from the fundamental rethink of the consumption-led resource intensive development model that is implied in the former, governments have so far put more vigour in taking up the challenges of the latter.

**Table 1: Transport Fuel Demand Growth in GMS**

| Country or Region | % increase, 1990–2005 | |
|---|---|---|
| | Gasoline | Diesel |
| GMS | 149 | 177 |
| Yunnan Province, PRC | 129 | 720 |
| Guangxi Zhuang Autonomous Region, PRC | 341 | 492 |
| Viet Nam | 328 | 365 |
| Thailand | 97 | 101 |
| Myanmar | 155 | 311 |
| Cambodia | 3 | 230 |

GMS = Greater Mekong Subregion, PRC = the People's Republic of China.

Note: Data for Cambodia is for 1995–2005.

Source: Organization for Economic Cooperation and Development. 2007. www.oecd.org/home/0,2987,en_2649_201185_1_1_1_1_1,00.html; and China Data Online. www.chinadataonline.org

Source: Sombilla et al, 2009

Agrofuels, strongly promoted by agribusiness corporations, have attracted the interest of each of the governments of the region, which have drafted various policies to stimulate their development (see box 1.1). The ADB is also ready to promote this sector and has proposed a sub-regional framework for developing rural renewable energy and agrofuels, which was accepted by representatives of Greater Mekong Subregion country governments in late 2008[2].

**Box 1.1 Policy backed targets in agrofuels sector, Mekong region**

- China : agrofuels to provide 15% of transport energy needs by 2020
- Lao PDR : agrofuels to replace 10% of fossil fuel consumption by 2020
- Vietnam : agrofuels to cover 5% of domestic fuel demand by 2025
- Thailand : 5 billion litres of agrofuels (a six fold increase) by 2022
- Cambodia : plan currently being drafted
- Burma/Myanmar: targets appear to have been abandoned.

[1] See for example, Weyerhaeuser et al 2007. News sources have reported that China is expected to see increased vehicle numbers from the current 10 million to 200 million by 2020, and that the government is constructing over 20,000 kilometers of new roads (Alton et al, 2005). Because of continuing economic development and population growth, the expected increase in overall private vehicle ownership is projected to push up the total private vehicle stock of Thailand in the year 2050 to about twice of the present level. This will drive fuel demands in 2050 to about 2.4 times, and the greenhouse gases (GHG) emission to about 2.5 times of the current levels" (Pongthanaisawan and Sorapipatana, 2010). The EIA International Energy Outlook (2010) states that "For both non-OECD and OECD economies, steadily increasing demand for personal travel is a primary factor underlying projected increases in energy demand for transportation. Increases in urbanization and in personal incomes have contributed to increases in air travel and motorization (more vehicles per capita) in the growing economies. Increases in the transport of goods result from continued economic growth in both OECD and non-OECD economies. For freight transportation, trucking leads the growth in demand for transportation fuels. In addition, as trade among countries increases, the volume of freight transported by air and marine vessels increases rapidly."

[2] During the 5th Technical Working Group for Agriculture Meeting held in Vientiane, Lao PDR, on 22–24 September 2008. A summary of its recommendations can be found in Sombilla et al, 2009.

Clearly, agrofuel policies are not only, and many analysts would say not primarily, justified on environmental imperatives. Governments have been keen to promote agrofuel production domestically[3] for a number of economic goals: replacement fuels could help manage the drain on foreign currency reserves in fuel costs, a new industry could constitute an engine of GDP growth and agribusiness expansion, and new markets for crops could provide opportunities for increased farm incomes. Energy security also provides an important driving factor in a region that is overwhelmingly dependent on foreign oil. In policy statements, the economic and energy security arguments are given more attention than the environmental goals, which are less clearly elaborated.

**Table 2: Total production of selected energy crops in GMS, 2007**

| Countries | Production (tons) | Yield (tons/hectare) | Area Harvested (hectare) |
|---|---|---|---|
| **Sugarcane** | | | |
| Cambodia | 130,363 | 19.34 | 6,739 |
| Laos | 223,300 | 31.76 | 7,030 |
| Myanmar | 6,368,000 | 44.85 | 142,000 |
| Thailand | 64,973,804 | 57.94 | 1,121,413 |
| Viet Nam | 15,879,600 | 55.33 | 287,000 |
| **Cassava** | | | |
| Cambodia | 362,050 | 16.09 | 22,507 |
| Laos | 55,500 | 6.81 | 8,150 |
| Myanmar | 139,000 | 11.30 | 12,300 |
| Thailand | 21,440,488 | 20.28 | 1,057,341 |
| Viet Nam | 5,572,800 | 14.53 | 383,600 |
| **Palm Oil** | | | |
| Cambodia | — | — | — |
| Laos | — | — | — |
| Myanmar | — | — | — |
| Thailand | 5,182,000 | 16.74 | 309,600 |
| Viet Nam | — | — | — |

Data source: FAO database, www.indexmundi.com
Table source: ADB Renewable Energy Initiative Brochure (undated)

For example, Thailand's AEDP does not make an explicit environmental case. Its goal is simply stated as "to increase [the] share of [the] alternative energy [mix] to be 20% of the country's [total] energy demand in the year 2022"[4], while specific objectives aim at replacing oil imports, increasing energy security, promoting community use of green energy, developing an alternative energy technology industry, and improving the efficiency of these technologies.

In statements by corporations and politicians alike, agrofuels are often deemed to be environmentally positive simply by virtue of their replacement of conventional fossil fuels, when in fact many serious environmental concerns have been raised about the development of the industry around the world[5].

Interest in agrofuels is linked to a resurgence of agribusiness development in the region. The region has seen the expansion of tree plantations for pulp and paper (eucalyptus, acacia) rubber, cooking oil/cosmetics (palm oil), and food crop estates for industrial food production (sugar, cassava) and animal feed (maize). The region is engaging in a variety of agricultural commodity markets - agro-energy is just one market amongst many.

In recent years, the trend of agribusiness expansion has been associated with a rise in land grabbing, a trend that has been growing, particularly in the poorer agricultural nations of the South[6] in the last decade. South East Asia has emerged as a very attractive region for foreign and rich domestic investors over the last decade[7]. Investors increasingly see opportunities not only in running production factories and other facilities, but also taking direct control over agricultural land, which has brought grave problems for the people already living on those lands[8]. Within the Mekong region, Laos and Cambodia have been prime targets in the rush to

[3] In a few cases, targets were not only aimed at domestic production. The governments of China, South Korea, and Thailand, to mention just three countries, included in their agrofuel development plans, the idea of securing agrofuel supplies from neighbouring or even far away countries.

[4] Sarochawikasit, 2009

[5] See www.biofuelwatch.org.uk

[6] Several reports (see for example, GRAIN, 2008, Cotula et al, 2009, IFPRI, 2009, World Bank, 2010) revealed the immense scale and the intense speed with which new investment deals in the agricultural sector were being negotiated to gain control over land in the South

[7] Manahan, M B (2010) Is Asia for Sale? Land Research Action Network Briefing paper series 2

[8] Invariably, given the size of expanses of land transferred in the contracts signed by businessmen and governments,

control land. Burma too, though much less is known about the extent and the consequences of such land acquisitions, given the political repression and reporting constraints in place there.

Some of the expansion of agrofuels in the region has followed this trend, with large concessions being granted for agrofuel plantation land in Cambodia, Laos and Burma - with devastating results for the people who lose their land in the process. However in other places, such as in Thailand, agrofuels have been promoted through raising prices, public subsidies and other incentives, making it attractive for smallholders to switch crops. Certain crops are said to be suited to smallholder production and this includes each of the fuel crops which have received greatest attention in the Mekong – cassava, oil palm, jatropha and sugarcane (see box 1.2). Whether these crops are indeed grown by smallholders is discussed further below.

In some parts of the region, attention has been given to community based energy initiatives, including small-scale agrofuel production. Maximising the benefits of liquid fuel production at the community level is still under experimentation, following disappointment with negligible yields from jatropha seeds, though there are isolated pilot projects in Cambodia and Thailand that show modest results. A major nationwide "community-oriented", or more correctly "community imposed", agrofuel crop cultivation programme has been implemented in Burma, which appears to have failed disastrously.

**Box 1.2: Agrofuel feedstocks in the Mekong region**

The crops that are being developed for the purpose, though not exclusively, of agrofuel production include (1) cassava (currently favoured in Thailand, China, Vietnam, and Cambodia), (2) sugar (Thailand, Burma, Vietnam, potentially Laos and Cambodia), (3) oil palm (Thailand and potentially Cambodia), and (4) jatropha (extensive plantations in Burma, still under research in Thailand, Vietnam, Cambodia, and Laos).

In addition, used vegetable oil has been recycled for small-scale diesel production in China, Thailand, Vietnam and Cambodia. Vietnam is also developing biodiesel using catfish oil.

With one notable exception, grains have not been a major focus of the agrofuel boom in the Mekong[9]. Aging stockpiles of China's maize harvests, plentiful at the turn of the century, were used for China's early ethanol programme. When the international market price shot up during the food crisis of 2007 however, reserves fell to record lows, leading to serious concerns for domestic food security. By the middle of the year, the government decided to ban any further expansion of grain-based ethanol[10]. The four state-owned maize-based ethanol plants have not been closed, but no new "grain ethanol" facilities have been authorised.

So-called "second" and "third" generation agrofuels (which will not use food crops as raw materials) are still undergoing research in the region, though a few commercial operations have been announced. A cellulosic agrofuel plant in Thailand was inaugurated in 2008 using sugar cane bagasse[11] and there are reports of two plants coming on stream in 2011 in China[12]. Bagasse can also be generated from wood chips, maize leaves and stalks and rice husks and straw.

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many of the target areas were already occupied by long-settled communities. Very few of the local people were given the chance to refuse to negotiate the terms of the deal. In cases from the region, 'landgrabs' had already been already signed, and the land already fenced and cleared, by the time the communities eventually heard of the deal that had been made to take their lands. Little information about the investment deals was open to public, or even subject to proper government scrutiny.

[9] Of the other countries in the Region, only Vietnam appears to be considering grains as a feedstock, in this case companies have been experimenting with the use of broken rice produced as a by-product of rice processing.

[10] Sweet sorghum (a non-food grain) is under research and development in China, for use of both grains and the sweet stems for fuel production. (USDA GAIN report ref CH 8025).

[11] Thai Roong Ruang Energy inaugurated Thailand's first cellulose-based ethanol plant in Wangmuang District, Saraburi Province in July 2008. The company has a licence to produce 400,000 litres of ethanol a year, and uses conventional molasses too. It is not clear what results have been obtained from the pilot scheme. Over half of the funding for the one billion Baht plant came from the Japanese New Energy and Industrial Technology Development Organisation (NEITDO), including the transfer of Japanese technology (Shaw, 2010). See also the company's website: http://www.trrsugar.com/e_group_ethanol.asp . Thai Agroenergy has also been working with the Japanese to develop cellulosic ethanol http://www.boi.go.th:8080/issue_content.php?issueid=38;page=3

[12] A private enterprise China Integrated Energy, Inc. announced that it has built a new 50,000-ton biodiesel [sic]

The following section (section 1) introduces the agrofuel promotion policies in each country and identifies some of the main initiatives and players involved in setting up infrastructure to develop the ethanol and biodiesel industries. A brief note is then made of the intended markets for current agrofuel outputs (section 2). After this, the consequences and pressures on land resources are discussed (section 3), followed by the food security implications (section 4) and the environmental implications of the development of the industry (section 5).

## 1. Kick-starting the engines – initial policies, early investments, first factories

The first convert in the region to agrofuels was the **People's Republic of China**, which first instigated an ethanol programme in 2000 as a productive way of making use of stale grain. It began to use stocks of crops, in particular wheat, rice and maize, which are grown over tens of millions of hectares nationwide. Before most countries in the region were even considering large-scale agrofuel production, China was exporting a billion litres of ethanol to Japan, South Korea, Singapore and Taiwan.

Five major ethanol production plants have been officially licensed so far[13], propelling China to become the third largest producer of bio-ethanol in the world, after Brazil and the United States. This has been achieved with substantial state support[14] including direct output-linked subsidies paid to the five producers, as well as tax exemptions and low-interest loans for capital investment[15]. Seventeen more ethanol production plants were in the pipeline in 2007[16].

Since the recent food market crisis, the emphasis for expansion of this sector has switched from grains to cassava[17]. This unexpected false start, along with the dramatic rise in car ownership and liquid fuel consumption, may be two reasons that have so far prevented the government from setting up national mandatory supply targets, although provincial supply mandates are operational[18]. In 2006, China's National Development and Reform Commission (NDRC) set an

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production facility in Tongchuan City, Shaanxi Province on 31 Jan 2011. http://www.prnewswire.com/news-releases/china-integrated-energy-completes-construction-of-new-50000-ton-biodiesel-production-facility-114923449.html. A deal involving COFCO, Novozymes, and Sinopec was signed in 2010 to develop a cellulosic ethanol plant in Zhaodong, Heilongjiang province, http://www.novozymes.com/en/news/news-archive/Pages/45871.aspx. Both plants aim to use agricultural waste, including "crop straw, agricultural waste and organic waste".

[13] Jilin Fuel Ethanol Co, a joint venture of Petro-China, Jilin Grain Group and the China National Cereals, Oils and Foodstuffs Corporation (COFCO). Henan Tian Guan Fuel – Ethanol Company, in Henan and Nanyang, a joint venture of Petro-China, Sinopec and Henan Investment Group. Anhui BBCA Biochemical Co, subsidiary of COFCO, in Anhui and Bengbu. Huarun Alcohol Co production plant in Heilongjiang and Zhaodong. The latest is Guangxi Zhongliang Bio-energy Co., Ltd. linked to COFCO which is based on cassava feedstock, - it began operating in January 2010. An ADB report states that while these ethanol companies are currently state-owned, there are moves towards their privatisation (Sombilla et al, 2009)

[14] China's agrofuels programme has received strong state support, an ADB report indicates that a subsidy of "as much as CNY1,883/t ($277) was provided in 2005 and CNY1,373/t ($202) in 2008, in addition to value-added tax rebate and the waiving of consumer tax" (ADB, 2009a). The GSI/IISD report finds that "China provided a total of RMB 780 million (US$ 115 million, roughly US$ 0.40 per litre) in agrofuel subsidies in 2006. Total support is expected to reach approximately RMB 8 billion (US$ 1.2 billion) by 2020, according to official sources. This figure does not include support to feedstocks, such as the RMB 3000 (US$ 437) per hectare per year available from 2007 for farmers growing feedstock on marginal land" (IISD, 2008, page 1).

[15] The Renewable Energy Law 2005, later amended in 2009, regulates these initiatives and set up a fund for biofuel development, offering subsidies for non-grain ethanol and biofuel demonstration projects amongst other incentives (articles 24 and 25).

