



Prospects and drivers for agricultural change in the Mekong region

The case of sugar, rice and rubber

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By Heike Baumüller

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1. Introduction

Agricultural production in the Mekong region has been and is being shaped by a drive towards modernization and trade expansion as well as the continued importance of the sector for food security and income generation. Thailand and, more recently, Vietnam have emerged as important players in the global agriculture market. By pursuing agricultural development through promoting export-led growth since the 1950s, Thailand has become one of the world's leading agricultural exporters, in particular of rice, sugar and natural rubber. Similarly, Vietnam has been turning towards higher-value, export-driven agriculture over the past 20 years to become one of the world's leading exporters of pepper, coffee, rice and cashew. While the sector's share of GDP in the two countries has fallen well below those of the services and industrial goods sectors, agriculture continues to employ a significant proportion of the labour force (see Table 1).

Table 1: Agriculture's share of GDP and labour force in the Mekong region

	Share of GDP (%)	Share of labour force (%)
Thailand	10*	49*
Vietnam	21**	58***
Cambodia	46***	71***
Laos	47***	80***

* in 2006, ** in 2005, *** in 2004

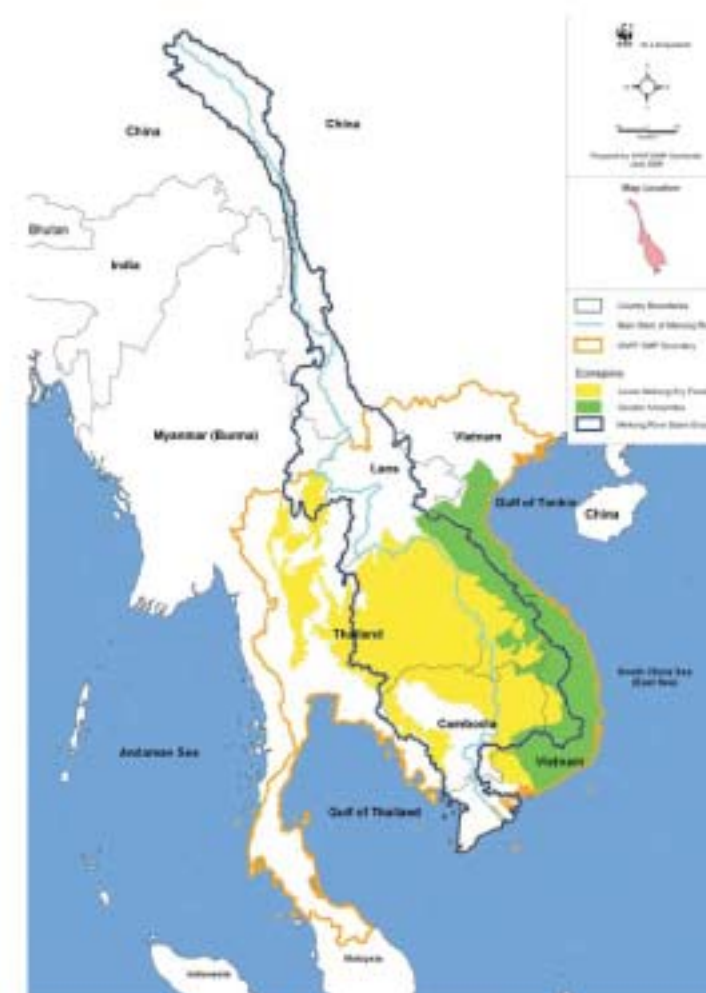
In contrast, the agriculture sectors in Cambodia and Laos remain dominated by subsistence farming with limited exports primarily to neighbouring countries. The sector continues to provide almost half of the countries' GDP (although this contribution is declining as other sectors grow more) and employs roughly three quarters of the work force. More recently, the two countries have seen rapidly growing interest in developing large-scale agricultural plantations for rubber, sugar and other commodities, largely driven by investors from Thailand, Vietnam and China (as well as some local and multinational investors) who are capitalizing on the countries' comparatively abundant land and cheap labour resources to produce raw materials for their domestic processing industries.

Expansion and intensification of agricultural production in the region have brought with them significant environmental change through increasing water consumption, habitat conversion, land and soil degradation, erosion and water pollution (both from use of agrochemicals and processing of agricultural commodities). Such environmental impacts are of particular concern in the Lower Mekong Dry Forests, Greater Annamites and Mekong River, which have been listed among WWF's 200 global priority 'ecoregions', i.e. regions with exceptional levels of biodiversity, such

as high species richness or endemism (see Map 1). Given that all three of these ecoregions span more than one country, the environmental impacts of agricultural production are not just a national, but also a regional concern.

This paper highlights where the most imminent threats to these ecoregions are likely to arise in the near future, with a particular focus on likely changes in the production of sugarcane, rice and rubber as well as other key commodities in the four countries. It goes on to identify the main driving forces behind agricultural change in the region, including multilateral, regional and domestic trade, investment and policy trends. Based on this analysis, the paper puts forward a series of recommendations to help minimize environmental threats while maximizing opportunities for agricultural development.¹

Map 1: WWF priority ecoregions in the Mekong countries



¹ The references supporting the findings presented in this document are available upon request.

2. Production trends

This section provides an overview of current production of sugarcane, rice and rubber in the four countries as well as tentative predictions for production changes in these and other commodities. The analysis focuses in particular on the following provinces in each country, which are located within the three WWF ecoregions (referred to as 'priority provinces' or 'provinces of priority interest to WWF's regional programme'):

- **Thailand** – Northeast (Loei, Nong Bua Lumpu, Udon Thani, Nong Khai, Khon Khaen, Sakon Nakhon, Nakhon Panom, Mukdahan, Amnat Charoen, Ubon Ratchathani, Buri Ram, Surin, Si Sa Ket, Kalasin, Roi Et, Yasothon, Maha Sarakham, Chaiyaphum, Nakhorn Ratchasima) and North (Chiang Rai)
- **Vietnam** – Northern Annamites (Nghệ An, Hà Tĩnh, Quảng Bình), Central Annamites (Quảng Trị, Thừa Thiên Huế, Quang Nam, Kon Tum, Gia Lai) and Southern Annamites (Đắk Lắk, Lâm Đồng, Dong Nai, Bình Dương, Ninh Thuận)
- **Cambodia** – Northeast (Monduliri, Rattanakiri, Stung Treng, Kratie, Preah Vihear, Kampong Thom)
- **Laos** – Central (Xiengkhuang, Borikhamxai, Khammouane) and South (Savannakhet, Saravan, Champasak, Xekong, Attapeu)

The maps included in this report provide further information on the location and extent of sugarcane, rice and rubber production in Laos and Vietnam, and rubber production in Thailand. Equivalent data for Cambodia was not available at the time of writing.

2.1 Past and current production

Sugar

Sugarcane figures as one of the key agricultural commodities produced in **Thailand** and, more recently, in **Vietnam** where the government has actively promoted its cultivation since the mid-1990s. Most of Thailand's sugar production (60-70 percent) is destined for export. In contrast, Vietnamese sugarcane is mainly used for domestic consumption. Until recently, sugar factories in Vietnam failed to make a profit due to insufficient amounts of raw material and inadequate equipment, resulting in high prices that have made the product uncompetitive in the international market.

In **Cambodia** and **Laos**, sugarcane cultivation had been largely for small-scale production for domestic consumption, although Laos has seen a rapid increase in production since the late 1990s in line with the country's general shift towards greater market orientation. More recently, interest among foreign investors to develop sugarcane plantations in these two countries has been growing rapidly with a number of large-scale projects in the pipeline.

The share of sugarcane production originating from the WWF priority ecoregions is

relatively small compared to overall production in the four countries (see Table 2), although this trend appears to be changing in some countries. In Thailand, for instance, the main sugar-growing areas have traditionally been located in the Central region, but are increasingly shifting to the priority provinces in the Northeast and the North in response to rising land prices.

Table 2: Sugarcane area and production in the Mekong countries

	Area (1000 ha)			Production (1000 tons)		
	Total	Ecoregions	Share (%)	Total	Ecoregions	Share (%)
Thailand*	1,032	423	41	63,398	25,003	39
Vietnam*	285	72	25	5,679	3,596	63
Laos	10*	1.9	19	223**	75	34
Cambodia***	7.7	? (small)		164	? (small)	

* 2006, ** 2004, *** 2000

Rice

Rice continues to dominate agricultural production in all four countries, grown as a food and export crop in **Thailand** and **Vietnam** and mainly as a subsistence crop in **Cambodia** and **Laos** (see Table 3). All countries use both rain-fed and irrigated production systems, with rain-fed production clearly dominant. The priority provinces in Thailand and Laos are among the major rice-producing areas in the countries. Thailand's Northeast provinces continue to be a significant source of rice exports, accounting for almost half of the total area and just over a third of production. In Laos, the share of total rice cultivation area located in the priority provinces is even more significant (60 percent) although overall area is still small compared to Thailand. In contrast, the proportion of rice-growing areas in the priority provinces in Vietnam and Cambodia is relatively small.

Table 3: Rice area and production in the Mekong countries

	Area (1000 ha)			Production (1000 tons)		
	Total	Ecoregions	Share (%)	Total	Ecoregions	Share (%)
Thailand*	11,056	5,396	49	30,626	10,831	35
Vietnam**	7,324	958	13	26,397	4,277	16
Laos***	779	453	59	2,529	1,471	58
Cambodia***	2,318	?		4,026	?	

* 2006, ** 2005, *** 2004, **** 2000

Rubber

Natural rubber has been promoted as a major export crop in both Thailand and, more recently, in Vietnam where growing areas have expanded rapidly since the early 1980s in response to high global market demand and promotion by the government. In contrast, efforts to expand rubber cultivation are a relatively new trend in Cambodia and Laos, mainly driven by overseas investors, and areas currently being cultivated remain small (see Table 4). However, the area in Laos has been expanding rapidly in recent years, financed by private (almost entirely foreign) capital, and rubber now counts as the second most widely cultivated agricultural product in the country. But given the lag time until rubber trees become productive, latex production in Laos is still low, with just 6 percent of plantations tapped for latex in 2007.

Table 4: Rubber area and production in the Mekong countries

	Area (1000 ha)			Production (1000 tons)		
	Total	Ecoregions	Share (%)	Total	Ecoregions	Share (%)
Thailand	2,294	246	11	3,071	117	4
Vietnam	516	424	82	554	451	81
Laos 12	3	25	1,250	453	36	
Cambodia	61	?		?	?	

Data from 2006.

While rubber production in **Thailand** is dominated by smallholdings which account for 90 percent of production, the opposite is true for **Laos** where plantation rubber holdings make up 75 percent of total holdings mainly due to prohibitively high start-up costs (estimated at US\$ 900/ha compared to US\$ 100 to US\$ 300 for rice). Smallholder models appear to be prevalent in Northern Laos, but large-scale plantation development is much more common in WWF priority provinces in Southern Laos. In **Vietnam** and **Cambodia**, rubber production is dominated by state-owned plantations, covering 58 and 65 percent of total cultivated area respectively. In Cambodia, private foreign investors are playing an increasingly important role in plantation development.

Land and climatic conditions in the priority provinces in Vietnam are very suitable for rubber plantations and the vast majority of rubber areas are located there. In contrast, the priority provinces in Thailand and Laos do not account for a significant share of production (although this share is growing). Almost three quarters of Thai production is taking place in the South of the country, while farmers in the North have traditionally grown annual crops rather than tree crops. Nevertheless, rubber cultivation has been expanding rapidly in the Northeast provinces as a result of

intense government efforts. The extent of rubber cultivation in the Cambodian priority provinces is unknown.

2.2 Predicted future production

Sugar, rice and rubber

Numerical predictions for cultivation area expansion are only available for Laos and Vietnam (and for rubber in Thailand; see Table 5). The estimates rely mainly on government projections which may or may not turn out to be realistic. The impacts of other factors driving production expansion (such as investment trends, processing capacities, global supply and demand and price changes) could not be quantified, although an assessment of these drivers has helped to identify possible trends, hotspots and likely areas of expansion.

Table 5: Sugar, rice and rubber expansion in the priority provinces

	Rice		Sugar		Rubber		Total		
	2005/6	2010	2006	2010	2006	2010	2005/06	2010	Increase
Vietnam	595	590	72	96	424	533	1,454	1,668	214
Laos	453*	656	1.8	102	3	52	458	810	352
Thailand	?	?	?	?	254	982	?	?	?
Cambodia	?	±40	?	±15	?	±50	?	105	?

Area in 1,000 ha. Numbers for 2006 apart from * (2005). Projections for Cambodia very tentative.

In **Vietnam**, the greatest expansion in the priority provinces is expected to be of *rubber* cultivation area given the availability of suitable land resources. Much of that increase will be focused on the Central Highland provinces (Central Annamites) as well as Binh Phước in the Southern Annamites. *Sugarcane* cultivation is also likely to expand considerably since most of the priority provinces are suitable for sugarcane cultivation, with the largest increases (by area) expected to take place in Nghệ An and Hà Tĩnh (Northern Annamites). *Rice* cultivation is predicted to expand in some provinces (mainly Northern and Central Annamites) and contract in others (mainly Southern Annamites).