[16] Schott 2009, page 39, citing Lee Sunny, Asia Times, 23 May 2007), of which two were indicated in Guangxi autonomous region, one by a company called Beihai Gofar Marine (with China Agri and possibly Sinopec) and the other in Wuzhou by China Agri in Cooperation with COFCO, both plants will focus on cassava.

[17] Currently the proportion of feedstock used is roughly maize 80% to cassava 20%, with cassava to make up a greater proportion from now on. Other minor feedstocks are being investigated in China including Sweet Sorghum, Sweet potatoes, Yams, Chinese pistachio, cornus wisoniana, and xanthoceras sorbifolia, etc.

[18] The compulsory use of E10 was initiated in 2004 in 4 provinces/prefectures producing bioethanol, this mandate was expanded to 27 cities in 2006, and the mandatory sale of ethanol now covers ten provinces Anhui, Guangxi,

indicative target of meeting 15% of transportation fuel needs with biofuels by 2020. Based on projections for 2020 motor vehicle fuel consumption, this would require roughly a 40-fold increase over 2005 biofuel production[19].

In contrast to ethanol, biodiesel production has not seen as much public investment in China. China has long been a net importer of vegetable oils. Past initiatives to recycle waste vegetable oil since 2005 provided limited biodiesel production opportunities, and the product was mostly not used for transport. Since the emergence of jatropha as a potential fuel crop, however China has begun to promote its cultivation in the Southwest[20] and many private sector actors, including foreign companies[21], been attracted to invest in new production facilities[22] (GSI/IISD, 2008).

State-owned companies such as PetroChina, Sinopec and Chinese National Off-shore Oil Corporation (CNOOC) have followed suit and are now investing in production plants. Despite considerable investment, actual output of biodiesel has not reached even 10% of China's installed biodiesel production capacity, due to the scarcity of feedstock resources (Schott, 2009). Unlike for ethanol, there are no official distribution channels for biodiesel yet, however biodiesel has found its way to retail petrol stations (GSI, 2008).

**Thailand** was also an early investor in agrofuel production, with initial commercial trials in 2001, community-based projects starting from 2004, and a first comprehensive national programme in 2005. A "roadmap" was produced in 2006 setting targets for 2012. This has subsequently been revised and incorporated into the Alternative Energy Development Plan (2008-2022). The Plan places agrofuel production as one element of an overall renewable energy programme and sets out financial incentives[23], research and development programmes and mandatory supply targets. By 2022, the AEDP aims for Thailand to produce six times as much as today's production figures, or 5 billion litres of agrofuel. Prices are subsidised through a system that is supposed to keep agrofuel blend prices lower than conventional fuel[24].

While large-scale production began with biodiesel, Thailand's focus for future agrofuel production is on ethanol. A blend of E10 is now supplied nationwide[25] with ethanol sourced from 19 production plants[26]. Around 90% of Thailand's ethanol is currently produced from sugarcane feedstock. Many of the ethanol plants in Thailand are linked to sugar processing plants[27]. By-products from sugar refining process (particularly molasses) that were already being used for the production of alcohol, were relatively easy to convert to fuel ethanol production.

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Hebei, Heilongjiang, Henan, Hubei, Jiantsu [sic], Jilin, Liaoning, Shandong (Schott, 2009). China has indicated that it aims for E20 to be compulsory in 2020, however there is no national mandate at present. There are also ongoing discussions regarding the provision B5 or B10 to be mandatory by 2020.

19 Wang et al. (2006) cited in Weyerhaeuser et al 2007

20 The provinces of Yunnan, Guizhou, and Sichuan each plan to convert 600,000 hectares to jatropha cultivation (Weyerhauser, et al 2007, cited in GSI/IISD 2008 p 15)

21 Interest reported from D1 Oils PLC (UK), Sunshine Technology Group (UK) , Biolux International (Austria)

22 According to GSI/IISD, "There are now at least 11 operating biodiesel plants, with at least another 28 planned or in construction… [C]ompared to the ethanol sector, the biodiesel industry is largely unregulated and there is significant involvement from the private sector" (page 3)

23 including an 8 year tax holiday for new ethanol plants, 0% taxes on machinery, price support (particularly for biodiesel) to ensure prices are lower than conventional fuels (BEFSk) reduced excise tax on flexible fuel vehicles to be able to use higher concentrations of ethanol fuel.

24 Referred to as an "adder", which which is made possible through the Oil Fund—a fund from levies paid by oil and natural gas producers and importers. However mismanagement of the biodiesel expansion programme has allowed prices to lead to soaring oil palm prices with the result that prices of biofuel at the pump have also risen above conventional oil prices (observation 20 February 2011).

25 "E" numbers in this paper are short for a percentage blend of ethanol mixed with conventional fuel and retailed at petrol pumps (eg E10 is a blend of 10% ethanol, 90% fossil fuel). Likewise "B" numbers refer to blends of biodiesel. Originally, ethanol was channelled through partially state-owned companies PTT and Bang Chak.

26 Ministry of Energy, note 5 more plants were already in construction in 2010. http://www.dede.go.th/dede/images/stories/english/information/ethanol-gasohol-apri-11.pdf

27 One of the first plants, Thai Agroenergy in Suphanburi, completed since 2005, is 75% owned by Lanna Resources Public Co Ltd a coal mining company.

However, it is expected that cassava will be promoted as the main feedstock for ethanol production as this is believed to have the greatest potential for expansion[28].

Current supplies of feedstock do not meet even half of the operational production capacity of existing ethanol plants. Nevertheless, many more ethanol plants are in the pipeline[29], banking on the policy-backed expansion of demand in the Thai market.

Diesel remains the primary transport fuel in Thailand, and initiatives for biodiesel production are also in receipt of policy support. The biodiesel sold at petrol pumps is made from palm oil, of which Thailand is the third biggest producer of in the world. The AEDP prescribed the scheduled introduction of compulsory supply of B2, B3, B5 and optional supply of B10. According to this plan, since June 2010, all diesel in Thailand was supposed to include a blend of 3% biodiesel, while B5 was scheduled to be made compulsory in January 2011[30].

However, problems have occurred. Domestic palm oil supplies have not expanded according to plan, which meant that fulfilling the higher biodiesel blend requirement led to a rapid fall in domestic crude palm oil reserves from September 2010. This had the result that domestic prices of palm oil soared in late 2010, reaching nearly double the international market price in early 2011[31]. This affected not only biodiesel production (biodiesel became much more expensive than conventional diesel[32]) but also led to a critical shortage of cooking oil[33]. In early 2011, fuel producers reportedly refused to comply with the biodiesel promotion policy, and ordinary diesel was seen to be on sale at pump stations on the main roads. The government was forced to announce that on 1st March 2011, the national mandate was to be reduced from B3 back to B2[34]. However in reality it appears that the biodiesel mandate has been withdrawn altogether: in June 2011, it is observed that biodiesel blends are still not on offer at most petrol pumps, and the Thai Ministry has not announced biodiesel prices on its website since March 2011. It appears the biodiesel production schedule has been derailed[35].

There are 15 biodiesel production plants currently operating in Thailand[36], mostly in the South close to the main oil palm cultivation areas, and around Bangkok close to the fossil fuel refineries and fuel distributors. As with ethanol, current biodiesel production is far below the maximum operating capacity of the plants. A special palm oil development investment zone has been proposed. A Thai-Japanese company, Green Alliances Co announced that it has established an oil-palm based biodiesel facility in Surat Thani selling the output to PTT. Thai multi-national corporation Charoen Pokphand has plans to begin production of palm oil from 2011[37].

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28 Given that sugarcane based ethanol is made from the residues of sugar production, its expansion is currently limited to the extent that the market for sugar expands.

29 According to information as of March 2010 from the Ministry of Energy a total of 48 plants have been licenced, though only 19 are operational.

30 Some pumps have been offering B5 since 2007.

31 The government maintains tight control over oil palm imports.

32 The price of diesel on 19th January 2011 was 30.29 per litre while palm oil biodiesel was 56 Baht per litre (data from oil palm farmer Athirat Damdee, 2011 compiled from Ministry of Energy sources).

33 Supermarkets limited their sales of cooking oil to 1 litre per family for several weeks, and by mid-February the shelves in many stores were seen to be empty of domestically produced cooking oil. The government controlled price of cooking oil, kept the retail price below the soaring market price and many distributors were unwilling to sell their stocks at the official price.

34 Thailand national news bureau "Palm oil shortage affects alternative energy promotion" http://thainews.prd.go.th/en/news.php?id=255402150022.

35 According to news reports in Thai language, the National Palm Oil Policy Board appears to be discussing the reintroduction of a biodiesel blend in order to absorb the surfeit of supply of palm oil, which implies that the mandates are being revised haphazardly. However this may also relate to the role of the board which is more to control the price of oil than to follow a diesel production schedule. There is still no direction from the Ministry of Energy. The Department of Special investigations is reported to have opened a file on the apparent misappropriation of government stocks by retailers during the cooking oil shortage (www.businessreportthailand.com/tapping-the-thai-palm-oil-industry-12675).

36 as of March 2010. Ministry of Energy – Agrofuels in Thailand, Department of Alternative Energy Development and Efficiency. http://www.dede.go.th/dede/images/stories/english/information/biodiesel-plants-jan-11.pdf

37 http://www.palmoilhq.com/PalmOilNews/thailand-cp-group-ready-for-palm-oil-in-2011/

While most palm oil refineries are privately owned, a large-scale Cooperative Operation has been established in Krabi since 1997, owned in turn by several cooperatives with 10,000 farmer members each with around 25 *rai* (4 ha) of oil palm land. The venture has operated at a profit for several years.

Thailand also has several years experience in developing small-scale biodiesel production, though output has been limited. Several projects have focused on reusing cooking oil. Jatropha biodiesel has not been produced on a commercial scale yet. While many initiatives have been begun at community scale, a viable jatropha production model for rural communities appears elusive. Initial research results indicate that jatropha may be of greater use for communities as a source of biomass production for heat or power, however studies are on-going (see section on community energy below).

**Vietnam's** agrofuel programme is much more recent. A government directive was issued in 2007 approving the development of agrofuels up to 2015, with a vision to 2025, which includes tentative agrofuel production targets[38]. Agrofuels have now been classed as a "specially encouraged sector" for tax purposes, and agrofuel production projects enjoy the highest level of investment incentives[39].

Stepping into this sector later than others, Vietnam has explored a wider range of raw materials, including catfish oil, rubber seeds, elephant grass, coconut, sesame, peanut, flax and seaweed. It is keen to research second-generation agrofuels which would make use of cellulosic biomass such as residues and stalks of agricultural crops. However, like other countries of the region, so far large-scale production is based on cassava and sugar processing residues. The country aims to ensure that agrofuels will be an important component of the fuel mix in 2025, the equivalent of 5% of the estimated fuel demand, but the government has so far been reluctant to make this target mandatory. A moderate interim target expects agrofuels to meet 1% of domestic transport fuel demand by 2015.

There are about forty commercial sugar mills in the country, eight of these are involved in the production of ethanol from sugar. This includes the top two sugar mills, Bien Hoa Sugarcane Company and Lasuco[40]. The first cassava-based ethanol production plant became operational in 2010[41], and a further three production plants were expected to come on stream during 2010[42].

Ethanol production in Vietnam has involved a growing commitment of foreign capital in Vietnam's sugar industry. The Thai Mitr Phol Company has significant investments in Vietnam. The International Finance Corporation (World Bank Group) funded joint venture between Tate and Lyle, Mitr Phol, and the Vietnam Fund Ltd. In 2000[43] Vietnam also has a technology-sharing pact with Brazil and has received investment support from Japan's Itochu Corporation, and Fair Energy Asia Ltd from Singapore.

According to some sources, about 70 small biodiesel processing plants using fish fat were already operating in the Mekong River Delta area of Vietnam in 2007, mostly to power fishing vessels (Sombilla et al, 2009). Since then, Vietnam has begun a more ambitious programme of

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38 Decision of 20 Nov 2007 (No. 177/2007/QD-TTg).

39 Companies operating in this sector are entitled to a specially low 10% tax rate for its first 15 years of operation, with a tax holiday for the first 4 years.

40 Bien Hoa and Lasuco are two of the three largest sugar companies in Vietnam. Lam Son Sugar, or Lasuco, government maintains a 37.5% holding. Bien Hoa's plant will be in an industrial estate west of the Vam Co Dong River in Tay Ninh Province. Vietnam's fuel giant PetroVietnam (specifically Petrosetco, linked to the Itochu Corporation, Japan), aimed to construct an ethanol plant in the Hiep Phuoc Industrial Zone of Ho Chi Minh City.

41 "Dong Xanh JSC's ethanol plant, the first in Vietnam, began operation in August. Its annual capacity is 100,000 tons of agrofuel a year. The plant is already working at 70-80 percent of its designed capacity, supplying ethanol to state-owned Petrolimex. Its principal feedstock is cassava grown in Quang Nam and Binh Dinh provinces" (commodity online).

42 Schott, 2009

43 Tate and Lyle sold its stake in April 2011

research and development of biodiesel from catfish oil, making use of the fact that tens of thousands of tonnes of fat are currently disposed of every year[44]. The first major biodiesel plant from catfish fat was inaugurated in Can Tho in 2009, by Minh Tu Co., Ltd.

**Myanmar/Burma.** Like many other initiatives put into operation by Burma's military dictatorship, its agrofuels programme has a dark history. So far, its implementation appears to have presented mostly negative results. By dictat, towards the end of 2005, the junta ordered all regions and all sectors of the country to cultivate jatropha bushes for fuel production[45]. Teachers, school children, nurses and civil servants were forced to buy and forced to plant jatropha curcas seedlings. They were expected to use their own labour and to give over a proportion of their own farmland, their school fields, their land reserves for the crop. Refusal to comply with the order was punished harshly by the regime, including fines, beatings, and arrests. The coercive nature of the programme, and the lack of knowledge and interest in the crop by local people, points to the programme's failure.

Yields of jatropha were reported by NGOs to have achieved only a quarter to a half of the planned targets. However, failure to meet government targets was not tolerated, with the result that many villagers fled their settlements to join the already considerable numbers of refugees and vulnerable migrant workers in neighbouring countries. In 2008, a group of farmers lodged complaints with the International labour Organisation after their land was confiscated by army officers (apparently hoping to make money amidst the early enthusiasm for jatropha planting). Reports indicate that members of the farmers group were subsequently interrogated, convicted and have been sentenced to jail for 10 years[46].

Despite the intensive efforts to force the production of jatropha seeds, it appears that up to 2008, not a single biodiesel processing plant was running in the country (Schott, 2009) and indeed plans for jatropha biodiesel industrial development appear to have been put on hold (Sombilla et al, 2009)[47]. One government authored report suggested that the expansion was so fast that the seeds were simply used for replanting to meet the expansion plans, with no surplus generation for biodiesel development[48]. Farmers have been unable to find a market to sell the seeds yielded from the millions of hectares dedicated to the inedible plant, even after plants had matured. Though some small-scale harvesting for local use has been reported.

The Myanmar Industrial Crops Enterprise (MICE) was created to oversee bioenergy development in 2006 with help from a South Korean corporation[49]. MICE did begin manufacturing small-scale jatropha oil expellers in 2007, but according to an FAO study, a total of only 26 machines have been distributed to villages[50].

There are indications that palm oil is produced in the country, sufficient to export "informally" to India (FAO 2009). Information is not easily available about where this is being grown or by whom. An investment in oil palm production over 68,000 ha was planned by Astral Asia

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[44] Vietnam has begun working with a Finnish Research Centre (see Enerfish project supported by the EC 2008-2011) to study the potential for using catfish oil as the feedstock. Small- and medium-sized enterprises from Finland, France, Germany, the UK and Viet Nam will be involved.

[45] For an overview see Biofuels by Decree (2008) by the Ethnic Community Development Forum

[46] www.ahrchk.net/ua/mainfile.php/2008/3104 Urgent Appeal Case: AHRC-UAC-009-2009 February 2, 2009

[47] South Korean biofuel giant Enertech, and Myanmar Agri-Tech (MAGT) are reported to have signed a preliminary memorandum of understanding (MoU) covering the production, export and refining of jatropha-based biodiesel fuel in Yangon on 5 November 2008. However it is not known if this project has made any progress. http://www.thebioenergysite.com/news/2292/mou-signed-to-mark-jatrophabiodiesel-deal

[48] See Kyaw, et al 2009 "Myanmar: Country Assessment on Biofuels and Renewable Energy 2009" http://www.asiabiomass.jp/biofuelDB/myanmar/pdf/Biofuel_Myanmar_Report_%20finaledited.pdf

[49] The state-run Myanmar Industrial Crops Enterprise (MICE) (also referred to as the Myanmar Perennial Crops Development Enterprise) jointly established a bioresearch centre with Korea's Haejohyub Bioenergy Myanmar Corporation. http://news.xinhuanet.com/english/2008-03/13/content_7783903.htm. See also Bernama "Myanmar and Korean Companies to Produce Biodiesel" Thursday, November 06, 2008 http://www.thebioenergysite.com/news/2222/myanmar-and-korean-companies-to-produce-biodiesel

[50] FAO (2009). Note this report mainly covers edible oils.

(Malaysia) in the South, but the joint venture MOU[51] was terminated in 2008. Myanmar also imports palm oil from Malaysia and Thailand, of which around 20% enters informally from Thailand[52].

Ethanol based on sugarcane is produced on a limited commercial scale. A military-based enterprise (the Myanmar Economic Corporation) began production at two ethanol plants in 2008[53]. A large private company (Great Wall) is in construction of a new bioethanol-processing plant. Another new factory will be constructed by an associate company of Great Wall in Katha Township[54].

In the **Lao People's Democratic Republic,** the agrofuel sector has been the subject of foreign investor interest for a few years[55]. The government has been actively encouraging the development of large-scale plantations, including cassava, sugar cane, and jatropha, by granting large-scale land concessions with low fees, and tax exemptions. A draft agrofuels policy has been proposed since 2006[56], and the government has been considering various targets of replacing fuel imports with domestically produced agrofuels[57]. While it appears that at least fifteen agrofuel companies are active in Laos, none has begun commercial production so far (Schott, 2009). A series of analyses indicate that there is little expectation of meeting fuel replacement targets, given production constraints within the country, and the sector's continued export-orientation (see eg Gaillard et al, 2010).

At present, there is no fuel ethanol production industry in Laos. Feedstocks such as cassava and sugarcane have been produced on a large-scale, however harvests of these crops are not currently used in Laos for agrofuel production. Some sugar factories export molasses for ethanol production in Thailand[58]. At least three companies have announced plans to construct large-scale ethanol production facilities in Laos[59].

Modest biodiesel production facilities operate, mostly for research, and some commercial interest has been shown in developing larger scale production facilities. The State Fuel Company has indicated plans to construct a production plant for jatropha-based biodiesel in 2011 (Schott, 2009). Private companies have also proposed to set up four large-scale jatropha diesel production plants[60]. However, there are no signs of these facilities yet. While jatropha grows

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[51] Other joint venture partners were Myanmar Combiz Services Co Ltd and Green Future Co. Ltd

[52] Cited in Shaw, 2010, see also http://www.fao.org/fileadmin/user_upload/ags/publications/edible_oil_web.pdf

[53] According to the ADB. An ethanol production plant, it is not clear if this is one amongst the Myanmar Economic Corp's plants, is located in Maunggone, Sagaing Division, about 200 miles from Mandalay, and is also relatively far from Yangon. "Both cities have high demand for petrol and diesel, but transporting ethanol to these cities is problematic because of the high cost" Sombilla et al, 2009.

[54] (Sombilla et al, 2009). This private company applied for a license and sought government policy on distribution, delivery, and marketing of bioethanol.

[55] By 2009, around US$50 million had been invested in agrofuel development (Gaillard et al, 2010).

[56] Included in the development plan for industry at the VIII General Congress of the Lao Revolutionary Party in 2006

[57] eg 5% of fuels from agrofuels by 2015 (Bhandhubanyong 2008), another report indicates that a target of 30% of fossil fuels to be replaced by 2020 and a target of 10% of diesel imports to be replaced by biodiesel by 2020 were both in discussion within the government policy circles (Gaillard and Rietzler, 2009), a more recent report indicates that the target is now to replace 10% petrol fuel with agrofuel by 2020 (Gaillard et al, 2010).

[58] Molasses from Mitr Lao's sugar production has been exported to another Mitr Phol company (Bio Green) for ethanol production in Thailand (according to The Nation Newspaper, November 17, 2009)

[59] Including Thai sugar producers Khon Kaen Sugar (Bangkok Post 18 February 2006) and Mitr Lao (Bangkok Post, 10 April 2008), and a Chinese company linked to ZTE corporation, by the name of Dynasty which may, or may not, have obtained concessions to plant 100,000 ha of cassava in the four southern provinces and has plans to construct a "production plant" in Champassak (Schott, 2009). Note also that the Henan Tianguan Group (partly owned by Sinopec) plans to build a cassava ethanol refinery in Laos in the next 3 years ("China No. 2 fuel ethanol maker eyes overseas plant", Reuters, 10 Mar 2010).

[60] Including Kolao, a Korean company that plans two jatropha diesel production plants in Champasak and Vientiane, a Chinese-Lao company, Mekong Agro Industry, which plans a jatropha diesel plant in Savan-Seno Special Economic Zone, and a lone Lao company, Manivone Industrial Tree Plantation Development, aiming to produce palm oil (Schott, 2009).

wild in Laos, and has been used by villagers as effective "live fencing", attempts to cultivate it on a commercial scale for the production of biodiesel have so far proved unviable[61].

**Cambodia** An agrofuels development policy is currently being drafted. The government has already waived import and export duties, and offered other tax breaks such as decade-long tax holidays for investors in agrofuels production (Schott, 2009). Being a "least developed country", producing commodities in Cambodia brings with it access to trade privileges, such as access to tariff-free trade with the European Union under the Everything But Arms Initiative[62].

The first and only ethanol production factory in Cambodia closed in 2010. Korean based MH Bioenergy's plant opened in Kandal province in November 2008 and produced sufficient ethanol to begin exports to Europe[63]. However the ill-prepared investment has met with poor economic conditions (including low ethanol prices in Europe, and high local crop prices, due to limited cassava yields), which have brought the factory to a halt. Land disputes also emerged as a result of economic land concessions linked to this development in Kampong Speu, as villagers were given little option, other than to accept "starkly inadequate" resettlement when their lands were being cleared for cassava plantations[64]. Plans for further ethanol development may use residues from sugar processing (see section 3 changing landscapes).

Recent interest from Plantheon (a member of the transnational Thai Charoen Corporation Group) has led to a joint venture with Mong Reththy Investment Cambodia Oil Palm Co[65] to build Cambodia's first crude palm oil factory which exports its oil products to Malaysia, Switzerland, Netherlands, India and France[66].

A small-scale jatropha-based biodiesel production plant has been built at a University in Phnom Penh by Biodiesel Cambodia. A larger jatropha-based biodiesel production plant[67] is planned for 2011 in Preah Vihear province. However, another Japanese-Cambodian joint venture has reluctantly had to halt their jatropha-based biodiesel production at their factory in Kampong Speu in November 2010 citing a lack of seed feedstock[68].

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[61] Gaillard et al (2010). According to Reitzler et al (2009) investors from China, Thailand, Vietnam, Korea, Italy, France, and Japan have all tried to establish jatropha plantations in Laos without success due to "improper business models, (ii) lack of understanding of the local context, (iii) lack of experience with Jatropha cultivation, and (iv) overestimated expectations".

[62] This is also available for products from Laos.

[63] The first shipment was exported to a Swiss-based commodities trader. Later shipments were more vaguely stated for the "European market". Phnom Penh Post (May Kunmakara) "First ethanol export marks start of lucrative industry, officials say" Wednesday, 7 Jan 2009 http://khmernz.blogspot.com/2009/01/first-ethanol-export-marks-start-of.html

[64] Pers comm.

[65] The Mong Reththy has a land concession 11,000 hectares located in Taney Village, Choeng Ko Commune, Prey Nup District, Sihanoukville Municipality. In 2008, Plantheon applied to develop another 10,000 ha for an oil palm plantation in Cambodia. Plantheon also has a sugar project partnered by another company in the Mong Reththy conglomerate, MRT-Thai Charoen Corporation Group (TCC) Sugar Investment Co. to produce sugar cane over 8,401 ha.

[66] http://www.mongreththy.com/index.php?page=mong_reththy_invest. This project is a joint venture with the Thai Charoen Corporation (TCC) Group from Thailand (Schott, 2009).

[67] Run by Angkor Bioenergy Co Ltd a subsidiary of Canadian company Pan-Asia Agrofuels Co. Ltd. Pan Asia Agrofuels headquarters is in Vancouver. It has operations in China, Vietnam, Laos, Thailand, and Cambodia. It has a partnership with Acqua International which is expected to market Cambodian biodiesel to GM, BP, Shell, and the US Navy (Schott, 2009).

[68] http://biofuelsdigest.com/bdigest/2010/11/19/cambodias-ntc-halts-production-as-low-jatropha-yields-bite/ it appears the company is now investing in 500 ha in Kampong Speu province and Koh Kong province to grow its own jatropha bushes to ensure future supplies for its currently closed plant.

## 2. Long journeys – export orientation and demands for import

In public speeches and policy statements, agrofuel programmes in the region are said to be justified, at least partly, on the grounds of improving domestic fuel security, and reducing fuel import bills. However, in reality, many of the developments so far have been made with an eye on the export market. The international markets for agrofuels are expanding. Markets which have shown an interest in importing fuels or feedstocks from the Mekong region include Singapore, China, Korea, EU, and Japan (see box 1.2).

**Box 1.2 Overseas markets of relevance to Mekong agrofuels sector**

- Singapore: This nearby trading state aims to be the world centre for agrofuels, both for processing and refining fuels as well as trading onward. It has not set out a mandatory agrofuels consumption target. Singapore has been identified as a target market within Cambodian, Lao and Burmese plans for jatropha production (Schott, 2009).

- South Korea: Targets for agrofuels to replace 4% of national fuel consumption by 2012, rising to 12% in 2030. It is estimated that around 80% of feedstocks will have to be imported in order to meet these targets. It was reported in 2008 that several Korean companies are in the process of negotiating purchases of more than 650,000 hectares of cassava, rapeseed and jatropha plantations in Southeast Asia[69]. The government has not yet approved the commercial use of ethanol, however Korean cassava plantations in SEA, once operational, are expected be used for ethanol.

- European Union: A legally binding target was set in 2007 to require that 5.8% of transport fuels must come from agrofuels in 2010 rising to 10% by 2020[70]. These targets were roundly criticised by NGOs, and even the European Commission's own scientists[71] for bringing about land use changes that release more GHG emissions than is saved by the use of renewable fuels. A decision was taken in 2010 to require that agrofuels must provide a reduction of at least 35% greenhouse gas emissions compared with conventional fossil fuel (rising to 50% in 2017 and 60% in 2018) and must not be grown on lands rich in biomass or biodiversity, such as forests, peatlands, wetlands and protected areas[72].

- Japan: Environment Ministry requires all new cars to be able to run on a blend of 10% ethanol starting in 2010. Currently, petrol may be blended with 3% ethanol. Domestic sugar-based ethanol annual production is limited and the country will most likely have to import ethanol to meet its targets. It has an agreement with Brazil to cooperate on ethanol development.

Countries within the Mekong have actively pursued export markets. In China, exports of ethanol output were promoted with a 13% VAT rebate. This proved problematic however. The volume of exports rose suddenly as international price of oil soared in 2006. This led to a spike in exports of China's grain-based ethanol in the course of one year[73]. With fears for a major

[69] USDA FAS, 2008 (which is cited in bibliography as Sun Young Choi and Francom, M.) Two Korean projects identified in Vietnam and Thailand were said to amount to 250,000 ha with the remainder likely to be sourced from Indonesia, Malaysia and Philippines. Note however that no other reference to the South Korean "Korth" company (supposedly investing in 50,000 ha of land for cassava and rapeseed in Thailand) has been found so this point needs further verification.

[70] Renewable Energy Directive (2008/98/EC). EU directive in 2009 adopting sustainability criteria for agrofuels and bioliquids Directive 2009/28/ of 23 April 2009 Renewable Energy, OJ L 140/28, 5.6.2009

[71] So says a leaked report (unpublished working paper) by the Commission's Joint Research Centre (JRC) Council (http://www.euractiv.com/en/transport/commission-scientists-blast-eu-agrofuels-policy/article-169668)

[72] http://eeas.europa.eu/delegations/india/documents/press_corner/20100610_01_en.pdf

[73] See for example, USDA GAIN report 2009 which shows exports jumping from 162 million litres to over 1 billion

grain shortage, the VAT rebate was abolished, and exports of ethanol were limited, falling by 87% the following year.

In the other countries of the region, on the other hand, there appears to be very little success in keeping agrofuel outputs within their own borders. The Burmese government appears to have failed to develop its own biodiesel processing plants, but has been developing deals instead to export jatropha seeds to Singapore, Thailand, China and South Korea. When the sole production facility in Cambodia was operational, its entire ethanol output was sold to European traders. All planned agrofuel production in Laos is, at least initially, intended for the external market, according to investment plans by South Korea Thai, China and Malaysian companies. In Vietnam also, the first produce of domestically produced catfish oil based biodiesel was shipped to Singapore[74].

In Thailand, most domestic agrofuel production is consumed within the country. However six companies have exported ethanol over the period 2008-2010, the biggest of these were exporters Akarat and Petrogreen[75]. It is expected that exports will be restricted as domestic ethanol consumption increases. Thai exports have been destined for Singapore, Netherlands, Japan, UAE, Taiwan, Korea, Indonesia, Philippines, and Australia (Ministry of Energy, 2010).