In **Laos**, *rice* expansion to meet the food demands of a growing population will be the most significant. In addition, *sugarcane* production is likely to increase substantially through planned large-scale foreign investments. While *rubber* is expected to expand most rapidly in the priority provinces compared to the rest of the country, actual area increases are not expected to be as major as for the other crops. For all three crops, the expansion is focused on the provinces of Savannakhet and Champasak, which account for 40 and 25 percent of total expansion in the priority provinces respectively.

For Thailand and Cambodia, likely trends can be identified. In **Cambodia**, *rubber* area expansion is predicted to pose the greatest threat to the Dry Forests given suitable soil conditions in the priority provinces. In contrast, *sugarcane* plantations focus mainly on provinces outside of the priority area although some expansion is expected to happen. Pressure on land conversion for *rice* cultivation is likely to come mainly from migrants cultivating rice for domestic consumption which could amount to a fairly substantial area.

It is unclear where in Cambodia's priority provinces these expansions are likely to take place. However, if already awarded land concessions are used as an indicator, the main provinces are likely to include Kratie, Stung Treng and Ratanakiri. Ongoing monitoring efforts by WWF have also raised serious concerns about rapid expansion of concessions in Mondulakiri, while large-scale expansion in other areas cannot be ruled out.

In **Thailand**, the agricultural estate is relatively stable and government policies generally focus on increasing production on current areas rather than expanding areas under cultivation due to very ambitious forest area targets. Of the three crops, *rubber* cultivation is expected to increase most significantly in the priority provinces although the share of total area under cultivation nationwide is likely to remain small. Future expansion of *rice* cultivation is likely to be limited due to water constraints. However, large-scale Mekong River water diversion for irrigation of the Northeast is a clear policy agenda of the new government. Similarly, *sugarcane* area expansion is not expected to lead to substantial land conversion in the Northeast provinces since any growth is likely to be absorbed by switching from rice cultivation. Nevertheless local experience shows that many smallholders continue to clear remnant forest patches on the boundaries of their land to increase cultivated area – and this can have significant effects at an aggregate level.

Environmental impacts

In terms of potential negative environmental impacts, the expansion of agricultural production can lead to the conversion of non-agricultural land (such as forests, some of which may be theoretically under some form of protection) to agricultural production as well as increased use of inputs (e.g. water, fertilizers or pesticides) when shifting from one crop to another or intensifying production. In general, both types of impacts are likely to occur in the four countries as a result of agricultural expansion. In **Cambodia** and **Laos**, land conversion is a particular concern due to the widespread availability of supposedly 'unused' or degraded land as well as weak regulatory systems and an absence of land-use planning.

In **Thailand** and **Vietnam**, concerns relate primarily to changes in production methods and the types of crops being grown (although land conversion can also

not be ruled out). For instance, while sugarcane is likely to be grown on existing rather than new agricultural land, the crop's high water demand is likely to increase pressure on water resources. Moreover, the growing shift to high-yield rice varieties will require more extensive use of agricultural inputs, including pesticides.

Other crops

In addition to sugar, rice and rubber, a number of other crops will be relevant in these ecoregions. They are likely to vary between the countries. Biofuel crops can also be expected to play an increasing role across the region (see below).

In **Thailand**, other relevant crops include cassava and eucalyptus which are already widely grown in the Northeast. No specific projections are available.

In **Vietnam**, fruit trees are expected to expand most significantly in the priority provinces (by 73,000 ha by 2010) while the cultivation of cocoa is also likely to increase (by about 44,000 ha). Cashew cultivation in the priority provinces, which already accounts for around 85 percent of total area nationwide, is predicted to increase by ca. 75,000 ha by 2010. For coffee, which also covers a significant area in the priority provinces (95 percent of total area), the government is planning to reduce the total cultivation area by about 5 percent in response to low market demand, with a shift from low quality to high quality varieties (although this plan might change in light of a recent rebound in world coffee prices). Moreover, the government has ambitious plans to expand *jatropha* cultivation for biodiesel production, although the location is still unknown.

In **Cambodia**, *jatropha* is among the crops that are mostly likely to be grown at a plantation scale. In addition, a number of tree species (teak and acacia) are listed among the crops to be planted on concession land in the priority provinces. Cassava also appears frequently as a minor crop in some of the provincial land concessions. However, the actual use intended for many of the concessions is still uncertain. In any case, according to anecdotal data, high cassava prices have led to a great deal of recent cassava planting in northeast Cambodia.

In **Laos**, maize cultivation area is expected to increase most significantly among the relevant crops in the priority provinces (220,000 ha), more than any of the three commodities examined above. Maize is grown mostly for export and processing into animal feed. Other important crops include coffee (61,000 ha), vegetable oil crops (50,000 hectares) and cassava (no prediction available). Overall, an additional 361,000 ha of agricultural land is estimated to be needed to meet these targets.

Also, as explained in more detail below, in terms of impacts of agricultural development on land conversion in **Cambodia** and **Laos**, the actual type of commodity is

likely to be secondary compared to the more general impacts of current land allocation practices.

Biofuels

All four Mekong countries are leaping onto the biofuel bandwagon. The Thai and Vietnamese governments are actively promoting the production and use of biofuels to meet domestic energy and fuel demand. The Cambodian and Lao governments, in turn, seem very willing to provide cultivation areas for biofuel crop production to overseas investors. Crops that have attracted the most interest in the region include sugarcane and cassava for ethanol, and palm oil and jatropha for biodiesel, although others are also being discussed.

Thailand is looking to develop biofuels that can be substitutes for petrol/gasoline (gasohol) and diesel (biodiesel). For gasohol, sugarcane is one source of raw material although to date sugarcane has been used mainly for sugar production rather than fuels. Cassava appears to be equally if not more important for gasohol production and the recent expansion of cassava cropping in the Northeast has been attributed to increased demand for ethanol production. The main source material for biodiesel is palm oil, which is grown in the Southern region but has not yet been tried in the Northeast.

In **Vietnam**, sugarcane and starch (e.g. from cassava) are the main sources of input for ethanol production. The government is planning to use 1 million ha of land, which has officially (although possibly disputably) been categorized as 'unused', to plant tree crops (e.g. jatropha) for biodiesel production. However, the intended location of these plantations is unclear. In the priority provinces, 2 million ha have been categorized as 'unused'.

In **Cambodia**, any (supposedly) 'underutilized' land is a candidate for conversion to bioenergy plantations. Anecdotal evidence points towards growing interest among foreign investors to increase production of biofuel inputs and processing. In addition to sugarcane, jatropha plantations have attracted particular interest, with several large concessions proposed for Korean, Japanese, and national companies in Kratie, Kompong Thom, and Stung Treng provinces.

In **Laos**, biofuel development is still in its infancy. However, foreign investors have embarked on a rush to acquire land concessions for biofuel production. Jatropha is among the crops that have attracted particular interest, but other crops are also being considered.

In addition to individual country initiatives, biofuels are also increasingly being addressed at the **sub-regional level** as part of the Greater Mekong Subregion

(which includes Cambodia, Laos, Myanmar, Thailand, Vietnam, and parts of China), notably through the Biofuels and Rural Renewable Energy Initiative launched by the GMS Working Group on Agriculture in June 2007 with the (rather broad) aim of developing strategies and options for the GMS in biofuels and rural renewable energy to reduce poverty among rural households, contribute to the production of clean energy and ensure sustainable development.

3. What is driving agricultural production changes?

Domestic policies

Export orientation will continue to shape agricultural policies in both **Thailand** and **Vietnam**, with an increasing trend towards encouraging domestic value addition and the modernization of agricultural production and processing. In **Cambodia** and **Laos**, poverty reduction and employment generation are likely to be the main factors shaping national policies in general and agricultural policies in particular, given high levels of rural poverty and the large share of the labour force engaged in agricultural activities. As part of this broader strategy, policy-making in **Cambodia** and **Laos** is focusing increasingly on enhancing processing capacity and diversifying exports (in terms of products and markets).

Investment trends for agricultural production and processing

Not surprisingly, processing capacities are considerably further advanced in **Thailand** and **Vietnam**. Indeed, the *sugar* industries in Thailand and Vietnam suffer from overcapacity which is stimulating expansion of sugarcane cultivation elsewhere in the Mekong region to make up the supply shortfall. No further investments in new processing facilities seem to be in the pipeline for the near future. In the case of *rubber*, the focus is increasingly on improving value addition with some new processing facilities planned in Vietnam. Companies will obtain a significant share of inputs from Cambodia and Laos, whose rubber output is being fully exported to investors' home countries (including China, Vietnam and Thailand) (see Table 6).

Indeed, **Cambodia** and **Laos** have yet to attract significant agri-business development due to the persistence of serious obstacles to providing a favourable business environment, including weak governance systems and poor infrastructure. In Cambodia, for instance, agri-business investments accounted for just 3 percent of total investment between 2000 and 2005. Instead, investments have focused primarily on cultivation (and to a minor extent processing) mainly from their regional neighbours as well as local business tycoons. While rubber processing in these countries is likely to remain limited for some time, they have attracted some investments in sugar processing.

More recently, **multinational companies** have started investing in related projects in some of the countries, notably sugar. For instance, Tate & Lyle has invested in

sugar production in Laos and Vietnam, Bourbon in sugar production in Vietnam and Cargill exports sugar from Thailand. Data on these investments were not available at the time of writing.

In the case of *rice*, investments in processing capacities and cultivation are likely to be less of a driver for production changes in the Mekong region, although efficiency improvements could reduce the need for increased productivity and cultivation areas. For instance, modern rice mills are becoming increasingly widespread in Laos and 10 percent of the existing mills are planning to upgrade their plants which would elevate the extraction rates by some 5 to 7 percent.

Table 6: Examples of known existing and planned investments in Laos and Cambodia

Company	Target country	Activity	Scale
Pakap (recently taken over by a Thai investor)	Laos (Vientiane municipality with inputs from Borkhamxai, Khammouane and Savannakhet)	Sugar cultivation and processing (existing)	2 processing factories (around 5,000 tons/day)
Mitr Phol (Thailand's largest sugar producer)	Laos (Savannakhet)	Sugar cultivation and processing (by 2009-2010)	US\$ 164 million, 50,000 ha, 2 processing factories, 20,000 smallholder contracted
Mitr Lao Sugar (joint venture between Mitr Phol, a Lao investors and UK-based Tate & Lyle)	Laos (Savannakhet)	Sugar cultivation and processing (by 2009-2010)	US\$ 158 million (US\$ 2 million by T&L), 1 processing factory (5,000 tons/day rising to 10,000 tons)
Lao Thai Hua Company (Thai-Lao joint venture between Thai Hua Rubber Public Company and New Chip Xeng Company)	Laos (Borkhamxai, Khammouane and Savannakhet)	Rubber cultivation (planned)	US\$ 34.5 million, 30,000 ha
Vietnamese-Lao joint venture between Champasak and B&K Lak Provinces and Ho Chi Minh City	Laos (Champasak)	Rubber cultivation (planned)	US\$ 5 million, 10,000 ha
Ho Chi Minh (Vietnam)	Laos (Champasak)	Rubber cultivation (?)	? (estimated at 10,000 to 16,000 ha)
Dak Lak Rubber Company (Vietnam)	Laos (Champasak, Saravan, Attapeu, Sekong)	Rubber cultivation (some existing, some planned)	Up to 10,000 ha
Thai-Vietnamese investment (incl. Vietnam Rubber Group)	Laos (Champasak)	Rubber cultivation (existing)	7,400 ha
Green Sea Industry Co. LTD (Cambodia)	Cambodia (Stung Treng)	Sugarcane, rubber and teak	100,852 ha total (share of each crop unknown)
Tai Nam Ltd. (Vietnam)	Cambodia (Kratie)	Rubber, cassava and cashew	7,560 ha total
3014 Gialai Company Limited (Vietnam)	Cambodia (Ratanakiri)	Rubber, cashew, and paulonia	9,380 ha total
Heng Development (Cambodia)	Cambodia (Ratanakiri)	Rubber and acacia	8,654 ha total
Oryung Construction (ACM) (Korea)	Cambodia (Ratanakiri)	Rubber	6,866 ha
Mean Rithy Co. Ltd (Cambodia)	Cambodia (Kampong Thom)	Rubber and acacia	9,784 ha total
Thai-Cambodian joint venture (set up by Charoen Sirivadhanabhakdi from Thailand and Mong Reththy from Cambodia)	Cambodia (Koh Kong – not a priority province)	Sugar cultivation and processing (by 2008)	US\$ 50 million, 60,000 tons of white sugar, 24,000 tons of molasses and 6 million liters of alcohol

NOTE: Many of these numbers are highly tentative given the limited information on land concessions that is publicly available. The nationality of concession holders in Cambodia is not always known. Names/countries in brackets refer to the companies' directors. According to the Cambodia Office of the UN High Commissioner for Human Rights, none of the concessions appear to have been cultivated to date.

It is important to note that in **Cambodia** and **Laos** the scale and process by which large tracts of land are leased to overseas investors is likely to have a far greater influence on ecoregional change than the specific commodities that are finally grown on the land. Both countries are seeing rapidly growing foreign and some domestic investment in large-sale plantations. In Cambodia, for instance, over 943,069 ha of land have been granted to private companies as large-scale economic land concessions (ELCs) for the development of agro-industrial plantations, with 36 of 59 concessions granted to foreign business interests or prominent local political and business figures. Of the known land concessions, 390,000 ha are located in the priority provinces (see Map 2). Taken together, existing and predicted land concession areas in these provinces are expected to exceed 570,000 ha by 2015.