Two countries in the region have attempted to source feedstocks from neighbouring countries. While the Chinese government takes a strong stand on retaining its own domestic output and grain supplies, it does not shy from making investments in foreign countries and acquiring land resources to secure ethanol supplies back home. The government is promoting agribusiness to invest overseas with a maximum subsidy per company per year of CNY 30 million (or just over USD 4.6 million). Since March 2011, the Ministry of Agriculture, Ministry of Finance, and Ministry of Commerce are drafting more detailed strategies of "Agriculture Going Out"[76], including the financial and fiscal support, tax breaks, and insurance. While food production is a strong focus, Chinese companies have also been investing in agrofuel crop cultivation abroad with state support in Laos, Cambodia, and Nigeria. Yunnan's provincial government biodiesel production plans include making use of land and output from Laos, Myanmar, and Vietnam[77].

Similarly, Thailand included in its first oil palm development plan the idea that 160,000 hectares out of its overall target would be secured from neighbouring countries[78]. Molasses from Lao sugar refineries have been transported across the border to Thailand for ethanol production[79]. State enterprises in Thailand and China also have investments in Indonesian palm oil and ethanol development[80]

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litres in 2006 and back down to 130 million the following year. http://gain.fas.usda.gov/Recent%20GAIN%20Publications/BIOFUELS%20ANNUAL_Beijing_China%20-%20Peoples%20Republic%20of_2009-7-17.doc.pdf While this infromation relates to China as a whole, it has had an impact on Guangxi to the extent that it was the context against which the Guangxi cassava ethanol plant was developed.

[74] Commodity Online, 28 Sept 2010, "Vietnam joins race for biofuel

[75] Others were Thai Sugar, Khonkaen Alcohol, Thai Ngun, PSC Starch (Ministry of Energy, 2010). In 2006, Univanich reported that they exported oil palm to Hamburg and Rotterdam as well as other European markets.

[76] Agricultural cooperation: draft development plan for twelfth five year plan. China's moves to promote overseas agricultural investment since March 2011 appear to be related to worries about domestic food security.The Chinese govt has floated the idea of subsidizing companies which buy farmlands overseas, to encourage companies to plant staple food overseas and secure the food supply, though the subsidy amount has yet to be clarified. Chen Jie, of China's Research Centre for Rural Economy has suggested China's need for agricultural overseas investment, as world's largest forex reserves holder. "China should build grain production bases abroad, especially in South America, Africa and some neighbouring countries with great potential to increase grain production". http://www.commodityonline.com/news/China-urged-to-invest-vast-forex-reserves-in-agri-sector-abroad-39475-3-1.html

[77] Weyerhaeuser et al 2007

[78] See Ministry of Energy Renewable Energy Development and Environment in Thailand (2006) http://www.jst.go.jp/astf/document2/22pre.pdf

[79] The Nation Newspaper, November 17, 2009

[80] eg in Thailand, partially state-owned PTT (subsidiary PTT Green Energy) has investments in PT MAR and Kalimantan Thai Palm PTE, and the China Golden Agri-Resources (Singapore/Indonesia, owned by the Sinar Mas

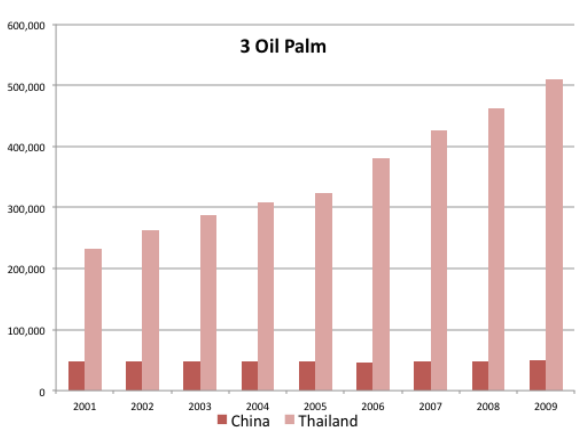
## 3. Landscape changes – crop change, land use change, tenure change

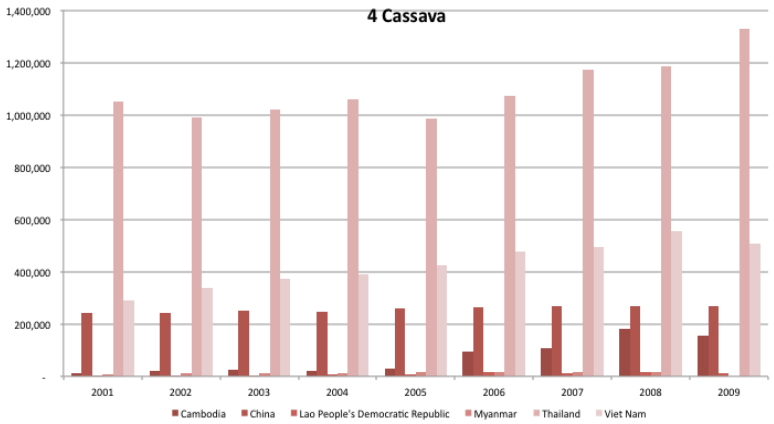
To produce the vast amount of feedstock required to meet the increased targets of both domestic and foreign fuel consumption described above, large areas of land and other resources will be required.

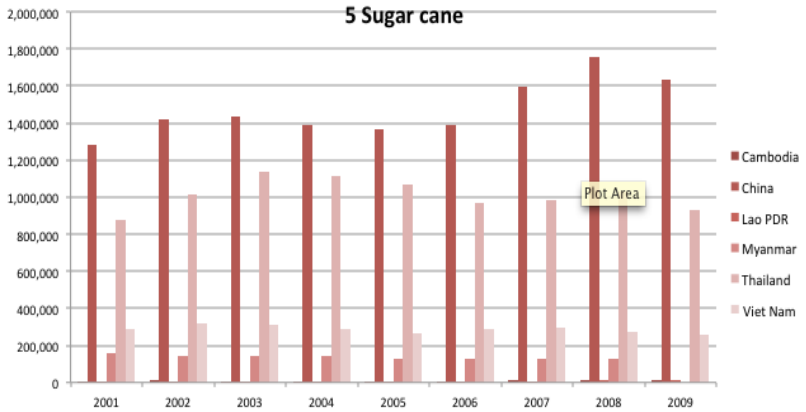
Looking at agrofuel crop expansion over the last decade, FAOstat data shows that there have already been significant increases in the cultivation of crops that can be used for agrofuels. Thailand's oil palm area has steadily doubled from around 233,120 ha in 2002 to 510,213 ha in 2009.

There are also notable increases in areas under cassava in Cambodia, Thailand and Vietnam. Cambodia's cassava crop area has grown over the decade from only 13,590 ha in 2001, to 96,324 ha in 2006 to 179,945 ha in 2008. Vietnam's cassava area has increased strongly and steadily during 2001 to 2009, from 292,300 ha to 508,800 ha. Thailand's harvested area of cassava grew from 1,048,960 to 1,326,743 ha, with a steady increase since 2005.

The areas harvested for sugar cane have fluctuated; declining in the middle of the decade, rising again in the last couple of years (as indicated in the figure 1.5 below). The most notable increases have been in China (from 1,388,980 ha in 2006 to 1,753,520 ha in 2008).




Figures 3-5 : Agrofuel crop trends in Mekong
Data source: FAOstat 2010

NB these graphs are indicative of trends over time, but note that different scales are used in the three graphs

Group) is in partnership with the fully state owned China National Offshore Oil Co. (CNOOC) and Hong Kong Energy Ltd. to develop crude palm oil-based biodiesel, and sugarcane- or cassava-based bioethanol on around one million hectares of land in Papua and Kalimantan, Indonesia (GRAIN, 2007 www.grain.org/seedling/?id=486).

**Table 3: Current area and planned expansion of selected agrofuel crops**

| Country | Agrofuel crop | Current area (ha) | Reports of planned expansion in cropping area |
|---|---|---|---|
| China | Maize | 27,000,000 | According to government, future ethanol expansion will not use maize. |
| | Cassava | 270,000 | A study by the Chinese Academy of Agricultural Engineering estimated that China could produce about 5 million tonnes (mt) of ethanol by 2012 from 1.29 million hectares (ha) of 'marginal land' planted to cassava, sweet sorghum, and sweet potato and could more than double to 12 mt by 2020 from 3.32 million ha of land. Of this 148,000 ha of grasslands and mudflats and other 'reclaimable' land is estimated to be suitable for conversion to cassava in the Southwest (cited in ADB, 2009a) |
| | Jatropha | Not known | 3 provinces of Southwest China have an initial target to cultivate 1 million ha, most of which will be in Yunnan. Yunnan has been proposed as a jatropha demonstration province. According to an ADB report (2009a), government plans indicate around 0.83 million ha of energy trees (mainly jatropha) will be planted in Yunnan from 2006 to 2010, and the area will be further increased to 13.3 million ha by 2020. |
| | Oil Palm | 50,000 (estimate FAOstat 2009) | |
| Thailand | Cassava | 1,600,000 | If cassava exports and cultivated area remain limited to present levels, the yield of cassava would need to increase by at least six times to meet target for cassava feedstock. A recent study assumes that between 200,000-350,000 ha of land will be converted to cassava to produce the additional quantities of ethanol required by the AEDP targets (BEFS, 2010) |
| | Sugar cane | 1,600,000 | According to an FAO study, the land area for sugar is not expected to increase significantly (BEFS, 2010). Note that ethanol is mainly produced as a by-product of sugar processing. |
| | Oil Palm | 630,000 | NB Area has already doubled since 2002. It is expected that another 400,000 ha will be required to meet the 2022 production target (BEFS, 2010). The govt originally announced that oil palm for Thailand could be planted on 160,000 ha of land in neighbouring countries. |
| | Jatropha | 16,000 | No govt plans for expansion. |
| Vietnam | Catfish aquaculture area | 6,000 | Not known |
| | Jatropha | Not known | 500,000 ha by 2025 |
| | Cassava | 508,800 (FAOstat 2009) | Not known |
| Myanmar / Burma | Jatropha | Somewhere between 12,140 and 728,434 ha. Possibly.<br><br>i.e. Not known | Original overall target was to have planted 3,200,000 hectares by 2010, Reliable government statistics are limited. Many reports confuse target areas with the total area actually planted. While one govt report says that 1.8 m acres (728,434 ha) have been achieved in by 2009, the same report also states that "some authority" placed the figure at no more than 30,000 acres (or only 12,140 ha) (Kyaw et al, 2009) |
| | Oil Palm | 101,700 (govt) | No targets set |
| | Sugar cane | 275,000 (govt) | No targets set |
| Lao PDR | Jatropha | 26,057 (Gaillard et al, 2010) | It is predicted that 53 million litres of biodiesel would be required for domestic consumption in 2020 to meet 10% substitution of diesel. This would imply plantations of 132,782 ha of jatropha if all the output is used within Laos only. Meeting domestic targets as well as export demands by investor companies could require up to 517,669 ha of jatropha plantations (Gaillard et al, 2010). Concession contracts are reported to have been granted over several thousand hectares nationally, however there is no clarity in the data. |
| | Sugar cane | 13,830 (FAOstat, 2009) | No expansion plan for biofuels published. Foreign companies are investing in large-scale sugarcane plantations. |
| | Cassava | 10,375 (FAOstat, 2009) | No expansion plan for biofuels published. There are several reports of foreign interest in cassava plantations. |
| Cambodia | Cassava | 300,000 (179,945 acc to FAOstat 2008) | No expansion plan for biofuels published |
| | Sugar cane | 13,297 (acc to FAOstat 2008) | No expansion plan for biofuels published |
| | Oil Palm | Not known | No expansion plan for biofuels published |
| | Jatropha | Not known | No expansion plan for biofuels published |

Sources: FAOstat database of harvested areas (latest published data)

If we look at the scale of the proposed expansion over the next ten years, based on the policies identified in section 1, the estimates of the additional areas required are considerable. The table below shows the figures of current land area under each crop, and in the final column, the expected size of the crop areas under various declared agrofuel promotion plans of the governments. The author has not attempted to make an independent calculation of the amount of area required to meet production targets, based, for example, on a formula of how many hectares on average are required to produce a tonne of fuel, as the data is not available in most cases to factor in various relevant factors (including the possibility of improving yields in existing fields, the possibility of cultivation switching from unproductive areas to more productive fields, the dual (non-fuel) uses of crop output, the potential for double or fallow cropping, etc).

However, numbers can give only an indistinct picture of how the landscape will change in the Mekong. It is important also to understand how the land is currently being used, on whose land will these crops be grown, who will be cultivating these crops, who benefits from these initiatives. More often than not, unfortunately, these questions are not addressed in the sectoral literature reviewed. The discussion below looks in general at some of the agrarian issues raised in the different countries that will affect how agrofuels develop in the Mekong in pursuit of the goals and targets outlined above.

In China, the main constraint in the attempt to squeeze another demand out of its existing agricultural sector is the lack of arable land. Most available land is already dedicated to food and key industrial crops such as rubber - often farmed intensively, and already raising concerns about unsustainable agriculture. As a result, it is difficult to pinpoint where room will be made for agrofuel crop expansion.

Areas identified for the promotion of jatropha plantations in three Southwestern provinces, slightly over one million hectares, are supposedly mainly in "barren lands". This appears to be a Chinese forest administration term for land that is "not being used for obvious productive production"[81], which indicates a biased view of rural land that tends to focus only on its value for economic activities that contribute to GDP. However such areas, uncultivated natural spaces, fallows, pastures, wetlands, sloping lands can nevertheless be of tremendous value to local communities for foraging, gathering, fishing, trapping, grazing and regenerating biodiversity and soil fertility[82]. The presence of pastoralists, indigenous peoples, small-scale farmers and women, as well as the productive and other uses they already make of 'barren' or 'degraded' lands are often ignored[83].

Importantly, such misnomers, whether deliberate or not, have the effect of justifying the transfer of these lands towards economic elites. The majority of land considered 'degraded' in China is designated to community groups, and there is a fear that common lands may be vulnerable to capture by wealthy individuals[84]. This makes it essential for local people to participate effectively in decisions about using such land.

In Thailand, a different set of issues can be illustrated. The main crops for agrofuels appear to be grown mainly by smallholder farmers on privately held land. In the case of cassava and sugar cane these are likely to be cultivated using household labour, though machines are often used for ploughing and workers are often hired during harvest. These crops, grown by several hundred thousands of farming households[85], represent two of the main cash crops in Thailand. Higher

81 Weyerhaeuser et al 2007.
82 See for example Chamberlain 2006.
83 See further Gaia programme et al, 2009.
84 GSI/IISD, 2008, cited in Schott, 2011.
85 Official data from Thailand's Agricultural Economics Office (2007) indicate that there are 474, 823 households in cassava production and 223,213 households involved in sugar cane production. For sugar cane it appears the average size of plot is 3-4 ha of land each (Bamford, forthcoming). It is not recorded how many of these farmers own the land on which they farm.

prices and good prospects have signalled a welcome change for farmers from previous decades of falling agricultural incomes. In the palm oil sector, some Thai farmers have organised into cooperatives, and these in turn have linked together to form a federation of cooperatives that is currently operating a medium scale commercial processing plant in Krabi[86]. Further efforts could be made to learn the lessons of this experience and initiate other models that support the smallholder farming sector.

The economic benefits of the rise in agrofuel prices can spread widely where crops are cultivated by hundreds of thousands of smallholder farmers. However, certain conditions need to be in place for smallholder farmers to see the promised returns from boom crops. The first of these is that the farmer should have secure tenure to his or her land. Since the beginning of the 1990s, a flawed and mismanaged, World Bank sponsored, land titling programme and other policies fuelled land speculation and oversaw a period of land grabbing and loss of land through indebtedness, with the result that a large number of small-scale farmers no longer own the land on which they farm[87].

Meanwhile, many of the fertile lands acquired by the rich and influential, during the 1990s, were never put into production, but were 'used' as collateral assets to obtain loans to fund other purposes. Following the financial crash of 1997, when many of these loans were written off as "non-performing debt", farmers groups demanded that the government revoke land titles over the lands that had lain idle for years, and redistribute them to the poor as stipulated in the Agricultural Land Reform (ALR) Law[88]. This did not happen in most cases, as the ALR Office chose the easier path of tenure regularisation (in areas already occupied informally by smallholders) and failed to tackle genuine land redistribution.

Meanwhile, a company called the Bangkok Commercial Asset Management (BAM) Co. Ltd, was set up in 1998[89] to sell off repossessed lands to wealthy buyers instead. This company saw the potential of the agrofuel boom, seeking to attract buyers to the very large areas still under bad debt in 2008 by proposing agrofuels crops as "green gold". The empty overgrown plots on offer amounted to hundreds or thousands of hectares each, beyond the reach of small farmers[90]. Access to smaller plots of fertile land, particularly in areas close to markets and main transport routes, is increasingly only possible for small farmers through lease. Tenant farmers can find it difficult to benefit from a boom in commodity prices[91].

Where smallholders do own the land on which they farm, and where they have access to sufficient resources necessary[92], many have been able to profit from the higher farm gate prices

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86 The Krabi Palm Oil Farmer Cooperatives Federation.

87 Leonard and Narintarakul, 2006. Landlessness was the main grievance of the rural poor during the poverty registration exercise of the pre-2007 coup government.

88 Already-occupied areas of state land were "allocated" under the Agricultural Land Reform Programme. The Agricultural Land Reform Office (ALRO) has been recently been promoting cassava production for agrofuel under a contract farming scheme in 6 provinces (in the North and Northeast).

89 Established in 1998 by the Ministry of Finance to manage / sell the non-performing loans and assets (NPL/NPA) of commercial banks and finance companies during the economic crisis.

90 The BAAC has also repossessed land from smallholders producers who defaulted on their loans and leased land to a major state-owned company Bangchak to produce oil palm, however the scheme is said to benefit smallholders (Bangkok Post, 17 Jan 2011) http://www.bangkokpost.com/business/economics/216721/baac-bangchak-to-grow-oil-palm-trees).

91 For example, when domestic rice prices rose in 2008, tenant rice farmers were asked to pay rent several times higher than in the previous year, despite legal controls on rent increases. In some cases, landlords were so keen to take advantage of the high prices that they withdrew leases, taking back the land to farm by themselves.

92 The use of the term 'smallholders' in the literature on agrofuels is not clearly defined. In other contexts, rural smallholdings in Thailand are often counted in the range of 15-25 rai (2.5 – 4 ha) of land, though clearly the quality of the land is as relevant as the quantity. According to one academic source, the average farm landholding in Thailand is said to be 3 ha per family. For oil palm, it is commonly stated that farmers in Thailand should have at least 25 *rai* (approximately 4 ha) to have a viable oil palm farm. However some organisations use the RSPO criteria which counts farmers holding ten times this amount or up to 250 *rai* (40 ha) as smallholders. Data from the World Bank (2010) indicate that 76% of the oil palm area is held by smallholders (cited in GIZ, 2011), and a figure of 72% has also been cited by Univanich, these appear to use the RSPO threshhold.

in recent years. Oil palm in particular has proved a profitable crop in the last two to three years. Once mature, oil palm trees provide an income throughout the year and demand by the refineries has been strong. However, crop prices have fallen again since the government biodiesel mandate was recalled in March 2011.

Oil palm farmers in Thailand often employ workers to harvest the heavy fresh fruit bunches. Much of the labour in the southern oil palm plantations is contributed by migrants. In some provinces, it has been estimated that up to 50% of the labourers come from Burma, many of whom have insecure legal status and precarious housing conditions. In general however, the majority of workers come from other parts of Thailand, particularly the Northeast. Brokers hire and assign workers to various plantations, and for this exact a very considerable percentage per tonne when supplying the harvested produce to the mills[93]. Ordinary but experienced labourers, according to one study, receive wages ranging from approximately 5,000-12,000 Baht per month[94]. However, it is estimated that only 5% of labour is full time. Low wages remain low regardless of the fluctuating profits made by the landowners and brokers.

In Cambodia and Laos, the key problem is the displacement of local people, as large-scale land concessions are given to domestic and foreign companies. Many of the companies investing in production facilities have also sought to start their own plantations of feedstock. In recent years, purchases, concessions or leases over land have increasingly been leveraged as an essential part of investment deals negotiated between companies and governments[95]. This mirrors a wider trend in global development, where companies not only seek to control the processing and trading arms of their business, but also to acquire land to gain control over the supply of feedstocks (GRAIN, 2009). Companies have gained rights to start plantations over thousands of hectares of land, sometimes supplemented by contract farming arrangements to source additional materials and to demonstrate local relevance.

With a marked acceleration in the middle of the last decade, the Cambodian State has been distributing large-scale economic land concessions to foreign investors, including several large companies from neighbouring countries like Thailand and China in collaboration with well-connected local companies[96]. These areas are invariably already occupied by settled communities. But despite this people have been barred by concession holders from accessing the land that had once been essential to their lives and livelihood security. Evidence from various reports show that households have been forcibly uprooted including by privatised military battalions[97]. The expansion of plantation areas is feared to lead to further displacements. Calls on the government to respect human rights and honour its human rights obligations towards its citizens have fallen on deaf ears.

The demand for concessions has increased partly as a direct response to the expansion of agrofuels, with vast new plantations being developed for sugarcane, cassava, jatropha and oil palm. From the patchy but official online database of land concessions of the Cambodian Ministry of Agriculture, Forests and Fisheries, it emerges that at least 108,000 ha has been granted to local and foreign owned companies proposing to produce sugar, cassava, oil palm and jatropha since 2006 (see appendix).

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According to its 2010 annual report, Univanich operates palm oil plantations of almost 40,000 *rai* (or 6,268 ha) of land. It also seems that some "smallholders", include office workers and other 'part time' farmers who farm by telephone. Many full-time and part-time 'smallholder farmers' hire labourers for all tasks of crop management (GTZ, 2008).

93 GTZ (2008) Field Survey on Sustainable Palm Oil in Thailand.

94 ibid. accordig to this survey, skilled labourers can earn 30,000-50,000 baht (1USD = approx 30 Baht).

95 see for example, Cotula et al 2009.

96 According to some estimates, concessions and long leases, and foreign ownership, etc. were now occupying an area of around 50% of the country's land; see "Country for sale", Adrian Levy and Cathy Scott-Clark, The Guardian, 26 Apr 2008 http://www.guardian.co.uk/world/2008/apr/26/cambodia

97 see for example the UN report on Economic Land Concessions in Cambodia: A Human Rights Perspective. http://cambodia.ohchr.org/WebDOCs/DocReports/2-Thematic-Reports/Thematic_CMB12062007E.pdf

A few examples raise serious concerns about the way in which land is being acquired for agrofuel plantations in Cambodia. The CJ Cambodia plantations associated with MH Ethanol[98], have been mired in land conflicts, some of which are still unresolved. Villagers report that they were intimidated by armed soldiers as they were told that the company now owned their land. In some cases, villagers were relocated to uncleared forested land, and many considered the compensation offered unfair. With reduced access to forest lands, important harvests of wild foods have been foregone, and it is now difficult for people to find land to graze their animals.

Elsewhere, a large-scale sugar production joint venture in Sre Ambel and Battamsakor Districts of Koh Kong province has been a centre of concern since 2006, following reports of serious human rights violations at two land concessions covering around 20,000 ha[99]. The Asian Human Rights Commission found that over 250 families were forcefully evicted including with the use of arms. Some villagers were shot, others beaten with rifle butts[100].

Meanwhile in March 2011, the very same Sre Ambel district of Koh Kong province has become the target of another company, Malaysia's Golden Land, which has announced it intends to apply for oil palm plantation concessions there covering 11,827 ha[101]. One of the oldest oil crop developments in Cambodia is the troubled Mong Reththy Group's oil palm development[102]. Economic concessions are granted for very long periods in Cambodia - mostly for 70 years. Companies seem under little pressure from the government to fulfil promises of jobs, relocation sites, compensation and agricultural production.

Local farmers and indigenous people in some villages, however, have refused to budge despite facing serious intimidation and abuse. People are standing up to the rampant landgrabs in various provinces of Cambodia. Protests are likely to continue and conflicts are likely to become more severe.

Equally, in Laos, the unrestrained allocation of land concessions to foreign investors has also been called into question, and the National Land Management Authority has been tasked with proposing a better approach. Criticisms against land concessions were raised in outcries by uncommonly vocal communities around the country, after their lands were seized and their access to rivers and forests were prevented as a result. Many communities were coerced or convinced to give up their lands 'voluntarily', as a contribution to "national development", or under heavy government pressure to adhere to the ruling Party's policy, but some families gained exceptionally little in return[103].

Data is very difficult to obtain in Laos about different projects and their land use implications. One well-known concession is that of Mitr Lao Sugar, a subsidiary of the Thai Mitr Phol Group, which was granted a 40-year concession in 2006 to cultivate sugarcane on 10,000 ha in Savannakhet Province. This is aimed at producing refined sugar, of which 95% is aimed for export, including to the UK, under the Everything but Arms tariff privilege. Land in Savannakhet is much sought after. Difficulties in finding land that was not already used led the

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98 This company is also mentioned in section 1 above and 5 below. MH Ethanol acquired a 50% stake in CJ Cambodia in 2000/1 and took full control of the company in January 2008 and renaming it MH Agro-System (Lee, forthcoming).

99 At the moment this plantation and processing complex is not producing agrofuels. However, according to an interview with the media earlier this year, Chamroon Chinthammit, CEO of the Thai company Khon Kaen Sugar Ltd (KSL), reiterated that the Koh Kong joint venture, (of which KSL are shareholders, along with the Cambodian business magnate, and ruling party politician, Ly Yong Phat, and a Taiwanese company called Vewong) also has plans to build a plant for producing ethanol from the sugarcane by-products, though plans are dependent on the plant processing an adequate amount of sugarcane. See also The Ecologist, (13 April 2011) "Revealed: The Bitter Taste of Cambodia's Sugar Boom" by Sam Campbell http://bit.ly/fHqTtm

100 See Asian Human Rights Commisssion urgent appeal, June 2006, Cambodia: Two villagers shot and several injured during the illegal forced eviction in Koh Kong (UA-321-2006).

101 [Malaysia's] Golden Land eyes Cambodian site" Published: 2011/03/10 Business Times, Malaysia.

102 See Lang, 2001.

103 See "Research evaluation of economic, social, and ecological implications of the programme for commercial tree plantations" report NLMA et al, 2009. See also Kuaycharoen, 2008

company to experiment with contract farming, however one company official states that the main interest of the company is managing their own large-scale plantations[104]. The company's demands are increasing. According to a GTZ report, Mitr Lao requested another 10,000 ha concession for the 2009-2010 production season, and plans to request another 24,000 ha within 3-5 years[105]. It is not confirmed what the output of these new sugarcane plantations will be used for, nor where the company expects to find such a large area of land.

There has been considerable commercial interest in establishing large-scale jatropha plantations in Laos, although as reported earlier, meagre results have cast some doubt on the crop's profitability. Several thousand hectares of land have reportedly been conceded to a single Korean company (Kolao Farm Co) -- and appear to be intended as large-scale commercial operations, hardly the pro-poor model that was originally associated with the crop. There have been problems with primary forest clearing and logging associated with at least one of Kolao's plantations[106].

## 4. Competing for food and water

In January 2011, world food price index once again reached the highs of 2008, when millions of people (particularly the urban poor) were severely affected by sudden jump in the price of basic foodstuffs[107]. Around the world, riots were sparked in many countries and governments intervened to restrict exports out of concern for domestic food security (see illustration right)[108]. Experts have warned that prices will continue to rise over the next ten years[109].

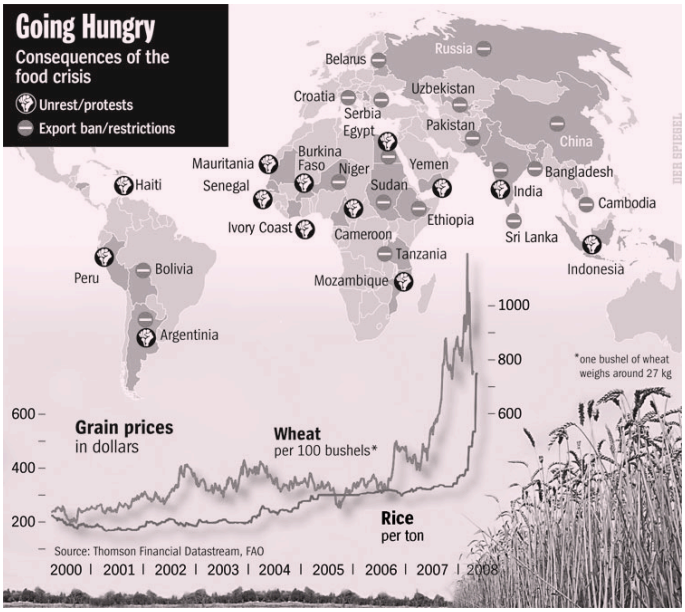


**Figure 4** Illustration of consequences of the food crisis
Image source: Der Spiegel, 2008

Up until 2008, agricultural food output prices had followed a low and stable 25-year trend. The highly unstable world food price rises of the last few years was linked to the global economic meltdown, which sent a rush of commodity speculators from other sectors into the food staples markets[110]. One reason that speculators were attracted to these markets was that global agricultural outputs, previously destined for food alone, have increasingly been diverted to produce agrofuels. A confidential report by a World Bank economist, leaked to the media, assessed that US and EU policies to promote agrofuels alone

104 Cited in Fullbrook, 2007.
105 Schoenweger and Uellenberg, 2009 http://www2.gtz.de/wbf/4tDx9kw63gma/gtz2010-0062en-foreign-direct-investment-lao.pdf
106 ibid. page 23.
107 World market rice prices tripled in 2008, wheat prices more than doubled, and corn prices almost doubled. (Rosset, 2010).
108 In many countries, public sector grain reserves had been sold on the advice of the World Bank (Rosset, 2006) leaving governments with scant resources to weather the storms and feed its people.
109 OECD/FAO Food Outlook 2008 - 2017. http://www.fao.org/es/esc/common/ecg/550/en/AgOut2017E.pdf
110 The Institute for Agriculture and Trade Policy's report indicated that trading on the commodities market contributed to the 80% rise in food prices that occurred between 2005 and 2008 and that the deregulation of controls against speculation induced artificial volatility in agricultural markets. While anomalies in the world's weather patterns did bring devastating floods and droughts, ruining harvests in a handful of major grain-producing countries, supply shocks clearly do not tell the whole story. see also Jayati Ghosh (2011) http://mrzine.monthlyreview.org/2011/ghosh250111.html

forced a 75% increase in food prices between 2002 and February 2008[111]. The then UN Rapporteur on the Right to Food, Jean Ziegler, likened the diversion of arable land towards agrofuel production to "a crime against humanity". Three years later, FAO published estimates of the number of people suffering from hunger in 2010 revealing that hundreds of millions of people had been added to total since the food crisis of 2007, with over one billion people suffering hunger on a daily basis worldwide. Clearly this has had impacts on poor consumers in the Mekong, affected particularly by the massive hike of the price of rice during the crisis, and there have been many calls for international regulation and pursuing domestic food sovereignty.