Map 2: Economic land concessions in Northern and Eastern Cambodia



The current practice of concession allocation in Cambodia has raised widespread concern. As a 2007 donor statement notes, progress in agricultural and natural resource management “risks being overshadowed by the rapid increase of Economic Land Concessions...at both the national and provincial levels.” Concessions are often given out in a non-transparent manner, and essential (and required) pre-conditions to the grant of a concession such as social and environmental impact assessments have not been met. This is also true for smaller ELCs (up to 1,000 ha), which provincial Governors can grant without reference to central authorities and for which information on numbers and ownership is not available.

Similarly, in Laos the current practice of allocating land concessions for plantation agriculture is regarded as the most serious emerging challenge to sustainable land use. Altogether, some 400,000 ha in agricultural concessions have been granted nationwide during the past five years, with the Chinese planting rubber in the North, the Vietnamese planting rubber and coffee in the South, the Thais seeking land for sugar, the Koreans wanting farmers to plant *jatropha*, and several pulp-and-paper companies seeking land for fast-growing wood fibre plantations. This is not necessarily a problem if the allocation and management of concessions is regulated in a sustainable way; however, this is not happening through the current processes.

Key players in the supply chain

Supply chains tend to be highly organized for heavily exported commodities in **Thailand** and **Vietnam** and strongly influenced by exporters and large-scale processors (such as sugar refineries and rice millers). In Vietnam, exports continue to be controlled largely by state-run enterprises, while private companies play a more significant role in Thailand.

In countries with poorly developed infrastructure, processing facilities and markets, such as **Cambodia** and **Laos**, collectors, traders and local processors often dominate the *rice* supply chain, leaving farmers with a limited choice of buyers who are often their only source of market and price information. In the case of *sugar* and *rubber*, overseas investors and buyers wield considerable influence.

Trends in global demand and commodity prices

Demand and prices for sugar, rubber and (to a lesser extent) rice are expected to rise (to varying degrees) over the next decade. Asian countries, notably China, are among the main drivers of rising demand for the three commodities. The ability of farmers to respond to market signals will vary across the region. Those in countries that are already oriented towards export markets, notably Thailand and Vietnam, are more capable of responding to price signals and changing demands.

In Cambodia and Laos, where the agricultural sector continues to be dominated by subsistence production, farmers are faced with a number of constraints in responding to market signals, including limited access to and participation in markets; lack of market information; dependence on a limited number of traders and overseas markets; and lack of readily available investment/credit and other supply side constraints that hinder production expansion in response to price increases.

World *sugar* prices continue to be artificially low due to high levels of support in several countries that has led to oversupply in this sector. Prices are expected to increase in response to a production decline in the European Union following the implementation of the EU Sugar Reform and diversion of sugar to ethanol production, particularly in Brazil. The major sugar-exporting countries, notably Australia, Brazil and Thailand, are in the best position to capitalize on demand growth and price increases. However, least-developed countries (including Cambodia and Laos) might be able to benefit from supply gaps in the EU through the Everything-but-Arms (EBA) initiative which will provide duty- and quota-free market access for sugar as of July 2009.

Similar to sugar, the global *rice* market is highly distorted. Given the importance of rice for food security and income generation in many countries, extensive liberalization in this sector is unlikely. Nevertheless, global rice prices are projected to increase over the next decade, although only marginally. Thailand and Vietnam are well placed to benefit from market opportunities, including growing demand for high-quality varieties which are increasingly being planted in the two countries. While farmers in Cambodia and Laos will find it difficult to compete with their more efficient neighbours, duty- and quota-free market access under the EBA by September 2009 might stimulate exports to the EU market provided that supply-side constraints can be effectively addressed.

Following a steep decline over the past decades, the price of natural *rubber* has recently recovered and is expected to remain high due to a persistently tight market where supply and demand are closely matched as well as to high oil prices which are making synthetic rubber an expensive alternative. This trend is expected to continue at least until 2011/2012 when new plantations come into production. The Mekong countries are expected to expand their rubber production in response to favourable price prospects, both through domestic producers (mainly in Thailand and Vietnam) or overseas investments (mainly in Cambodia and Laos).

Regional economic integration

A number of regional and bilateral initiatives are underway or in the pipeline which are likely to bring with them shifts in agricultural production to cash crops,

increased trade flows and growing domestic and foreign investment in tradable commodities:

The **Greater Mekong Subregion (GMS) Program** – comprising Cambodia, China, Laos, Myanmar, Thailand and Vietnam – focuses on economic cooperation, including an emphasis on infrastructure development and trade facilitation. Supported by the Asian Development Bank (ADB) and other donors, the GMS Program includes a relatively new Core Agriculture Support Program (CASP), which, among other components, will focus on facilitating cross-border agricultural trade and investment. In addition, three economic corridors (North-South, East-West, and South) are currently under development as part of the Program which will link the GMS countries. The corridors are expected to completely transform the GMS with significant environmental and socio-economic impacts. A clear early example of this is the rapidly growing Thai investments in Laos' Savannakhet Province after the recent completion of the Japanese-funded Friendship Bridge between Savannakhet and Mukhdahan, Thailand.

The four Lower Mekong countries (along with Myanmar) launched the **Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy (ACMECS)** in 2003 in an effort to bridge the economic gap between the five countries and to promote prosperity on a sustainable level. One of the main aims is to build partnerships to transform the border areas of the five members into zones of economic growth and social progress and achieve sustainable development through South-South cooperation.

All four countries are members of the **Association of Southeast Asian Nations (ASEAN)**. ASEAN was established in 1967 by Thailand, Malaysia, Singapore, the Philippines and Indonesia, joined by Vietnam in 1995, Laos in 1997 and Cambodia in 1999. Under the ASEAN Free Trade Agreement (AFTA), countries have committed to reducing tariffs to 0-5 percent by 2002/2003 (for Thailand), 2006 (for Vietnam), 2008 (for Laos) and 2010 (for Cambodia). Importantly, tariff reductions for self-designated 'sensitive' or 'highly sensitive' products will be delayed until 2010. This category was mainly included to cover sensitive agricultural products such as rice and sugar due to political resistance in the face of expected stiff competition from Thailand. These exceptions – combined with a small intra-regional market and significant overlaps in agricultural production – have meant that AFTA's impact on intra-regional agricultural trade has been and is likely to continue to be limited.

Bilateral trade relations with China and other Asian countries

China presents a huge market for Southeast Asian countries while China relies on the region to meet its growing demand for energy and raw materials. Since the late 1990s, China has greatly expanded its engagement with ASEAN countries through

increased investment, trade and aid. Eventually, China is expected to overtake the US, EU and Japan as ASEAN's main trading partner. Thailand already exports rice, sugar and rubber to China; and China receives two thirds of Vietnam's rubber exports. In contrast, agricultural trade with Laos and Cambodia is underdeveloped and China has stepped up efforts to increase investment and strengthen capacities to use agricultural technologies. Cambodia and Laos do indirectly export their rubber to China through Vietnam and Thailand where the raw materials are processed.

Trade relations will be further strengthened through the ASEAN-China Free Trade Area (ACFTA). Negotiations were launched in 2002 and are set to be implemented by 2010 for the original ASEAN members (including Thailand) and 2015 for more recent members (including Cambodia, Laos and Vietnam). Extended deadlines apply for 'sensitive' and 'highly sensitive' products. Unlike in ASEAN, agricultural trade liberalization has become a focus of early liberalization efforts between China and ASEAN countries; under the 'Early Harvest Programme' tariffs on around 600 unprocessed agricultural products were eliminated by January 2006. For the time being, sugar, rice and rubber are not included in the Programme.

ASEAN is also negotiating bilateral agreements with other countries. By 2012, trade deals with Japan, India, Australia, New Zealand, and South Korea are expected to be completed.

Most recently, in September 2007, **Vietnam** eliminated import duties on 40 types of unprocessed agricultural products from Cambodia and Laos, including cassava, sweet potato, cashew nuts, pepper, rice, corn, soybeans, peanut, castor beans, sesame, seaweed, sugarcane and raw rubber. Quotas will continue to apply for some products.

4. Looking ahead...

Where is agricultural expansion most likely to occur?

A number of provinces falling within the three ecoregions can be identified where sugar, rubber and rice cultivation is likely to expand most by 2010.

	Sugar	Rice	Rubber
Vietnam (by 2010)	Nghệ An (30,000 ha) Gia Lai (20,000 ha) Đắk Lắk (15,000 ha)	Nghệ An, Hà Tĩnh (18,000 ha) Đắk Nông, Lâm Đồng (12,000 ha) Quảng Bình, Gia Lai (11,000 ha)	Bình Phước (29,000 ha) Đắk Lắk (27,000 ha) Gia Lai (15,000 ha) Kon Tum (13,000 ha) Đắk Nông (10,000 ha)
Laos (by 2010)	Savannakhet (49,000 ha) Champasak (20,000 ha) Borikhamxai (19,000 ha)	Savannakhet (70,000 ha) Champasak (43,000 ha) Saravan (31,400 ha)	Champasak (27,000 ha) Savannakhet (15,000 ha)
Thailand (by 2010)	Limited area expansion.	Limited area expansion.	Mukdahan (93,240 ha) Yasothon (87,463 ha) Nakhon Panom (77,558 ha) Nong Bua Lampu (61,925 ha)
Cambodia	Stung Treng, Ratanakiri, Monduliri (others?)		

Values in brackets refer to estimated area expansion by 2010.

How significant are the different crops for the three ecoregions?

Rubber: Priority crop at the regional level

The area under rubber cultivation is expected to expand most significantly and/or rapidly within the three ecoregions. A substantial share of the production is being sold either directly or indirectly to the (growing) Chinese market. Rubber production and trade clearly has a regional dynamic, with the majority of rubber produced in Laos and Cambodia funded and exported by Thai, Chinese and Vietnamese crossborder companies for processing.

Sugarcane: Focus on Thai-Lao investment linkages

Laos is likely to see the greatest expansion in sugarcane cultivation among the four countries (by area), stimulated by investments from Thailand's largest sugar producer Mitr Phol (partly in joint venture with Tate & Lyle) which obtain their inputs through contract farming with small-scale producers.

Rice: Targeting small scale-farmers

In contrast to rubber and sugar, any expansion of rice areas in the ecoregions is likely to be driven by small-scale farmers. Continued population growth, migration and high poverty levels (notably in Cambodia and Laos, but also in some of the more remote regions of Vietnam and Thailand) will drive the expansion for house-

hold consumption.

Monitoring the expansion of other crops

Other crops are also likely to expand significantly (in some cases even more significantly than rice, rubber or sugar) in the three ecoregions, such as cashew, fruit and cocoa cultivation in Vietnam; maize, vegetable oil crops and coffee in Laos; and cassava and eucalyptus in Thailand.

What can be done?

Ensure transparent and legally compliant land allocation in Laos and Cambodia

- Effectively implement policies and regulations that should govern the allocation of land concessions in Laos and Cambodia, but are not often properly implemented.
- Collect specific data on the location, extent, use and ownership of land concessions, and their relationship to other land categories within the landscape.
- Re-connect landscapes through the integration of land use planning (LUP) approaches into development planning and policy.
- Analyse relative socio-economic and environmental benefits of land concessions compared to other potential land uses and revenue streams.
- Develop "green" model concession agreements where approval is conditioned on compliance with a specific set of recognized environmental and social standards.
- Promote the development and/or enforcement of good forest classification systems so that areas of ecological value and importance to rural livelihoods (e.g. Dry Forest) are not miscategorised as "degraded", "unused" or "underutilized" and then allocated for land concessions.

Promote the use of environmentally sustainable and socially equitable farming methods

- Carry out environmental and social impact assessments of large-scale agriculture projects to understand their likely effects and identify more sustainable alternatives.
- Encourage crossborder (regional) and foreign investors to support and implement internationally recognized better management practices for key commodities.
- Work with smallholders to encourage more sustainable farming methods and explore options for alternative livelihoods that reduce land conversion pressures.

Promote regional cooperation to manage the environmental impacts of agriculture

- Explore new and strengthen existing avenues for regional cooperation on environmental issues within the GMS, ASEAN and ACMECS processes.
- Explore opportunities for using regional mechanisms to conduct environmental

and social impact assessments of crossborder agricultural development, and to enhance the transparency of agricultural investment and trade.

Better understand threats and opportunities of biofuels across the region

- Monitor investment trends and assess possible impacts of biofuel crop cultivation.
- Develop regional (via the GMS) and national biofuel policies that include specific environmental and social criteria.
- Raise awareness among governments, the media and the general public on the pros and cons of biofuel production in the four countries.

Summary of production trends and drivers in the Mekong region

	Thailand	Vietnam	Cambodia	Laos
Current production	Large-scale production of sugar , rubber and rice mainly for export (but two-thirds of rice production is for local consumption) Share of rice in provinces of priority interest to WWF significant, while sugar and rubber still small	Rice the main agricultural crop (for food and export) Rapidly expanding production of sugar (for domestic use) and rubber (for export) Share of rubber in WWF provinces significant, while sugar and rice still small	Sugar production until recently for household consumption Rice the main agricultural crop (for subsistence) Rubber cultivation a new but growing trend Share of sugar , rice and rubber in WWF provinces small	Sugar rapidly increased recently, but still small Rubber cultivation a new but growing trend Rice the main agricultural crop (for subsistence) Share of rice in WWF provinces significant, while sugar and rubber still small
Likely expansion of sugar , rice and rubber in provinces of priority interest to WWF's regional programme	Sugarcane expansion absorbed by existing agricultural land Rice expansion limited Most significant expansion in rubber (although still only small share of total area of rubber cultivation nationwide)	Most significant expansion in rubber , followed by sugarcane Some rice expansion and contraction for domestic consumption	Sugarcane expansion more limited (although unclear) Rice expansion through migration Rubber expansion greatest	Most significant expansion in rice , followed by sugarcane Rubber expansion most rapid, but comparatively small area
Likely expansion of other crops in provinces of priority interest to WWF's regional programme	Cassava and eucalyptus already widespread Jatropha at an experimental stage	Mainly fruit trees and tea, also cocoa Coffee area expected to decrease, shift to high quality varieties No estimates for cashew available	Tree crops (teak and acacia), cassava (minor) and cashew (unclear) Country-wide expansion of Jatropha	Mainly maize expansion Also coffee , vegetable oil crops and cassava

Summary of production trends and drivers in the Mekong region (con't)

	Thailand	Vietnam	Cambodia	Laos
Environmental threats	<p>Logging ban since 1989 (although forest deterioration continues)</p> <p>Sugarcane mainly grown on existing farm-land, but dislocation of landless farmers might threaten protected areas</p> <p>Switching to sugarcane can increase pressure on water resources</p> <p>Forest clearance for rubber unlikely due to lack of secure land tenure that encourages long-term investments</p> <p>Limited rice area expansion due to water shortages, protected area encroachment esp. by poor farmers a threat</p> <p>Shift to high quality rice varieties could reduce conversion pressure but also increase soil and water contamination</p> <p>Plans for large-scale water diversion from the Mekong to Irrigate Northeast</p>	<p>Sugarcane mainly grown on existing farm-land, but land conversion remains a concern</p> <p>Switching to sugarcane can increase pressure on water resources</p> <p>Increasingly moving away from shifting cultivation for rice, thereby lessening impacts</p> <p>Shift to high quality rice varieties could reduce conversion pressure (due to higher productivity per ha) but also increase soil and water contamination</p> <p>Encroachment of protected area driven by rapid population growth</p>	<p>Home to some of the most diverse dry forest areas</p> <p>Encroachment into protected areas a serious concern</p> <p>Uncontrolled and unmonitored land clearance for subsistence rice production by migrants</p> <p>Increased pressure on water resource in particular from rice and sugarcane expansion</p> <p>Widespread illegal logging</p> <p>Little consideration of environmental impacts from land concession allocation</p>	<p>Large majority of protected areas located in provinces with largest agricultural expansion</p> <p>Encroachment into protected areas a serious concern</p> <p>Threat of land conversion for rice from large number of poor villages located near protected areas</p> <p>Shifting upland rice cultivation discouraged, but still source of land clearance</p> <p>Increased pressure on water resource in particular from rice and sugarcane expansion</p> <p>Little consideration of environmental impacts from land concession allocation</p>

Summary of production trends and drivers in the Mekong region (con't)

	Thailand	Vietnam	Cambodia	Laos
Domestic policies	<p>Emphasis on domestic value addition for exported products; poverty reduction and organic agriculture</p>	<p>Emphasis on domestic value addition and industrialization</p>	<p>Emphasis on poverty reduction (incl. employment creation, value addition, diversification of export products and markets)</p> <p>Land allocation practices likely to have most significant impact</p>	<p>Emphasis on poverty reduction (incl. employment creation, value addition, export diversification) and organic agriculture</p> <p>Land allocation practices likely to have most significant impact</p>
Investment trends for production and processing	<p>World's leading exporter of organic rice but ranks very low globally for overall organic production of all other crops</p> <p>Well-developed processing industry</p> <p>Investment in new sugar processing factories unlikely</p> <p>No estimates for rice available</p> <p>Emphasis on higher-end rubber products</p> <p>Investment for rubber (cultivation) and sugar (cultivation and some processing) in Cambodia and Laos</p> <p>Existing multinational investment in sugar (e.g. Cargill)</p> <p>Thai companies are becoming regional multinationals (e.g. Mitr Phol, CP)</p>	<p>Well-developed processing industry</p> <p>Investment in new sugar processing factories unlikely</p> <p>Existing multinational investment in sugar (e.g. Tale & Lyle, Bourbon)</p> <p>Some investments in rice processing</p> <p>Emphasis on value addition in rubber (incl. higher-end rubber products) and investment in new processing factories (incl. in the priority provinces)</p> <p>Investment for rubber (cultivation) in Cambodia and Laos</p>	<p>Under-developed processing industry</p> <p>Overseas investment for rubber (mainly Vietnam, others unclear) and sugar (mainly Thailand, Tale & Lyle, others unclear)</p> <p>No estimates for rice available</p>	<p>Under-developed processing industry</p> <p>Overseas investment for rubber (mainly China, Thailand and Vietnam) and sugar (mainly Thailand)</p> <p>Planned upgrading of some rice mills</p>

Summary of production trends and drivers in the Mekong region (con't)

	Thailand	Vietnam	Cambodia	Laos
Key players in the supply chain	<p>Sugar</p> <ul style="list-style-type: none"> Large-scale sugar factories Private exporters (all Thai-registered) <p>Rice</p> <ul style="list-style-type: none"> Large-scale rice millers Private exporters (all Thai-registered) <p>Rubber</p> <ul style="list-style-type: none"> Private exporters (esp. members of the Thai Rubber Association) 	<p>Sugar</p> <ul style="list-style-type: none"> Sugar factories (mostly state-owned until recently) Traders (linking farmers and sugar mills) <p>Rice</p> <ul style="list-style-type: none"> Large-scale rice millers State-run exporters (for overseas exports) Private traders (for domestic trade) <p>Rubber</p> <ul style="list-style-type: none"> State-owned companies (cultivation and export) 	<p>Sugar</p> <ul style="list-style-type: none"> Foreign-owned planned sugar factory Domestic and foreign traders (mainly for informal trade) <p>Rice</p> <ul style="list-style-type: none"> Rice millers (esp. commercial mills although only few) Collectors (linking farmers and mills) <p>Rubber</p> <ul style="list-style-type: none"> State-run companies, but role of private (mainly foreign-funded) companies growing Vietnamese buyers 	<p>Sugar</p> <ul style="list-style-type: none"> Foreign-owned existing and planned sugar factories Domestic and foreign traders (mainly for informal trade) <p>Rice</p> <ul style="list-style-type: none"> State Enterprise for Food and Crop Promotion (commercial trade which is still small) Rice millers (esp. commercial mills although only few) <p>Rubber</p> <ul style="list-style-type: none"> Cross-border companies (mainly China, Thailand and Vietnam)
<p>Participation in international trade</p> <p>Source: FAO STAT, accessed November 2008</p>	<p>Third largest sugar exporter mainly to Asia (98% of exports); 60-70 percent of production exported</p> <p>Largest rice exporter mainly to Africa (37%) and increasingly Asia (28%) esp. China (almost 50% of Asia); over a third of production exported</p> <p>Largest rubber exporter mainly to Asia (esp. China 27%), also Japan and India; most of the production exported</p>	<p>Sugar production mainly for domestic use, some exports to China, Singapore and the Philippines</p> <p>Fifth largest rice exporter mainly Asia (52%), Europe (20%) and the Middle East (13%); ca. 10% of production exported</p> <p>Fourth largest exporter of rubber mainly to China (ca. two thirds) as well as Korea, Germany, Taiwan, Russia and USA; 85-90 percent of production exported</p>	<p>Sugar exports small and largely informal, official exports set to increase somewhat</p> <p>Official rice exports small (mainly to the EU), more significant informal exports to Vietnam and Thailand</p> <p>Rubber production exported to Vietnam (minimally processed)</p>	<p>Most of the sugar production exported to China, exports to China, Thailand and the EU expected to increase</p> <p>Official rice exports small (mainly the EU and North America), more significant informal exports to China, Thailand and Vietnam; around 10 percent of production exported</p> <p>Raw natural rubber exported to investor countries (mainly China, Thailand and Vietnam) for processing</p>

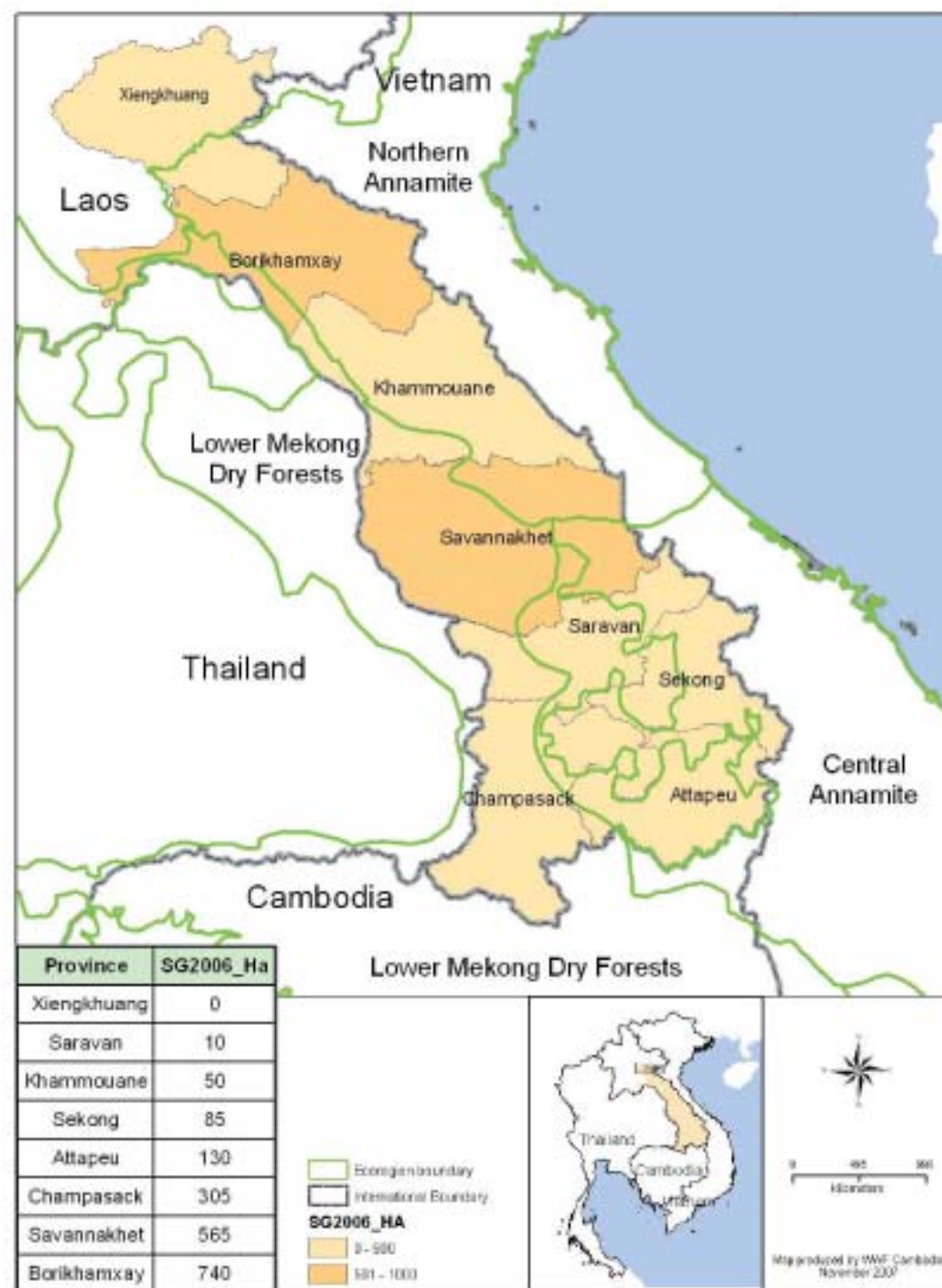
Summary of production trends and drivers in the Mekong region (con't)

	Thailand	Vietnam	Cambodia	Laos
Economic integration	<p>Could benefit from expected removal of (some) market distortions in sugar (e.g. EU sugar reform which will lead to production decreases in the EU)</p> <p>Rice exports expected to increase by 29 percent (despite remaining market distortions)</p> <p>Expected to benefit from continuously growing rubber demand, esp. China as well as EU and India</p>	<p>Sugar production mainly for domestic use, some exports to China, Singapore and the Philippines</p> <p>Fifth largest rice exporter mainly Asia (52%), Europe (20%) and the Middle East (13%); ca. 10% of production exported</p> <p>Fourth largest exporter of rubber mainly to China (ca. two thirds) as well as Korea, Germany, Taiwan, Russia and USA; 85-90 percent of production exported</p>	<p>Sugar exports small and largely informal, official exports set to increase somewhat</p> <p>Official rice exports small (mainly to the EU), more significant informal exports to Vietnam and Thailand</p> <p>Rubber production exported to Vietnam (minimally processed)</p>	<p>Most of the sugar production exported to China, exports to China, Thailand and the EU expected to increase</p> <p>Official rice exports small (mainly the EU and North America), more significant informal exports to China, Thailand and Vietnam; around 10 percent of production exported</p> <p>Raw natural rubber exported to investor countries (mainly China, Thailand and Vietnam) for processing</p>
Commodity prices	<p>Could benefit from expected increases in sugar prices (resulting from domestic reforms, e.g. EU sugar policy, and diversion of sugar to ethanol production esp. in Brazil)</p> <p>Could benefit from expected (marginal) increases in rice prices</p> <p>Could benefit from potentially significant increases in rubber prices (until 2011/2012)</p>	<p>Rice exports expected to increase by 29 percent (despite remaining market distortions)</p> <p>Expected to benefit from continuously growing rubber demand, esp. China as well as EU and India</p>	<p>Duty-free export to Vietnam for 40 unprocessed agricultural products (including rice, rubber and sugar)</p> <p>Duty-free export of rubber, sugar (as of July 2009) and rice (as of September 2009) to the EU</p> <p>Could benefit from EU sugar reform through increased exports to the EU (as domestic production decreases)</p>	<p>Duty-free export to Vietnam for 40 unprocessed agricultural products (including rice, rubber and sugar)</p> <p>Duty-free export of rubber, sugar (as of July 2009) and rice (as of September 2009) to the EU</p> <p>Could benefit from EU sugar reform through increased exports to the EU (as domestic production decreases)</p>