Within the Mekong countries, agrofuel production is not known to have had a notable impact on global food supplies, however there are ways in which it has had a direct impact on local food security. The gravest impact has already been noted in section 3 above where people have been removed from their land and denied access to natural resources as a result of large-scale land concessions, including sugar, cassava oil palm and jatropha plantations. In Cambodia and Laos, agrofuels have provided the stimulus behind recent investor interest in land in the region, and in many cases have led to the expulsion of whole communities from their lands. In Burma, people across the country were forcibly co-opted into growing a, so far, useless crop sacrificing their own land for the national agrofuel experiment, with some refugees reportedly fleeing to avoid punishments associated with failing to meet the targets[112].

Local food security is also reduced where natural spaces are lost and local people's reliance on these is ignored. Such losses have been rapid and extensive wherever new economic uses of land emerge, and the agrofuel boom has proved no exception. As noted above, jatropha species have been signalled as being suitable for "marginal lands" in China, Burma and India, based on assumptions of the under-productiveness of such land. In fact the rich biodiversity of such places, otherwise referred to as fallows, woodlands, grasslands, wetlands, and secondary forests, makes them good sources of food, well used and often managed by the poor as 'commons'. These foods include vegetables, bamboos, mushrooms and small animals, such as rodents, frogs and snails, and herbs of various sorts[113].

In Thailand, the expansion of agrofuel crops has, in the main, involved the displacement of other cash crops on privately held land[114]. Oil palm crops mostly have competed with rubber crops, with some farmers cultivating both. However, local people report that oil palm has also been planted in areas that formerly were rice fields. In some cases, paddies had been abandoned more than a decade before, apparently because traditional water channels were blocked by the expansion of rubber farms, making it more difficult to produce rice.

On the other hand, there are signs that new areas of existing rice paddy land in the South are, recently and increasingly, also being converted to palm oil, mostly around the Lake Songkhla area. It was reported that over 27,000 hectares of paddies in Phattalung province alone were converted to oil palm over the last decade[115]. Of greater concern perhaps, is a recent news article announcing the collaboration between the Thai Ministry of Energy and Ministry of Agriculture and Cooperatives to turn a supposed 5 million rai (800,000 ha) of 'abandoned rice fields' all over the country into oil palm plantations to meet the rising domestic demand for biodiesel[116].

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111 http://www.guardian.co.uk/environment/2008/jul/03/biofuels.renewableenergy. Other figures vary considerably: the US department of Agriculture considers that agrofuel policies only contributed 3% to the price rises, Oxfam estimate that the figure is around 30%, IMF cites 20-30%, while the OECD cites 60% (Bello, 2009).

112 See section 1 above.

113 The Lao Participatory Poverty Assessment (Chamberlain 2006) found that the loss of these natural spaces have significant implications for the food security and nutritional health of the poor.

114 However note in the following section there are indications that in some areas secondary forests have been cut to plant oil palm crops.

115 Bangkok Post "Palm Oil Frenzy raises concern" 7 March 2008 citing Surasak Suwanavongse, chief of the agricultural office in Phattalung, who said that the rice figures dropped from 570,000 *rai* (91,200 ha) to 400,000 *rai* "with the balance turned into [oil] palm fields". According to the Office of Agricultural Economics, the 2009 figure for the province had fallen to 361,669 rai (or approx. 57,870 ha).

116 ASTV Manager online, 26 October 2010. In Thai language.

The use of this form of words is clearly aimed to pre-empt concerns about food security.

Looking at the expected market expansion of cassava and oil palm, the authors of the Biofuel and Food Security (BEFS) study also expect that in Thailand these crops will expand into rice growing areas. The study has projected, on the basis of a large number of market assumptions, that as the "harvested areas of cassava and oil palm [expand], the area of land under rice cultivation may decline by almost two million hectares" by 2022[117]. If this were to happen as predicted, measures would need to be in place to avoid serious restrictions in domestic rice supply. This may also have knock-on implications for countries that import rice from Thailand.

In addition to the dangers of biofuel crops taking over rice-growing land and other spaces, water demands are critical. Oil palm is a very thirsty crop, with each *rai* (0.16 ha) needing 5,500 litres of water per day. A 2008 survey for GTZ concluded that the water table is receding in palm oil growing areas in Thailand, despite plentiful rainfall. The authors concluded that this was probably a result of soil hardening (linked to prolonged chemical fertiliser use), which decreases rainfall permeability and increases the demands on groundwater[118]. While cassava and sugarcane do not currently require high inputs of water[119], the expected improvements in yield to fulfil Thai government targets could increase demands on irrigation, which would present significant challenges[120].

In addition to the conversion of lands from rice land to fuel crops, impacts can also be detected as a result of diverting the output of a crop from food to fuel uses. As mentioned above, national food security was under direct threat in China as maize stocks were diverted to a rapidly expanding ethanol production programme. This led to a rapid rethink and a banning of maize-based ethanol.

In another example, palm oil output can be used to produce not only biodiesel, but also cooking oil and other products. Biodiesel processors are therefore in direct competition with the suppliers of cooking oil. As the demand for biodiesel rose by 50% in the middle of 2010 in fulfilment of the policy mandate (a shift from B2 to B3), the supply of palm oil in Thailand became severely restricted. Lobbying by palm oil refiners forced the government to raise the price of edible oil by around a third[121], but even so the shelves remained empty for prolonged periods. Where supplies of cooking oil were available, sales were restricted to one litre bottle per family.

Food stalls and restaurants began to re-use oil several times over, raising fears about the potential health risks for consumers. The supply crisis has subsided as the government acted in March 2011 to lift the biodiesel mandate. This episode has derailed the Thai government's biodiesel supply plan, and warns of potential consequences of emerging competition between uses of agricultural crops for food and fuel.

The increasing diversion of crops to agrofuel production is also likely to have consequences for the price of other foodstuffs[122]. The impacts of these vary and not all points raise concerns for

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117 BEFS, 2010, page 23, however market assumptions are not the only factor for predicting land use change and other parts of the report present much lower estimates of crop expansion, so some caution is required in reciting this figure.

118 http://www.sea-cr.com/sea-cr%20book/Palmoil%20%20Thailand%20concise%20report%20Oct%2008.pdf

119 Only 14% of sugarcane plantations in Thailand are irrigated (BEFS, 2010: 46).

120 (page 23 BEFSk) Water extraction footprint is12.3 litres for one litre of ethanol. At the current rate of water footprint, the total cassava ethanol water footprint is expected to reach 4,846 million m3 by 2022.

121 Bangkok Post, January 2011.

122 While cassava is not a staple food in the Mekong region, it is a common component of processed food consumed by the urban poor. Cassava is also used in the region as a cheap replacement for maize in livestock feed - for example when maize prices soared in late 2007 (BEFS, 2010). If cassava is diverted to produce ethanol as predicted, and assuming the price of both maize and cassava rise, it can be expected that the prices of meat and eggs will also rise. Likewise, as Vietnamese fish oil and residues are currently processed into cattle feed, it has been suggested that costs of meat and other products could be affected if oil stocks are diverted for the national fuel programme (Sombilla et al, 2009).

human right to food in the Mekong region. It must also be said that sustained higher prices for their products can increase incomes for farmers and related communities, and potentially increase their food security. However, as mentioned in the previous section, the extent to which farmers can genuinely benefit from prevailing high prices depends critically on secure access to sufficient land, water and other resources as well as their relative bargaining power.

## 5. Concerns for the environment

While some Mekong region governments make very little of the environmental case for agrofuel development, several environmental impacts of the expanding sector do need to be examined.

**Accounting for carbon**

Critics have questioned, for example, whether such fuels genuinely contribute carbon emissions reductions or not. Agrofuels produced in some circumstances have been shown to release more carbon than they purport to save. For example, when plantations encroach into forests or biomass rich soils, or displace existing crops onto such lands, or when they require more fossil energy to produce and refine than they replace[123]. It is therefore critical to assess conditions of cultivation and processing[124].

Much has been written to expose the poor environmental record of agrofuels in many cases around the world. Particularly perverse examples that have been well studied are the expansion of oil palm plantations in cleared tropical rainforest lands particularly where peat soils are exposed and disturbed (for example in Indonesia). One scientific study found that, in these cases, the ecosystem destruction releases so much carbon, that it would take 423 years for the carbon "debt" of clearing peatland rainforests for palm oil crops to be repaid with the token "savings" of replacing fossil fuels with biodiesel (Fargione et al, 2008) (see figure 1).

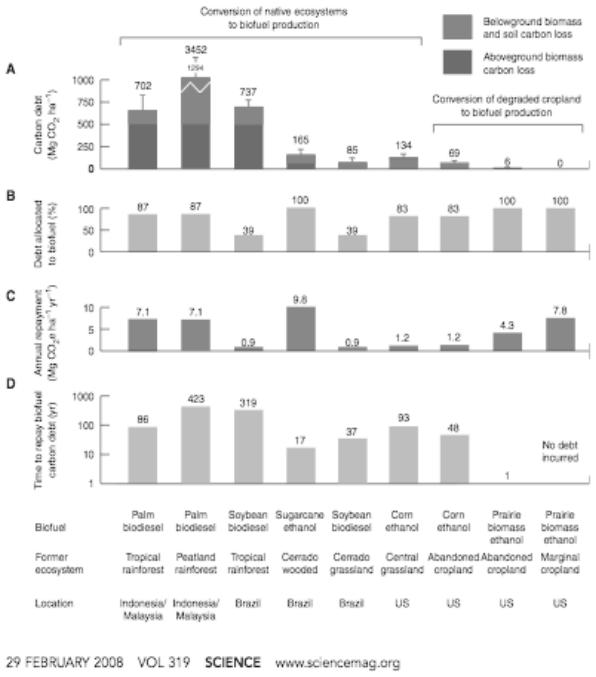


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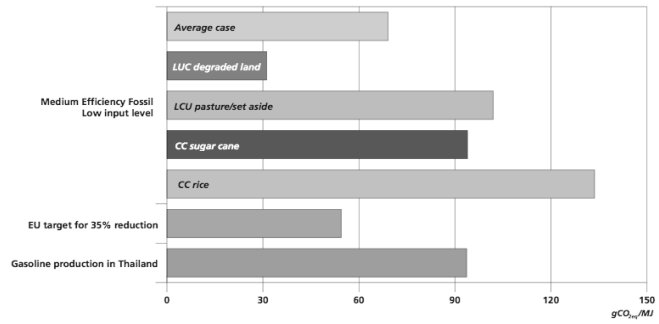
FIGURE 7.5

**Influence of LUC and CC on the medium efficiency fossil scenario**




*Source:* JGSEE.

**Figure 5** (left): This diagram from Fargione et al, 2008 displays the differences in carbon emissions of certain agrofuel crops when comparing the "carbon debt" caused by destruction of the former ecosystem (row D).

**Figure 6** (above): This shows the influence of land use change (LUC) and crop change (CC) on emissions of ethanol production from a recent FAO study in Thailand. Note the very large carbon emissions released in switching crops or cultivating natural spaces to plant cassava.

[123] Maize has been highlighted as a particularly ineffective crop for agrofuel production from the point of view of reducing carbon emissions. Paul Crutzen's research into life-cycle analyses of maize-based ethanol warned that where nitrogen based fertilisers were used, the overall process of production has a net warming effect on the climate (Crutzen et al, 2007), which may instructive for China's residual maize-based ethanol production.

[124] Scientific studies have found that the deepest parts of the carbon footprint of agrofuels are from the plantation processes (ecosystem destruction), and from the refining processes particularly for ethanol (intensive energy use) See BEFS 2010.

Planting agrofuel crops in "marginal areas" has also been widely critiqued[125] from an environmental perspective. The very definition of marginal land is frequently contested. Many spaces that are defined as "degraded" upon technical criteria[126], such as a certain percentage of canopy cover or the absence of activities that generate GDP, are nonetheless valuable natural spaces from which communities and especially the poor can derive useful benefits. These lands can sustain diverse and important functions within a healthy ecosystem. In some countries, technical definitions have formed the basis of some very harmful policies. For example the carbon rich peat forests of Indonesia were termed "marginal lands" by the government on the basis of their acidic soils[127].

Even the jatropha bush, sensationally promoted as a high oil-producing, 'environmentally-friendly' feedstock for biodiesel, has been cast into doubt. A report based on a life-cycle analysis study of jatropha-based biodiesel in Kenya found that land use change is also a critical determinant in the emissions balance of jatropha production[128]. Unless the crop was grown in existing or abandoned agricultural fields, the report found that up to six times more greenhouse gas emissions were released than are counted in conventional fuel.

Turning to research within the Mekong region, the FAO sponsored Biofuel and Food Security study in Thailand examined greenhouse gas emissions of ethanol and biodiesel production, taking into account a life-cycle analysis. It showed that certain land use and crop changes, particularly converting land to cassava, could seriously affect the overall greenhouse gas emissions of ethanol output. The study indicates that where cassava crops are planted in areas previously used for growing rice, or in natural spaces such as pasture and common land (see figure 2 above), the release of soil carbon generates carbon emissions so high that they can exceed the emissions of conventional gasoline production in Thailand[129].

Furthermore, the BEFS study concluded that encroachment of palm oil onto secondary forest in Thailand would also release unacceptable levels of greenhouse gases[130]. Some local studies have noted that oil palm plantation areas did expand rapidly into watershed forests, wetlands, community forest, public spaces and rice fields, after the government announced its expansion plans, "since very little spare land could be found for the crop"[131]. High methane emissions are also found to arise from untreated wastewater ponds from palm oil refineries.