Summary of production trends and drivers in the Mekong region (con't)

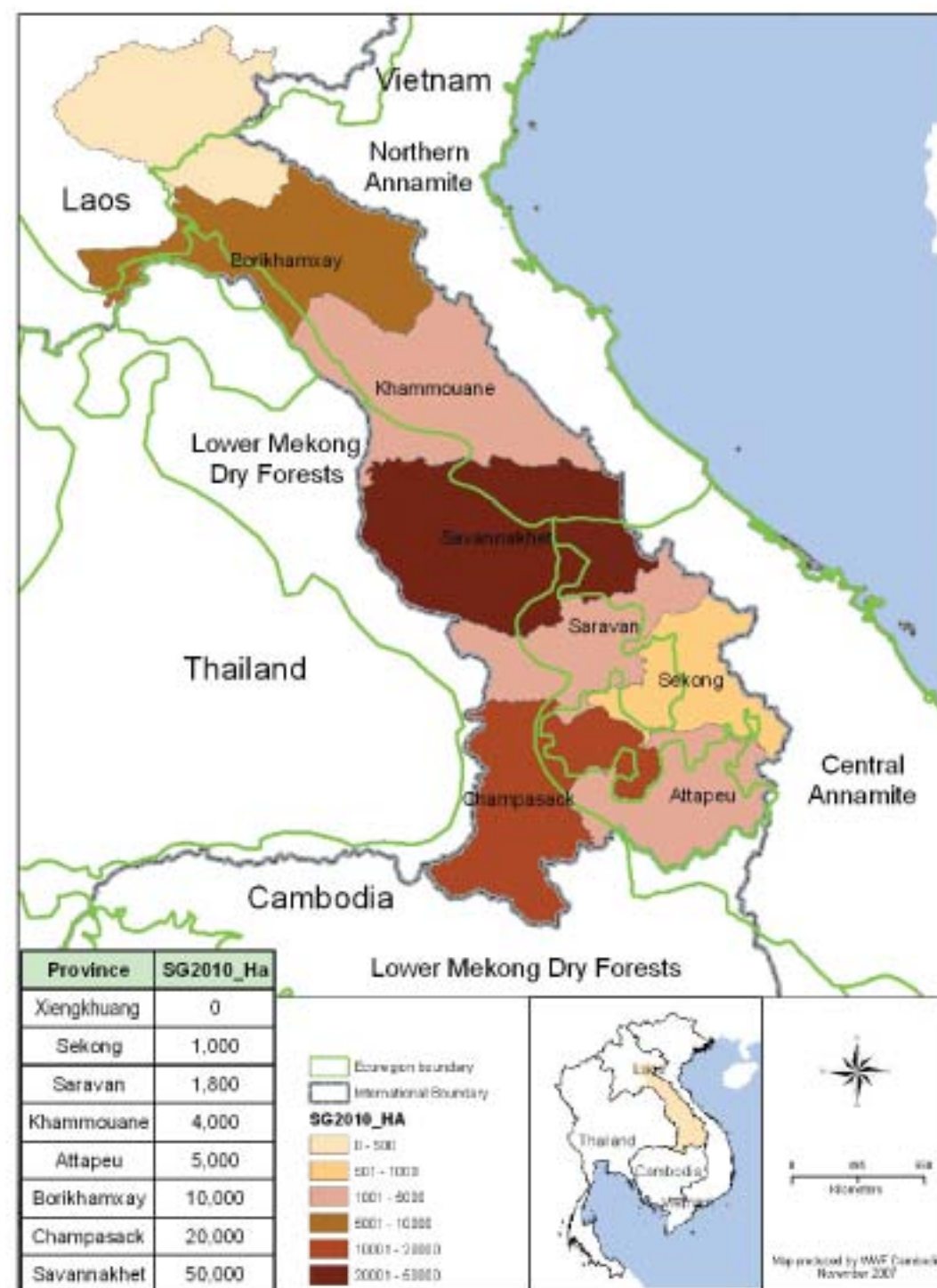
	Thailand	Vietnam	Cambodia	Laos
Biofuels	<p>Significant development of bioethanol (mainly sugarcane, others such as cassava) although market uncertainty has deterred investors</p> <p>Ethanol input demand stimulated investment in sugarcane production in Laos</p> <p>Significant development of biodiesel (mainly from palm oil, jatropha)</p>	<p>Government efforts to promote biofuels (bioethanol and biodiesel), incl. from sugarcane, cassava and jatropha</p> <p>Governments plans for 1 million ha of jatropha</p>	<p>Government efforts to promote biofuel investment</p> <p>Rapidly growing interest among foreign investors to grow biofuel crops (esp. jatropha and sugarcane)</p>	<p>Government efforts to reduce fossil fuel imports</p> <p>Rapidly growing interest among foreign investors to grow biofuel crops (possibly maize, soybean, sugarcane, jatropha and cassava)</p>

Map 3. Sugarcane Production 2006 by province in Laos



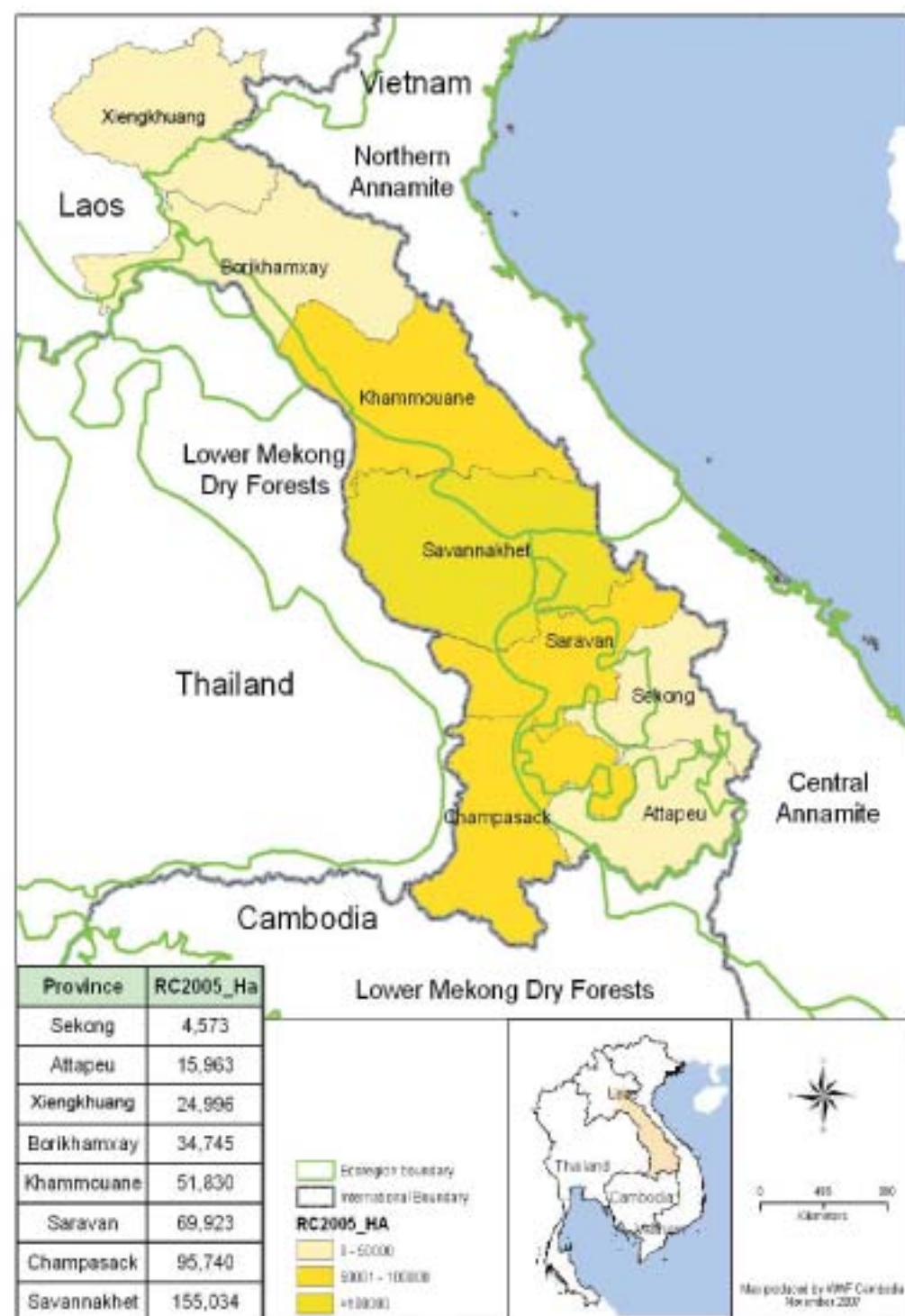
Note: SG - Sugarcane production, RB - Rubber production, RC - Rice production

Map 4. Sugarcane Production 2010 by province in Laos

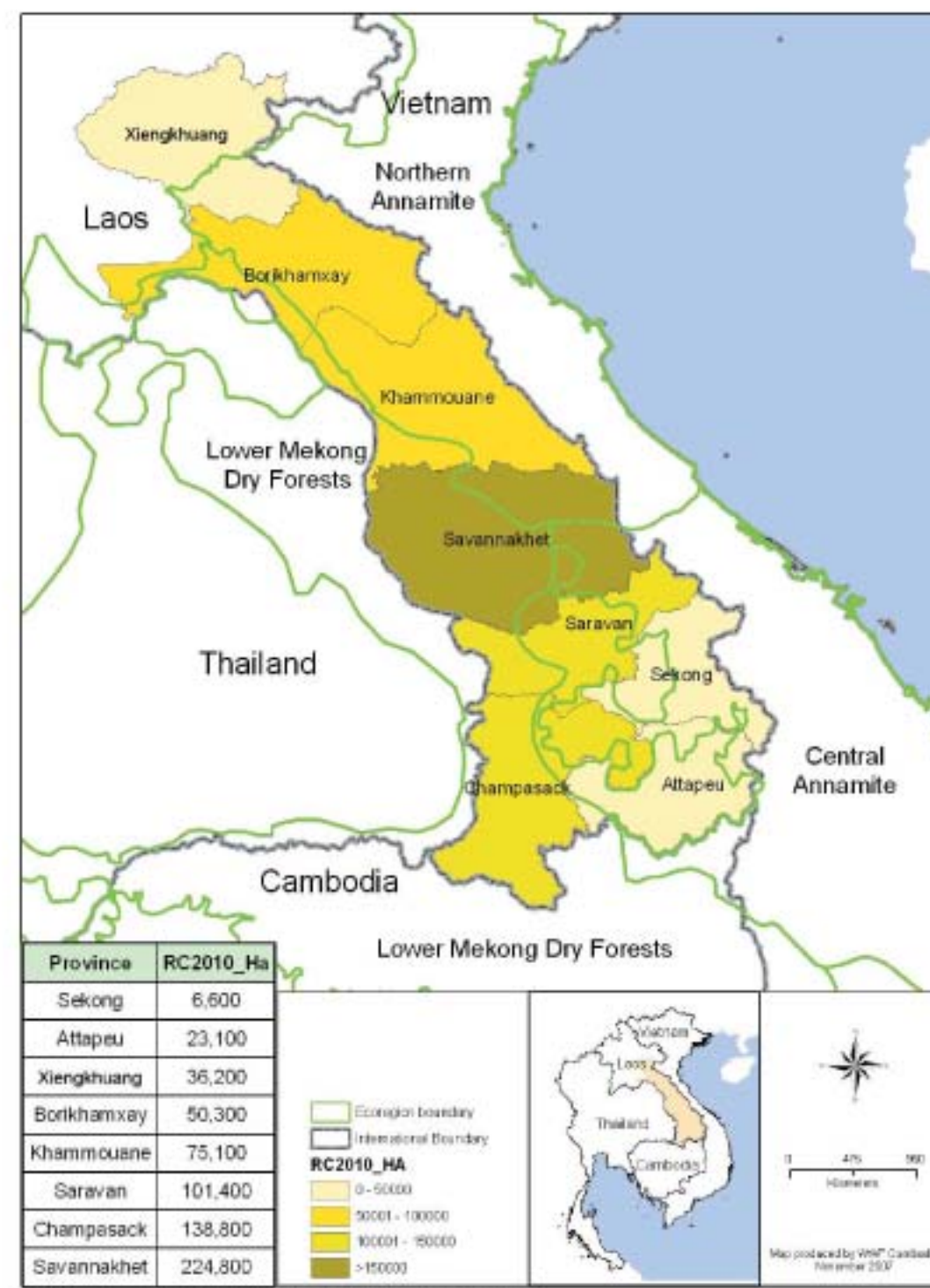


Note: SG - Sugarcane production, RB - Rubber production, RC - Rice production

Map 5. Rice Production 2005 by province in Laos



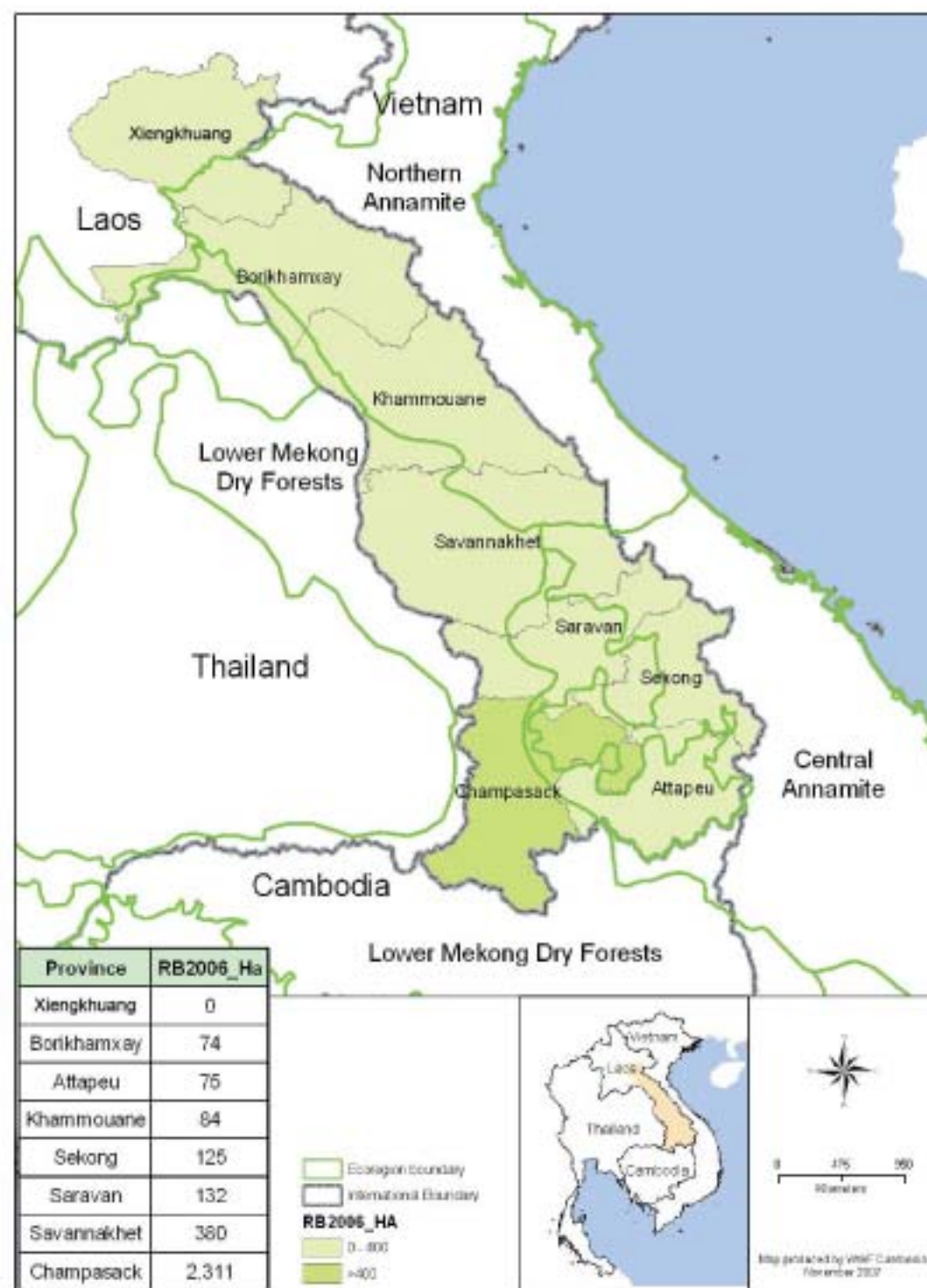
Map 6. Rice Production 2010 by province in Laos



Note: SG - Sugarcane production, RB - Rubber production, RC - Rice production

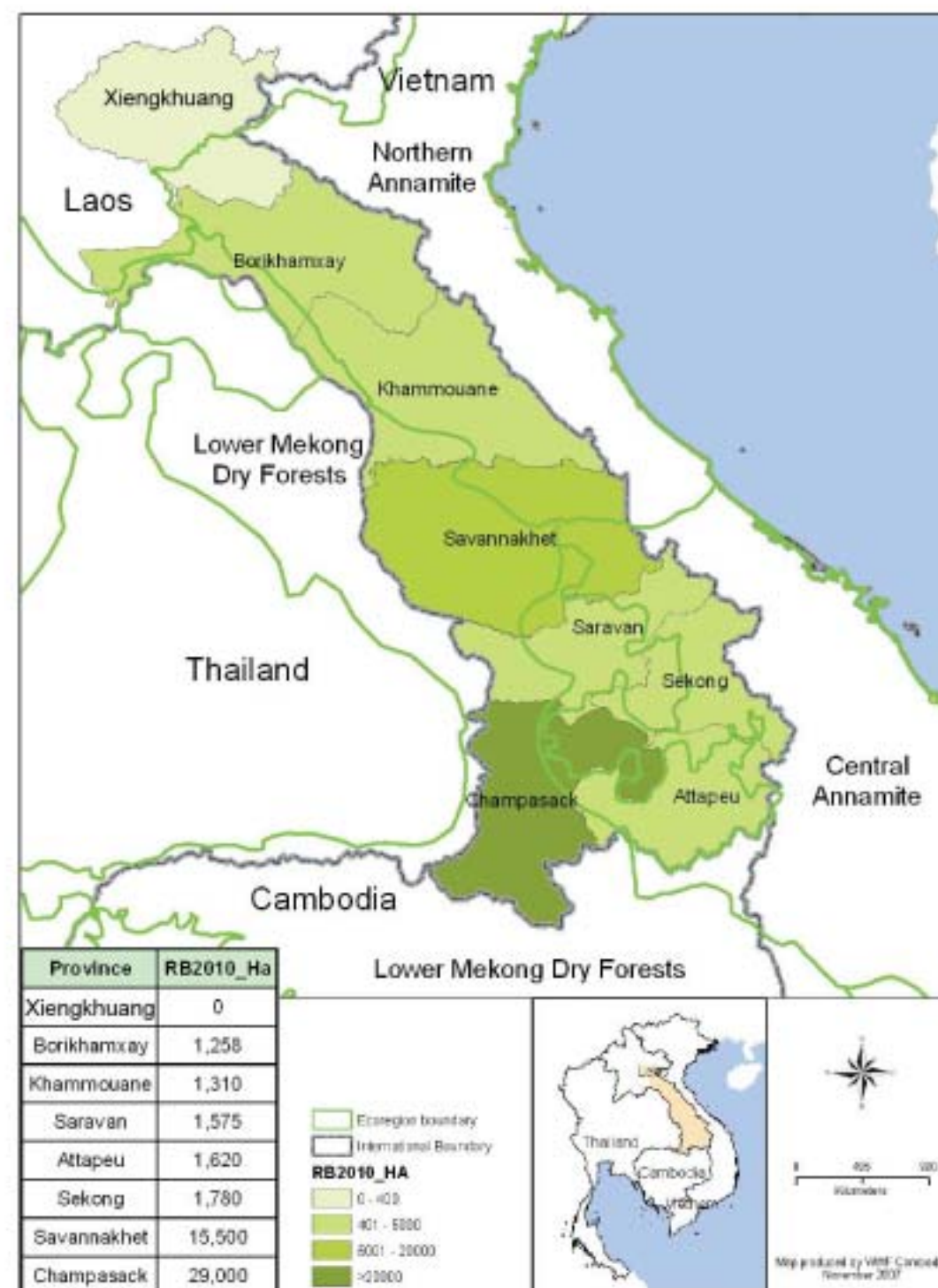
Note: SG - Sugarcane production, RB - Rubber production, RC - Rice production

Map 7. Rubber Production 2006 by province in Laos



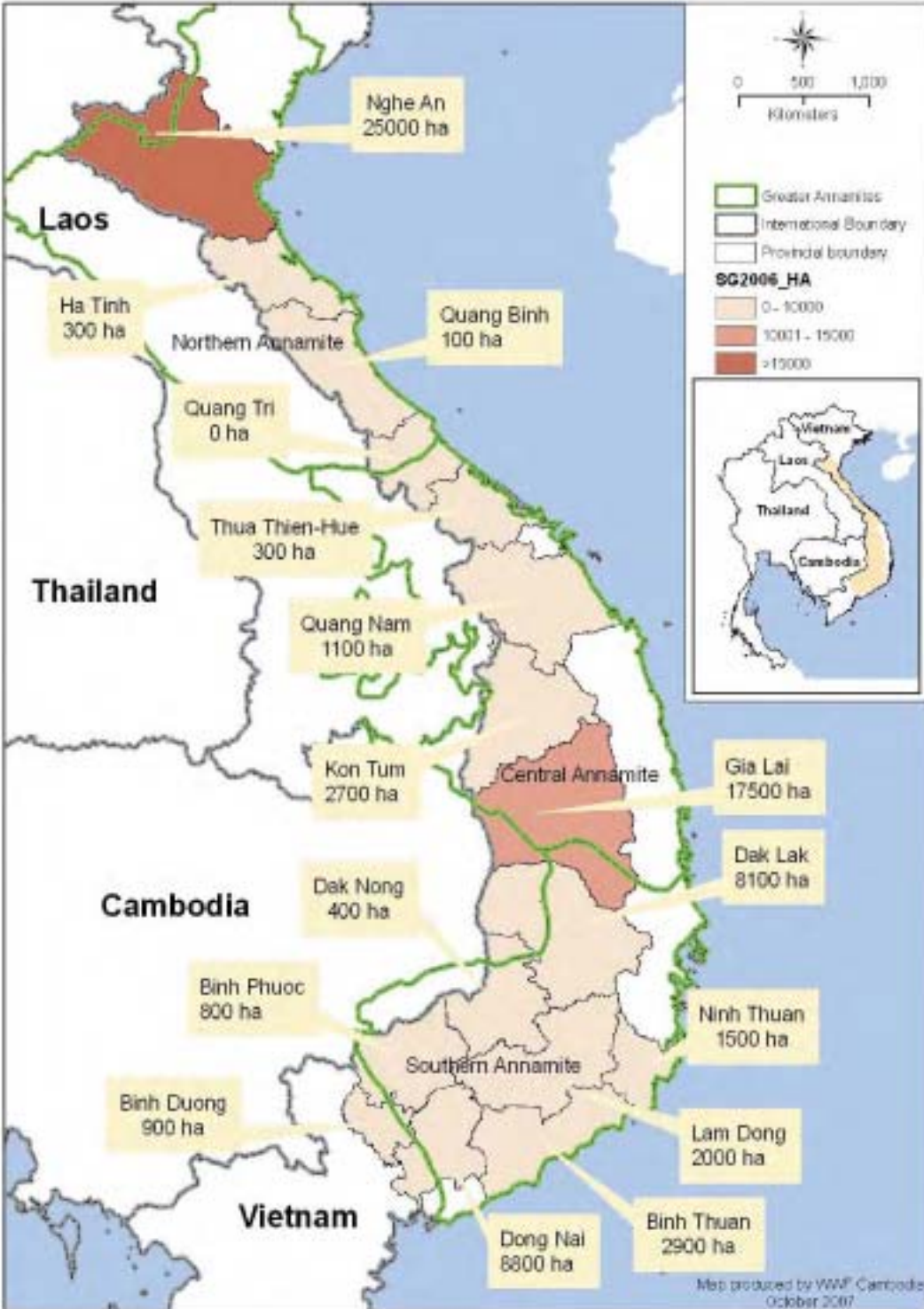
Note: SG - Sugarcane production, RB - Rubber production, RC - Rice production