The refining process is another critical determinant of the overall greenhouse gas emissions of agrofuels, particularly ethanol, which requires very high energy input. Where fossil energy is

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125 See Gaia project et al (2008) Agrofuels and the Myth of the Marginal Lands. Individual definitions of degraded land vary considerably from soils that do not visibly support much plant and animal life, eg due to acidity, salinity, water-stress, toxicity, etc, to areas that are not stocked with commercially viable crops.

126 Many policy documents "identifying" vast areas of available land are technocratic in the extreme, based on scales that cannot take into account local ecological and social realities. A recent report by the APEC Biofuels Task Force estimated that some 4 million sq kilometers (or 400 million hectares) of marginal lands are available in the APEC region (21 countries) for biofuel development. It suggested that in order to find the average suitability of feedstocks on marginal lands in each economy, the consultant must have had data at one point on each of the 100 square-kilometer squares that went into an average. "If those data could be recovered or reproduced, it would be possible to generate a histogram of the portions of marginal land in each economy that have different degrees of suitability" Milbrandt, 2009.

127 Gaia project et al, 2008.

128 A Life cycle assessment study of jatropha grown in the Dakatcha woodlands of Kenya. http://www.actionaid.org.uk/doc_lib/kenyan_jatropha_final_report.pdf

129 Even switching crop from sugarcane to cassava was found to result in unacceptably high emissions. It should be noted that the BEFS researchers also found that where cassava is grown on "degraded land" there can be an improvement in carbon sequestration by planting the crop. Unfortunately there is no definition of "degraded land" which makes it difficult to include this finding.

130 Land use changes and crop changes to palm oil production were not comprehensively examined in the study. However it states that "in the case of a land use change from secondary forest, total emissions increase by 80 [grammes of $CO_2$ equivalent per MegaJoule], taking the overall level well above the EU sustainability threshold value".

131 Yangdee, 2008. Forest boundaries and forest land use categories in Thailand remain contested.

used, processing cassava, molasses or sugarcane into fuel, the BEFS study found, results in higher greenhouse gas emissions than gasoline production[132].

In reality, sugar ethanol processing plants in Thailand currently use biomass energy for the refining process. The biomass is derived from a range of on-site by-products of sugar processing. Use of this source of fuel was found to limit overall carbon emissions of the refining process to low levels. Thai cassava-based ethanol, on the other hand, was found to "perform poorly" as a result of using fossil fuel at the refining stage.

The overall balance of GHG emissions in comparison with gasoline emissions therefore varies considerably depending on the context in which agrofuel crops are cultivated and processed. Even where GHG emissions are 'saved', however, the overall significance as a means of mitigating climate change may be minimal. A study of the jatropha expansion plans in South Western China indicated that the resulting greenhouse emissions reductions would make "only a trivial contribution to China's national energy security" and would amount to "far less than 1% of … China's total CO2 emissions from oil products consumption"[133].

**Soil and water pollution**

Aside from the mitigation of climate change, there are several other environmental impacts to consider, namely those that concern land, water and other forms of pollution.

The expansion of ethanol production in Thailand from the existing figure of 1.25 million litres per day to the target of 9 million litres per day in 2022 is expected to have a serious impact on water quality near processing facilities. Wastewater treatment plants located close to major rivers and populated areas are feared to present a "high risk of soil, surface and ground water contamination"[134]. The increased number of production plants would create huge quantities of wastewater[135] in excess of what could be re-used as fertilizer. Storing toxic spent wash in ponds "would be an enormous task, and its effect on groundwater and surface water systems in and around mills and plants could be very damaging"[136]. In Thailand "palm oil mill effluent" (POME) has also been known to contribute to surface water pollution[137].

In countries where environmental regulations are poorly enforced, and particularly in areas where water is used directly from rivers and streams for bathing and consumption, there are concerns for water quality deterioration around ethanol plants. Cambodia's only ethanol production plant (run by MH Bio-energy) was accused of discharging toxins into Samraong lake in Ponhea Leu, Kandal province[138] which was used by local villagers for fishing and drinking. The lake was covered with green scum, killing tons of fish and reportedly prevented villagers from fishing in the lake for up to two months. In a second reported incident, eventually admitted by the company, pollution was discharged into the Tonle Sap River. This led to fish catch losses of over 63 tonnes, representing over USD 100,000 worth of fish for local villagers[139]. A third

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132 Where low efficiency fossil energy is used in the refining process, the BEFS study in Thailand found that the overall emissions not only fail the EU standards for agrofuel production, but exceed the emissions generated in gasoline production (BEFS, 2010).

133 Weyerhaeuser et al 2008. This finding may have overestimated the potential emissions 'savings' of jatropha as it was based on an older set of assumptions of emissions calculations for jatropha in a 2005 study in South Africa (Mitsui, 2005). A more recent study of the life cycle emissions can be found in Mortimore, 2011.

134 According BEFS, the soil infiltration rate of wastewater in storage ponds at Ratchaburi Distillery, for example, is high. The spent wash generated at the distillery plants is acidic (pH 4.5), has a very high temperature (65-70 °C), contains about 232-1,600 milligrams per litre (mg/L) of nitrogen and has a high content of biochemical and chemical oxygen (43 000 and 80-100 000 mg/L respectively), suggesting a large quantity of organic matter in spent wash. However, the study states that the actual effects of stored spent wash on local water systems, especially on groundwater, need further assessment.

135 By 2022, the total wastewater generated from sugar-based ethanol would be at least 7.89 million m3.

136 BEFS, 2010: 52-53.

137 Setiadi and Hussaini, 1996 cited in Daniel et al 2009 "Agrofuels in Thailand: Policies, Practices and Prospects".

138 Phnom Penh Post (2 Sept 2008) "Dead fish raises suspicions".

139 According to Tonle Bassac Fisheries Administration (FiA) officials reported in Phnom Penh Post (29 August, 2009) "Toxic Plant Run-off Takes Toll on Fisher's Wallets".

very similar incident occurred in March 2010, weeks before the plant closed, however liability for this was denied by the company. Problems also were found at a related company's cassava feedstock plantation areas. Poorly designed ponds mixing manure and spent wash led to water contamination and brought "invasions of flies" to the nearby villages, which was soon associated with a spate of diarrhoea and vomiting, particularly amongst children and elderly people[140].

Fertiliser management could raise another concern. Cassava can be grown in areas that are prone to drought and high temperatures, and few inputs are used by farmers even in dry and poor soils, while still producing a high starch content. The crop has a tendency to deplete soil nutrients, however (Sombilla et al, 2009). Meeting the high agrofuels production targets is expected to require higher fertiliser inputs. This could spell problems for natural resource management. Fertiliser applied for agrofuel crop production in Thailand[141] currently leaches about 8,680 tonnes of nitrogen load to groundwater aquifers, which would be expected to increase, if higher yields are demanded. Scientific studies have raised concerns on the basis that the application of nitrogen-based fertilisers in agriculture release significant amounts of nitrous oxide, a powerful greenhouse gas[142]. The unguarded use of fertilisers can bring other environmental problems. As mentioned above, a 2008 survey for GTZ concluded that the water table is receding in palm oil growing areas in Thailand, despite plentiful rainfall. The authors pointed to soil hardening (as a result of prolonged chemical fertiliser use), which decreases rainfall permeability and increases the demands on groundwater[143].

**Project finance and climate justice**

Many of the above points raise issues of environmental rights and climate justice[144]. The climate crisis faced by the global community is critical and man-made -- unleashed by the unsustainable model of consumption growth, that has been strongly criticised for two or three decades already, but is still being pushed in the region today. China, Thailand and Vietnam's carbon emissions are heading skyward, literally and figuratively, but agricultural communities contribute hardly at all to their national carbon footprints[145].

The main producers of carbon emissions in these countries are the industrial and transport sectors. While it is imperative to seek sustainable solutions to the climate crisis and seek ways in which this can be tied to poverty alleviation strategies, rural communities are justified in asking why they must bear the environmental costs to their farmlands and waterways from nearby agrofuel plantations and processing plants.

Rural communities in the other Mekong countries are low energy users. Few have the luxury of regular access to external sources of energy that many reading this paper can take for granted. Rural energy needs have settled very low on national list of priorities. Millions of rural people make do with what they have, and what their environment provides[146]. As many as 50% of the

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140 Cited in Lee, (forthcoming) Moving Beyond Misconceptions: MH Ethanol - Case study of a Korean agro-industrial investment in Cambodia, (Final Draft, December 2010).

141 (BEFS, 2010). While, this is only a small fraction (two percent) of the annual groundwater recharge, problems can arise for local water users.

142 Crutzen, et al 2007.

143 The BEFS study suggests that oil palm yields could be increased through better management practices and by limiting chemical fertilisers in favour of organic methods and products, which would also reduce production costs (BEFS, 2010). Currently farmers often use a blend of chemical and organic fertilisers in Thai palm oil plantations, which are generally monoculture.

144 For additional points on land rights and other human rights issues and food security concerns see above sections "changing landscapes" and "pause for food and water".

145 One indication of low energy use in Thailand, where 99% of households have access to the national grid, is that 9.16 million households or around half the country's population use less than 90KWhrs of electricity per month and are not required to pay, this covers the vast majority of rural households of Thailand.

146 Biomass, especially in the form of fuelwood, remains the major source of energy for lighting and heating in several Mekong countries, especially in the rural areas. Biomass is used by 56% of the rural population in Viet Nam, 85% of households in Cambodia, 92% of households in the Lao PDR, and 42% of urban households and 93% of rural households in Myanmar (Sombilla et al, 2010). In China, 60-70% of rural household energy use in the rural areas is from bioenergy (agricultural residues). In Thailand too, fuelwood is also still significant, accounting for 65% of

population of Lao PDR[147], are using biomass fuel on a daily basis - directly-harvested wood, forest litter and animal dung for heating and the cooking stove. The ambitious plans of Mekong governments to replace fossil fuels with renewable energies and bring about universal rural electrification, through large-scale agrofuel plantations, dam building, and nuclear power, are not something ordinary citizens tend to hear about in advance, are able to influence, nor, in all too many cases, are able to benefit from.

Many industrial agrofuel projects have already been exposed around the world for their serious impacts on the environment and local communities[148]. Nevertheless, since 2009, the UNFCCC has allowed Clean Development Mechanism (CDM) funding to be allocated for agrofuel plantations[149]. At least one project in Vietnam has submitted a proposal for CDM registration on the basis of a jatropha plantation project[150].

CDM projects are funded on the basis that they can generate carbon credits that can be commercially traded to polluting companies elsewhere. The ultimate buyers use these credits as a way around taking their own action to meet their emissions commitments. The CDM is therefore fiercely criticised as a mechanism that not only funds many controversial projects in the South, but also helps to legitimise and prolong the existence of unsustainable, climate-threatening industries in the North[151].

At present, there are many new proposals, and ongoing protests, at the UN Climate negotiations about how to finance the reduction of greenhouse gas emissions from land use, land-use change, and forestry (known in the UN jargon as LULUCF emissions)[152]. A new set of rules providing money for LULUCF projects is feared to lead to an increased financial incentive for corporate groups to seek control of agricultural lands that are clearly already under heavy pressure.
Concerning agrofuel refineries, projects to mitigate the emissions from agrofuel processing technologies, particularly capturing biogas, have already received CDM funding. In Thailand, for example, Univanich's POME Biogas project is already receiving Certified Emissions Reduction credits. MH Bio-Energy in Cambodia is seeking CDM registration for a biogas project at its (temporarily closed) ethanol plant[153].

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the alternative energy used nationally (BEFS, 2010). Significant health and environmental challenges have also been associated with the burning of biomass in the home (see eg Junfeng and Smith, 2007).

147 Cited in LIRE, 2010.

148 see for example www.biofuelwatch.org.uk.

149 Since 2009, agrofuels for large-scale plantations became eligible for CDM funding, up to end 2010 no plantation projects had been financed through the scheme (Biofuelwatch). The EU Emissions Trading Scheme does not yet cover credits for soils, farmlands, or forests. CDM funding is linked to the ADB's Carbon Market Initiative, approved in November 2006, which provides financial and technical support to developers of projects that can qualify as CDM projects. Under this initiative, the Asia Pacific Carbon Fund has provided up-front funding to the value of 25–50% of future carbon credits expected from projects (ADB, 2006).

150 A project that has been submitted to the CDM process involving jatropha plantations in Ninh Thuan province of Southern vietnam. Biodiesel will be produced from jatropha oil seeds on "degraded land", and will be used for transportation. The technology for biodiesel production will be introduced from Japan. The production plant, with a capacity of 30,000 litres per day, will be built at an industrial park in Ninh Thuan District. Total annual expected CO2 emission reduction is about 7,531 tons CO2 per year by the project or about 52,714 tons CO2 in the first 7 years crediting period. (https://cdm.unfccc.int/filestorage/RFIOSCU69EWNJL3Q4ATPB1YMH50ZK7/PDD.pdf?t=WEt8MTMwMDYwMDA3NC42|_C2ydu0FD5804DZ8bwekYBDep0s=). Another case requires verification as info source is not official (http://www.celsias.com/project/cdm-project-of-diesel-tree-plantation-jatropha-cur/). The Natural Energy Technology & Development Joint Stock Company says it has applied for cdm for its project to cultivate 13,000 ha of jatropha of Ca Nang commune, Chieng Khay commune, Muong Gion commune – Quynh Nhai District – Son La Province.

151 See Docena, H (2010) "The Clean Development Mechanism Projects In The Philippines: Costly, Dirty, Money-Making Schemes" Focus on the Global South.

152 Some negotiators at the UNFCCC are proposing ways to include soil carbon, cropland management, revegetation, forest management and grassland management to qualify for CDM funding.

153 See above. This project was approved by the Cambodian Ministry of Environment on 29 June 2009 however it has not yet been validated by the CDM Executive Board. See Project Design Document, MH Bio-Energy cited in (http://enviroscope.iges.or.jp/modules/envirolib/upload/984/attach/cambodia_final.pdf ).

Agrofuel refineries are beginning to incinerate biomass waste to generate small and large-scale electricity generation, likely to be a key feature of the future plants. According to Biofuelwatch, plantation companies around the world, growing, for example, oil palm, sugar cane and eucalyptus, are profiting from CDM funding for some 705 biomass projects[154].

## A note on community based energy promotion

The analysis above concerns large-scale developments. In the following section we can highlight some of the few existing initiatives for community-based development in Thailand. Further study is required to supplement these examples.

The Thai government has plans for a "one district, one community energy source" to accelerate the implementation of community-scale energy projects in 300 Tambon (sub-district) Administration Organizations nationwide[155]. This aims to allow for local participation in planning, implementing and problem-solving related to community energy provision, they aim to reduce the energy cost of each community by 15-20%. Within this policy, the government seeks to set up a "community energy volunteer programme", following on the model public health volunteer scheme[156].