Map 8. Rubber Production 2010 by province in Laos



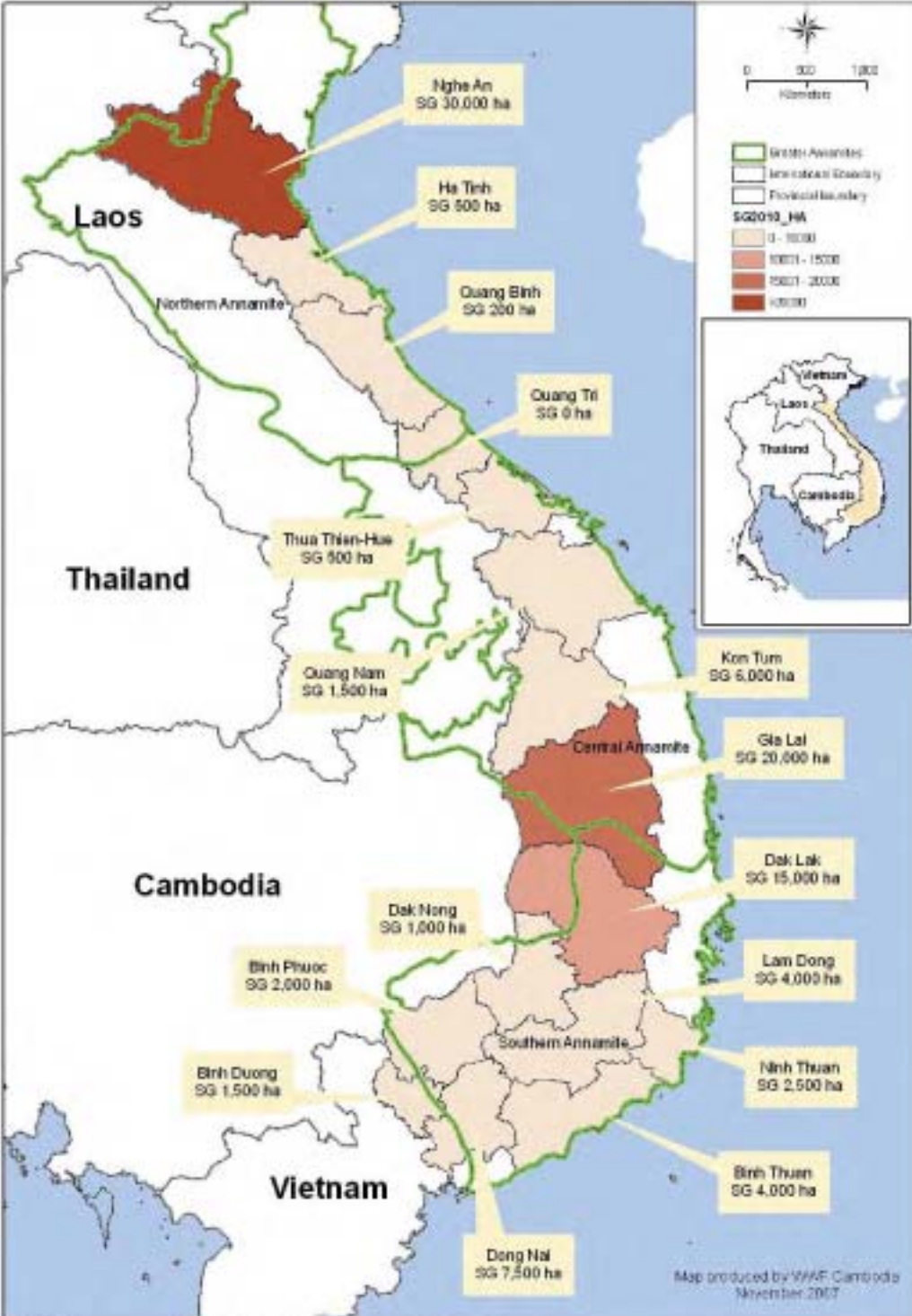
Note: SG - Sugarcane production, RB - Rubber production, RC - Rice production

Map 9. Sugarcane Production 2006 by province in Vietnam



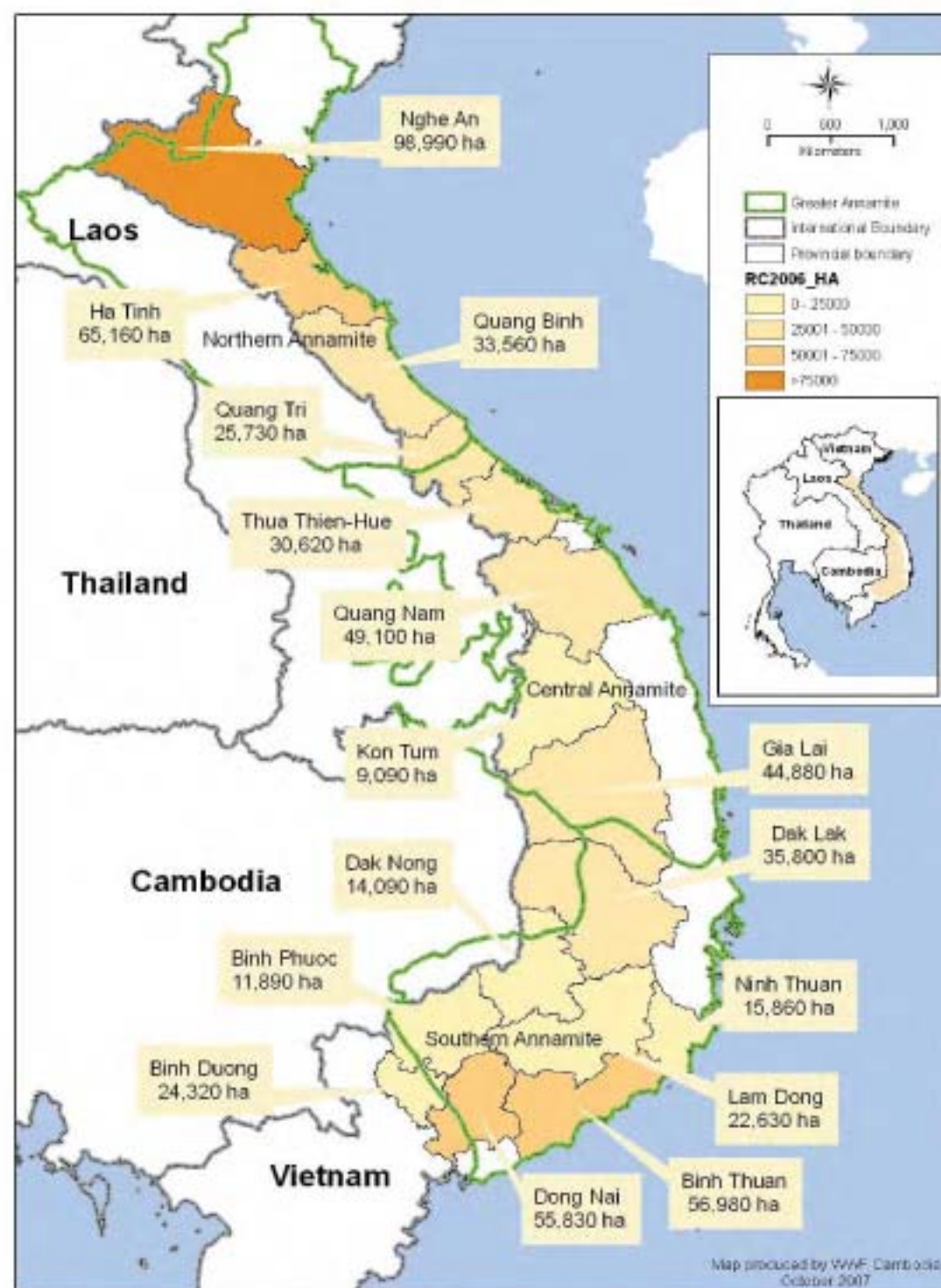
Note: SG - Sugarcane production, RB - Rubber production, RC - Rice production

Map 10. Sugarcane Production 2010 by province in Vietnam



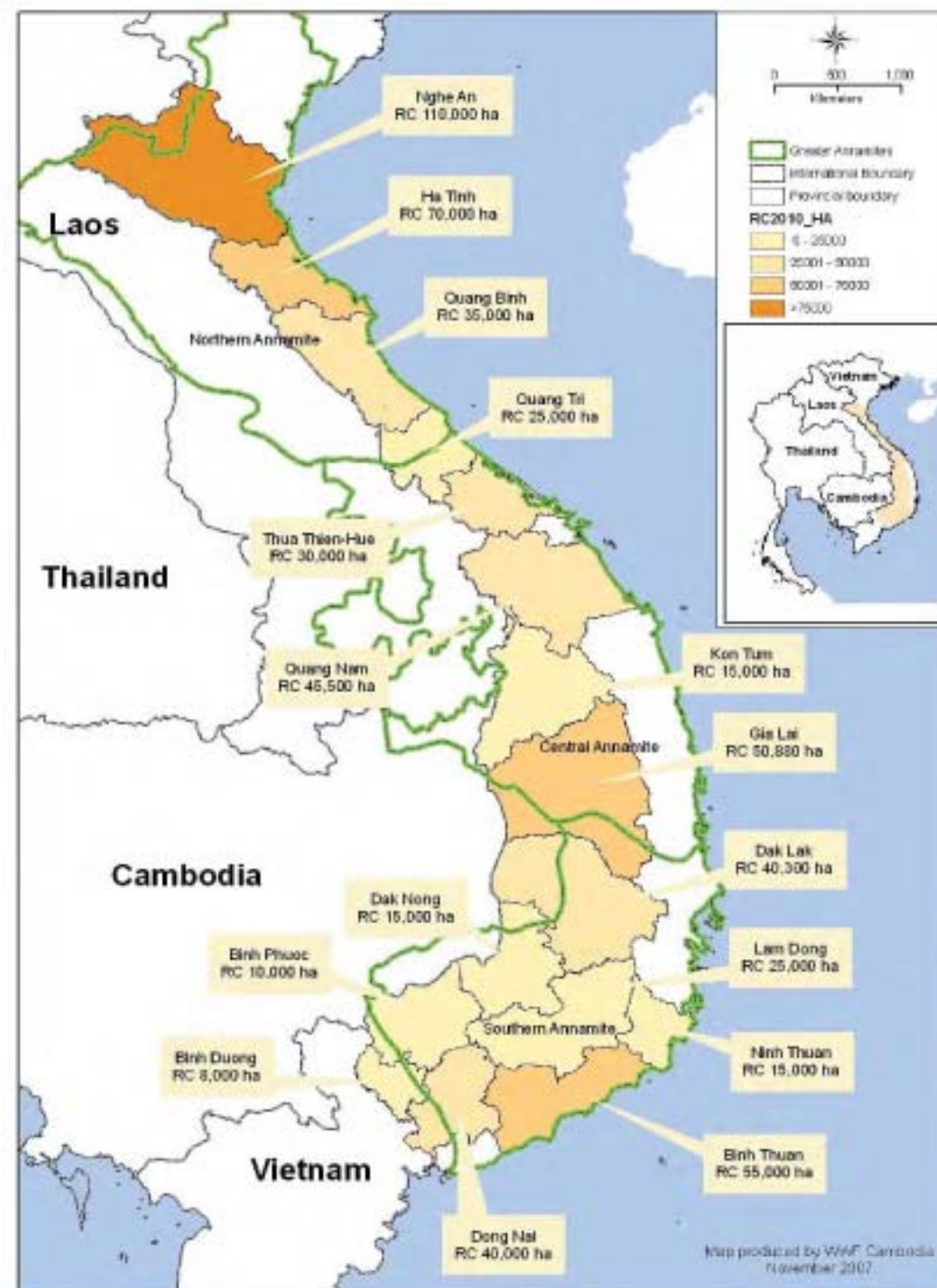
Note: SG - Sugarcane production, RB - Rubber production, RC - Rice production

Map 11. Rice Production 2006 by province in Vietnam



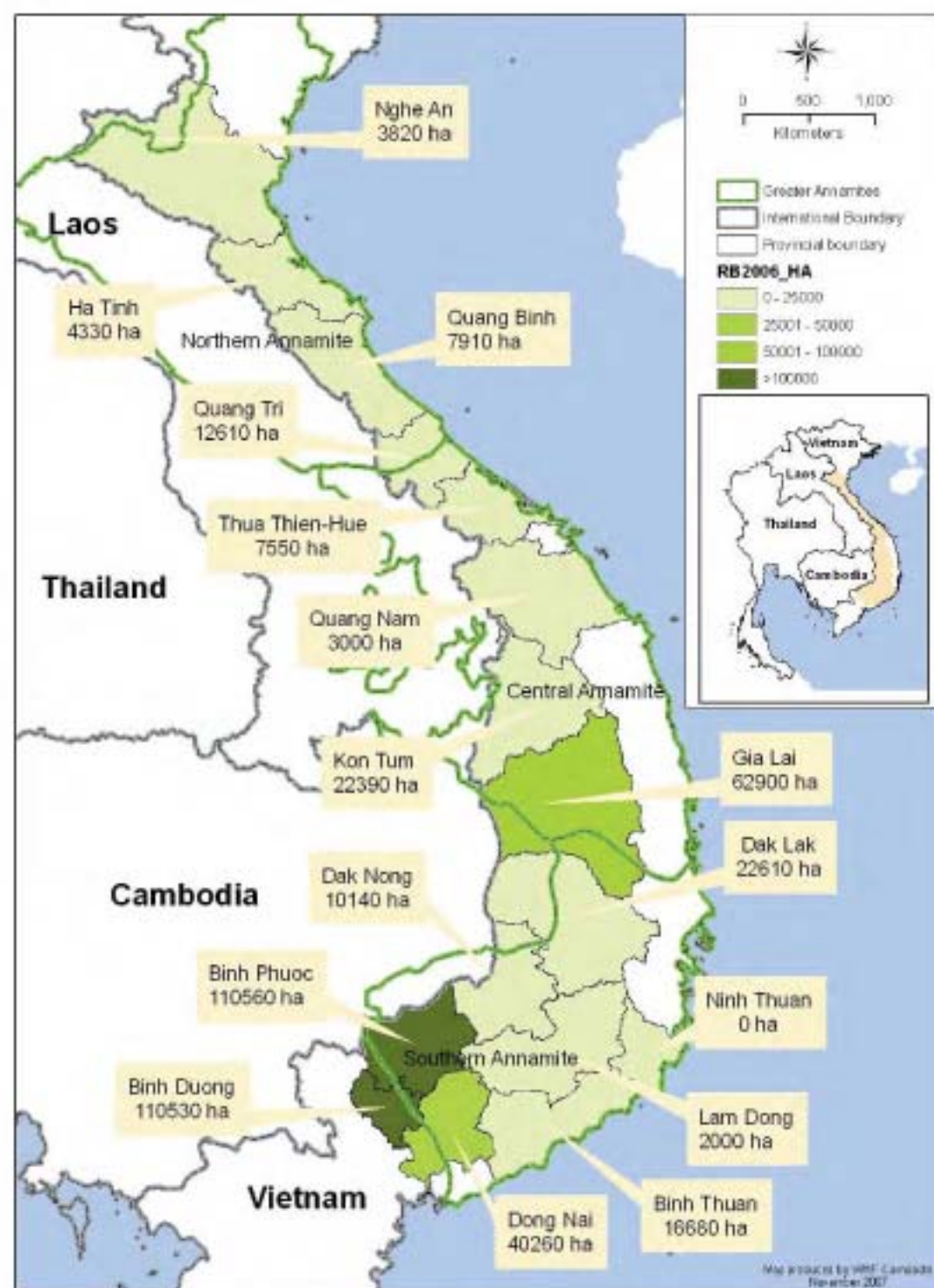
Note: SG = Sugarcane production, RB = Rubber production, RC = Rice production

Map 12. Rice Production 2010 by province in Vietnam



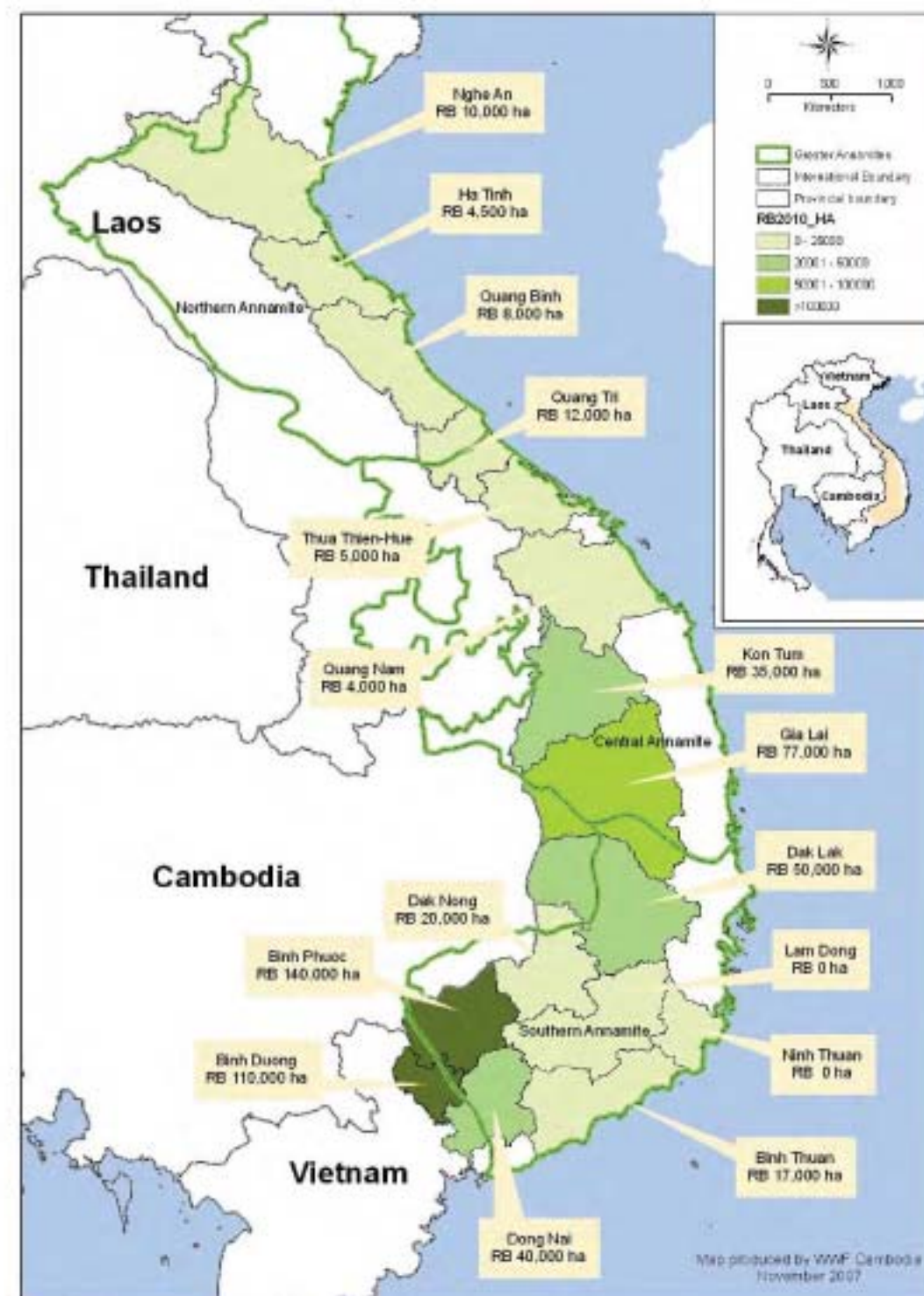
Note: SG = Sugarcane production, RB = Rubber production, RC = Rice production

Map 13. Rubber Production 2006 by province in Vietnam



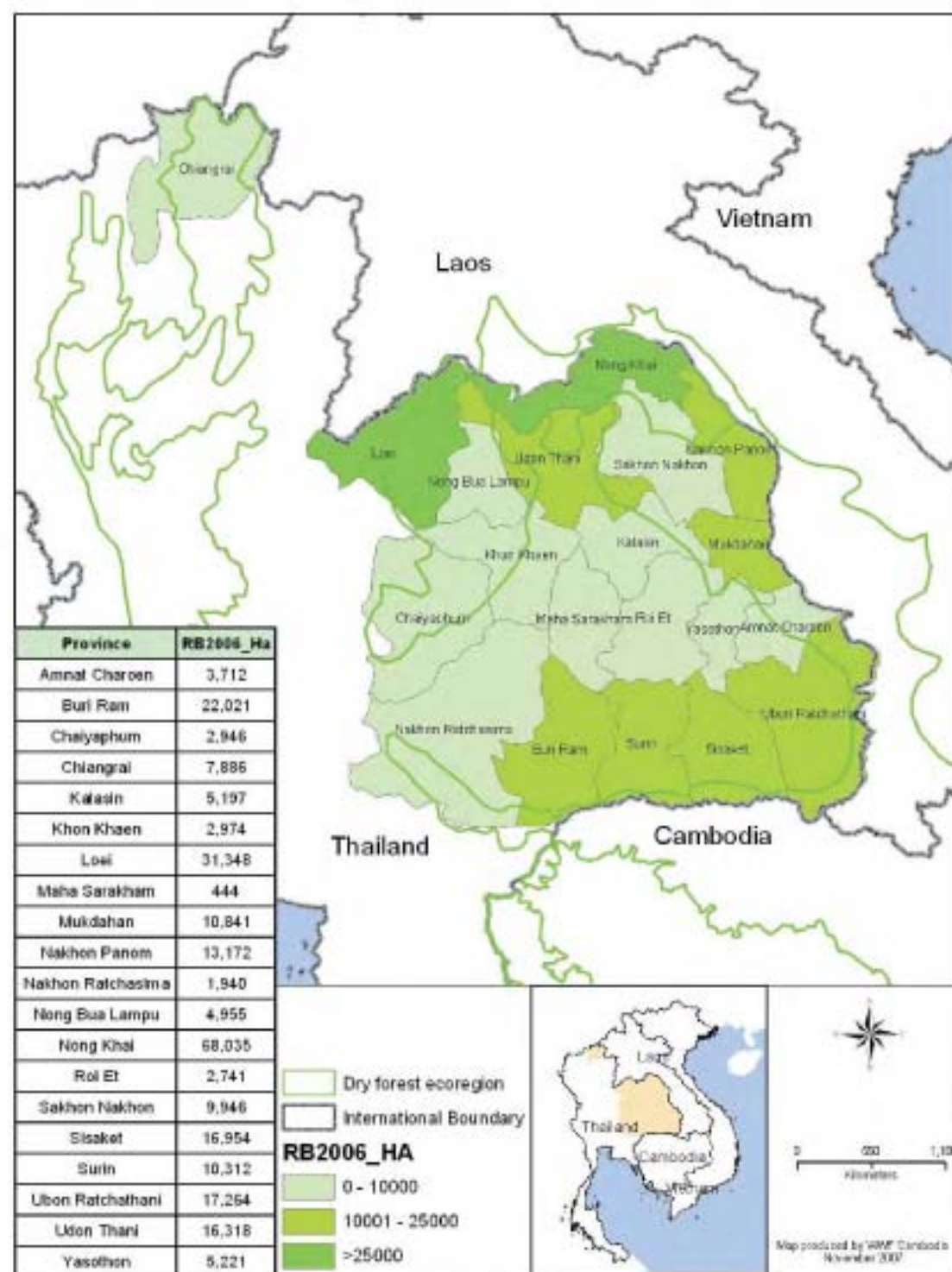
Note: SG - Sugarcane production, RB - Rubber production, RC - Rice production

Map 14. Rubber Production 2010 by province in Vietnam



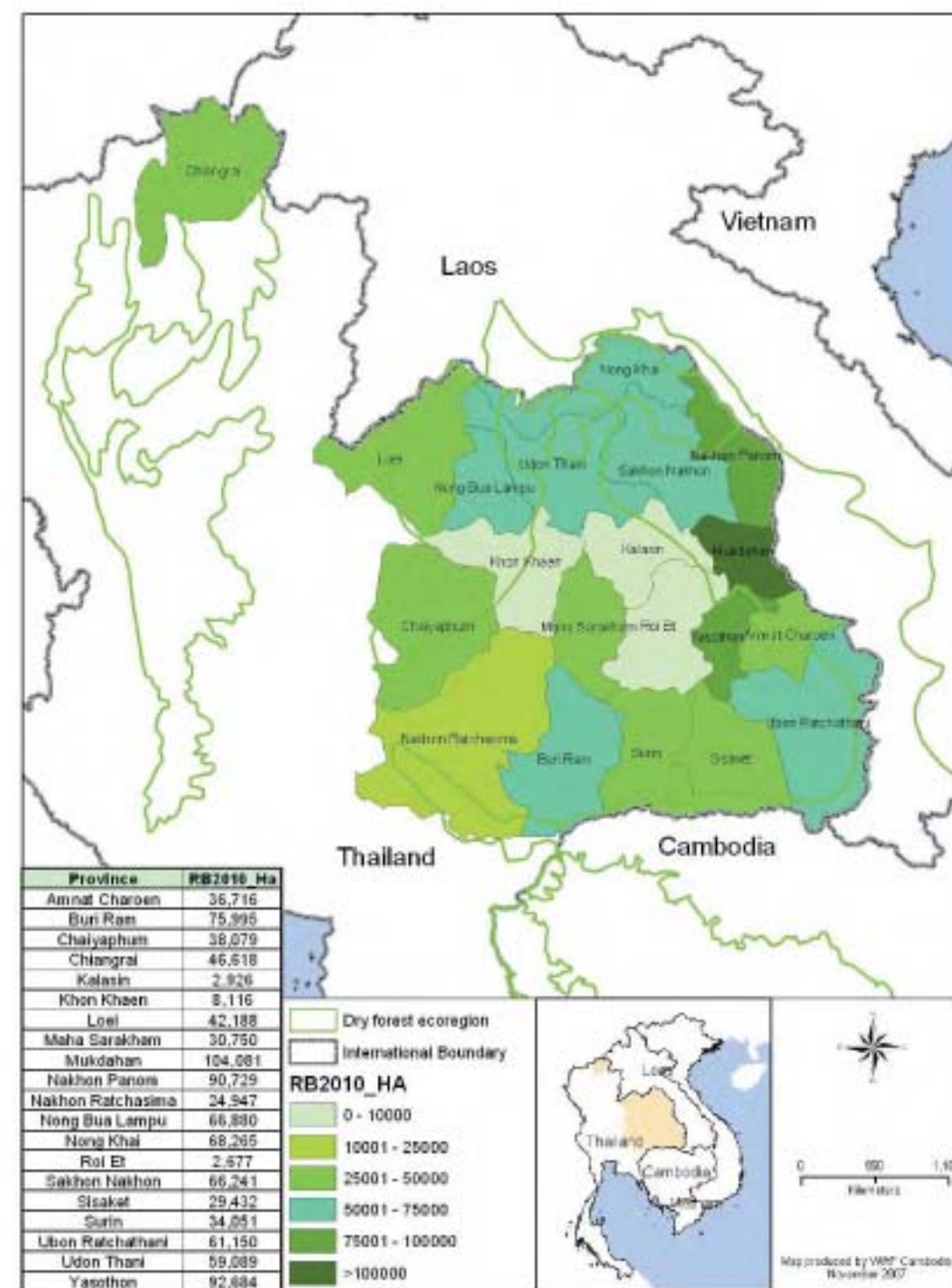
Note: SG - Sugarcane production, RB - Rubber production, RC - Rice production

Map 15. Rubber Production 2006 by province in Thailand



Note: SG = Sugarcane production, RB = Rubber production, RC = Rice production

Map 16. Rubber Production 2010 by province in Thailand



Note: SG = Sugarcane production, RB = Rubber production, RC = Rice production