As in many other countries around the world, jatropha was, for a time, seen as a potential agrofuel that was ideally suited to community-based fuel production. The bush species, which grows wild in the Mekong region, was already known to local people. The experience of jatropha development has been touched in section 3 on above. In Thailand many small-scale farmers were sold seedlings by traders, middlemen, extension services on the promise that jatropha had a great future as a biofuel crop. However the crops failed to achieve anywhere near the spectacular yields promised. Seeds develop in small quantities at a time, and must be harvested before they dry, which makes collection very labour-intensive. Failing to make any money, farmers simply uprooted or abandoned their crops. On top of the waste of time, of land, of investment costs, and raised expectations, the crops are also said to be difficult to clear, as the roots are extensive and thick. This has given jatropha a poor image amongst farmers, and has caused some observers to liken the promotion of the crop as "snake oil".

However some successful community-level initiatives should be noted. The Viengsa Agricultural Cooperative has developed the cultivation of jatropha primarily for biodiesel, but is making use of a wide range of other products from the plant. Once harvested by the farmers, the seeds, hulls, leaves and stems of the jatropha bush are sold on to other members of the Co-op for processing. Biodiesel is sold to members of the co-op at less than the open market cost, with priority going to those members who need fuel for tractor engines. Fertiliser derived from jatropha seed residues appears to be used by community members on crops such as rice, vegetable and fruit. Charcoal is sold direct to households for use in cooking. A micro power plant is also due to be set up. Biomass or charcoal will be sourced from co-op producers to power the plant's steam turbine. The power plant will serve five to ten nearby communities within a 50Km radius (all Co-operative members). Alongside the community income, the average profit from jatropha products to the co-op is said to be $43,940[157].

Other examples have been supported directly by the government, such as a community biodiesel production system in Thung Song district, Nakhon Sri Thammarat province. It is important to note that the BEFS financial analysis found that all assessed community based "zero-waste"

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154 http://www.biofuelwatch.org.uk/docs/lulucf_leaflet.pdf.

155 From THAILAND'S ENERGY POLICY delivered to the National Assembly on 30 December 2008 by Mr. Abhisit Vejjajiva,Prime Minister of Thailand and ENERGY STRATEGY directed by Mr. Wannarat Channukul, Minister of Energy, on 12 January 2009.

156 The new scheme has yet to take off as the role of the volunteer has not yet been clarified.

157 This project was initiated with the help of researchers based at University of Kasetsart in 2006, and has been the subject of several articles. http://www.thebioenergysite.com/articles/315/thailand-jatropha-cooperative.

projects were financially unviable at this stage without external support. However there are non-financial additional benefits mentioned by participants in various schemes including increased sense of self-sufficiency and improved cohesiveness within the community of such cooperative activities (interviews, 2010).

Teams of scientific researchers in Thailand remain confident that biodiesel can be produced at a community scale with simply managed technology, given sufficient fuelstock from a variety of local resources, including jatropha seeds, used cooking oil, etc[158]. This fuel could be useful in rural communities to power agricultural equipment such as irrigation pumps, tractors and the motorised carts used for transporting goods in rural areas of the Mekong. Researchers recognise however that the harvest of seeds alone has not been sufficient to gain interest from farmers. Scientists are now looking at coppicing jatropha stems, a process which helps generate a large amount of biomass, from which compressed pellets could be produced for solid fuel. The heat energy obtained from such fuel can be used directly for agricultural processes such as drying or for electricity generation. However, research trials and pilot testing are still at early stages in Thailand, Laos, and Cambodia.

## Summary

Worldwide, demand for and supply of bio-ethanol and biodiesel have boomed during the last decade[159]. However in the Mekong, its development has been patchy. There have been some false starts: before consequences for food security were carefully analysed, as in the case of maize based ethanol in China; and before technical viability was fully developed, as in the case of jatropha-based biodiesel. In Thailand the government decision to enforce the supply of B3 nationwide has had to be undone as a result of poor programme management. This has set back the country's plans to follow an alternative energy "roadmap". In Cambodia, the only operational ethanol producer has been shut down for 12 months, and in Laos the sector has barely emerged beyond the research stage.

A boom can be detected, however, in the number of new agrofuel refinery projects in Thailand in the last two years, with a rush of interest by companies taking up the financial investments and the public policy guaranteed market[160]. China's agrofuel programme is largely state-led and highly subsidised, and is expanding. Vietnam's agrofuel policy has set more cautious targets, but several companies are poised to expand production. Despite the strong policy commitments made, many of the government targets for expansion of production over the next ten years still appear wildly ambitious given land constraints and the limits of environmental sustainability.

Some of the delays in the sector so far have also been attributed to the dual economic obstacles of a relatively low price for oil until end 2010, and relatively high feedstock prices. Agrofuels are not currently commercially viable in any country in the world, not even US or Brazil (the leading producers), without significant support from the state[161]. However, the price of oil has risen once again (passing $100 a barrel in January 2011) and the market conditions for agrofuel are likely to improve, which could signal a renewed drive by the industry[162].

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158 interviews with academic team of Bioenergy Centre, Chiang Mai University.

159 Average annual growth of 50% during 2002–2007 and almost doubling in the last two years. Bio-ethanol dominates global production of bio-fuels, as development started some twenty years earlier than biodiesel. In 2007 global production of bio-fuels was 63 billion litres of bio-ethanol vs. 4 billion litres of biodiesel. The plantation area in Malaysia and Indonesia has doubled since 1997, reaching around 10 million hectares by 2005. Current plans aim to treble the area devoted to oil palm in Indonesia alone to 20 million hectares by 2020, or, if plans of the 'National Team on Agrofuel' are believed, to nearly 30 million ha by 2025 (Pye, 2010).

160 Note however that in light of recent events in the palm oil sector, the policy priority applied to the Thai biodiesel programme is now in some doubt.

161 According to IISD's Global Subsidies Initiative, the U.S. agrofuels industry, alone, under existing policies, may benefit from support worth over US$92 billion from 2006 to 2012 (Shaw, 2010).

162 Although it should be noted that given the higher prices of oil-based fertilizers and other agro-chemicals, feedstock prices may also rise further. Bank et al (cited in Gaillard et al 2010) state that "the price movement of

With the expansion of industrial processing facilities, the expansion of the cultivated areas for the target crops over the next ten years in the Mekong is likely. Different contexts in each country have influenced different approaches for the conversion of lands to agrofuels, with varying degrees of coercion and/or public incentives. Preliminary steps in agrofuel development so far in some countries of the region have been linked to communities being expelled from lands (in Cambodia), forced to dedicate their own labour (in Burma), and has involved violence and other human rights abuses. Governments or regional governance bodies have done little to ensure that these experiences will not be repeated. In Laos, the government has been reconsidering its land concession programme since 2007, but large-scale concessions have still moved ahead in the intervening years. In the face of strong local protests, or where there is evidence of human rights abuses, how can public support for the relevant investment programmes continue to be justified?

In other areas, many farmers, who hold sufficient land and other resources, see opportunities in this sector. Annual crops, such as cassava, that can be grown without hefty investment in external inputs are attractive crops for poorer farmers, although soil nutrient depletion problems need to be addressed. In Thailand, incomes for palm oil producers increased markedly last year, enticing some farmers to switch from more labour-intensive rubber farming.

However, several realities facing small-scale farmers can mean that not all farmers can gain the benefits of emerging markets. Farmers must have secure land tenure, in practice as well as in law, such that they have strong protection against eviction, land seizure. Without such security, higher land values can herald new threats of land grabbing. Land and water may be monopolised by others, and resources can become degraded. Higher input costs can diminish returns even where crop prices are relatively high, and can present risks in a market where farm gate prices can dive suddenly. Where farmers do not have access to critical price information, fair markets, or the resources for transportation or storage, middle-men can extract disproportionate profits at the expense of primary producers. Wages received by an agricultural labourer may stagnate regardless of rising prices, or the rent that a tenant farmer has to pay may increase with the value of his or her crop. Genuine support for smallholder production is called for, linked together with improving tenure security, more equitable prices, and redistribution of large holdings to provide opportunities for the landless.

The tendencies in the Mekong countries, as elsewhere, of capital investments towards increasingly intensive land use and monocrop plantation models conform to an old paradigm of industrial, energy-intensive agriculture. This has been rejected as unsustainable by peasant movements[163] as well as the recent International Assessment of Agricultural Knowledge, Science and Technology for Development[164]. Increasingly, the role of small-scale farmers are being recognised, and the value of maintaining diversity of agro-ecological methods, which can pursue a multiple set of goals, not least mitigating and adapting to climate change. Peasant agriculture remains an essential and valuable component of the planet's future agricultural development. Much more support and respect could be given to reviving local traditions, common throughout the Mekong region, of multi-cropping, intercropping, and preserving natural spaces.

Where new cash crops are introduced, care must be taken not to prejudice local food security. It is now well-acknowledged, thanks to the high-profile campaigns of the last few years, that development of the agrofuel sector has carried risks for food security, at the local, national and

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biofuel feedstock is likely to follow the global petroleum market if more than 10% of that crop is used for biofuel production".

[163] La Vía Campesina and other peasant movements have challenged the intensive monocrop agricultural model and have formulated alternatives to industrial capitalist agriculture including proposals for food sovereignty. For a summary of La Via Campesina's food sovereignty proposals see for example, "Food Sovereignty: Global Rallying Cry of Farmer Movements" http://www.foodfirst.org/pubs/backgrdrs/2003/f03v9n4.pdf.

[164] This assessment was prepared with the help of more than 400 experts in this field over four years under the auspices of the UN, Information available at www.agassessment.org.

international scales, as well as the destruction of and loss of native ecosystems concessions etc. The international food price crisis of 2008, we now know, was strongly related to the worldwide boom in agrofuels.

In the Mekong, whole communities have been evicted to make way for agricultural land concessions, including concessions for cassava, sugarcane and oil palm, in Cambodia, Lao PDR and Myanmar. This has directly led to the impoverishment of those families and their food insecurity. The likely expansion of demand for agrofuel and other crops, and continued government support for large-scale plantation models, raise serious concerns for the food security of poor and vulnerable communities in target areas.

Market changes have also brought concerns for food stocks. The diversion of oil palm stocks to biodiesel has had a direct impact on the cost and availability of cooking oil in Thailand earlier this year. There are grounds for concern about the future impacts on prices and stocks of various foodstuffs as the diversion of crops to fuel uses increases to meet ambitious national targets. As food prices once again soar, this year could bring more dire news for the landless poor and the hungry.

Several environmental problems have been associated with the industrial processing plants for ethanol, from cassava and sugar, and for biodiesel. If the industry expands without any satisfactory solution to current wastewater treatment problems, then neighbouring people are likely to suffer the consequences. Likewise, if current expansion targets are pursued, higher yields will have to be achieved for crops such as cassava, this is expected to increase the demands for irrigation. How can these be met without putting water resources under strain and disadvantaging the poor?

Concerning carbon emissions, the main crops promoted in the Mekong, sugar, cassava, oil palm and jatropha were amongst those said to perform best in terms of fuel efficiency and emissions savings. However, recently each crop/product has been shown to create unacceptable levels of emissions under specific production conditions. Biomass rich environments must not be allowed to be destroyed for cultivation of the feedstock, and fuel processing must be strictly controlled. While national price supports and incentives are propping up the expansion of the agrofuel sector, policies must be monitored and evaluated for their environmental and social impacts as well as their economic performance, whether or not the policies are founded on any seriously intended environmental rationale.

Finally, it would be a mistake to consider agrofuels as a genuine long-term approach to mitigating global warming or even improving energy security. Clearly fuel crops could never provide enough liquid fuel to power the rising number of cars. This is true globally as well as within the region. Even under the most optimistic scenarios for Mekong agrofuel production by 2020, and depending on a massive investment of public money, land, water and other resources, the production of agrofuels only hope to replace around 5% of domestic transport fuels consumption. Focussing on reducing the use of transport fuels for movement of people and goods in high greenhouse gas emitting countries, in the Mekong as elsewhere, is, inescapably, a more important long-term imperative for this region.

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## Appendix I

List of concessions granted for agricultural crops that can be used for fuel
Cambodia, from Ministry of Agriculture, Forests and Fisheries, 2010
Source: http://www.elc.maff.gov.kh/en/profile.html

| Date contract signed with MAFF | Province | Name of Cambodian company | Nationality of partner company | Sugarcane | Cassava | Oil Palm | Jatropha | Et al | Area (ha) |
|---|---|---|---|---|---|---|---|---|---|
| **1995** | Sihanoukville | Mong Reththy Investment Palm Oil Cambodia Co Ltd | | | | x | | | 11,000 |
| **1998** | Koh Kong | Green Rich | China | | | x | | x | 60,200 |
| **1999** | Kampong Speu | CJ Cambodia 2 | Korea | | x | | | | 3,000 |
| **1999** | Pursat | Ratana Visal Development Co Ltd | | | | x | | x | 3,000 |
| **1999** | Rattankiri | Global Tech Sdn Bhd, Rama Khmer International and Men Sarun Friendship | | | | x | | x | 20,000 |
| **2000** | Battambang | Leang Hour Hong Import and Export | | x | x | | | | 8,000 |
| **2000** | Kampong Cham | TTY Industrial Crops Development Import Export | | | x | | | | 1,070 |
| **2000** | Kampot | Camland Co ltd | | | | x | | | 16,000 |
| **2000** | Sihanoukville | Mong Reththy Investment Cassava Cambodia Ltd | | | x | | | | 1,800 |
| **2001** | Kampong Speu | CJ Cambodia 1 | Korea | | x | | | | 5,000 |
| **2004** | Kampong Cham | Vannma Import Export Co Ltd | | x | x | | | | 1,200 |
| **2006** | Oddar Meanchey | Crystal Agro Co Ltd | Thai | | x | | | x | 8,000 |
| **2006** | Koh Kong | Koh Kong Plantation Co Ltd | | x | | | | | 9,400 |
| **2006** | Koh Kong | Koh Kong Sugar Co Ltd | Thai | x | | | | | 9,700 |
| **2007** | Oddar Meanchey | Angkor Sugar | Thai | x | | | | | 6,523 |
| **2007** | Kratie | (Camb) Tong Min Group Engineering | China | | | | x | x | 7,465 |
| **2007** | Kratie | Doty Saigon Binh Phouc (SBK) | Vietnam | | x | | | x | 6,436 |
| **2008** | Oddar Meanchey | (Cambodia) Cane and Sugar Valley | Thai | x | | | | | 6,595 |
| **2008** | Oddar Meanchey | River Sugarcane | Thai | x | | | | | 6,618 |
| **2009** | Kampong Speu | Fortuna Plantation (Camb) Ltd | Malaysia | | | x | x | | 7,955 |
| **2009** | Kampong Thom | BNA (Camb) Corporation | Korea | | x | | | x | 7,500 |
| **2009** | Kratie | PDA (Camb) Co Ltd | Korea | | x | | | x | 5,256 |
| **2009** | Rattankiri | Heng Heap Investments | | | | | x | x | 7,000 |
| **2009 / 2010** | Kratie | Carmadeno Venture (Camb) Ltd | India | x | | | | | 7,635 |
| **2010** | Svay Rieng | NK Venture (Camb) Ltd | India | x | | | | | 1,200 |