

CHAPTER 3

SUGARCANE FIELD OPEN BURNING IN THAILAND

Thailand is the fourth world producer of sugarcane with about 1.26 million hectares of harvested area, and the cultivation of sugarcane has extended during the last decades to serve the energy need of the country. Sugarcane field burning is still a common practice in supporting production intensification, especially during the harvesting season from November to April. This corresponds also to the period when the Northern part of the country generally faces the problem of haze pollution from biomass open burning. To assess the contribution of sugarcane field burning to air pollution in Thailand, an air pollutants emissions estimate is required. However, country-specific factors involved in the calculation using IPCC 2006 Guidelines for National GHG Inventory are still missing for the case of Thailand. In this regard, one of the major outcomes of this study would be to provide a better understanding of factors that influence the emission of air pollutants and climate forcer agents from biomass open burning for Thailand. This chapter aims to assess the area of sugarcane burned on a regional basis, which is one of the key factors to evaluate the resulting emissions. The assessment methods is based on a bottom-up approach using a questionnaire survey that was specifically designed to collect primary data from farmers on sugarcane cultivation and particularly open burning practices.

3.1 Methodology

3.1.1 Description of sampling sites

To assess the sugarcane field burned areas in Thailand, a questionnaire survey was conducted with the objective of evaluating the actual area of sugarcane open burned in Thailand. Based on this bottom-up approach, the number of areas to be sampled to conduct the survey, i.e. the sampling size, was estimated based on the overall area of sugarcane plantation subject to open burning, i.e. the population size, following Equation 3.1 (Yamane, 1967). For this study a 95% confidence level and 5% precision was selected.

$$n_0 = \frac{N}{1 + N(e^2)} \quad (3.1)$$

where, “ n_0 ” refers to the sampling size, “ N ” refers to the population size 1,259,240 ha of sugarcane planted areas in year 2011, and “ e ” refers to the desired level of precision (0.05).

Based on Equation 1, the sample size for the questionnaire survey was determined to be 399 samples. Taking into account that some unexpected issues may occur with the questionnaire survey, an extra 5% was added to the sampling size. Thus, the total sampling size was calculated to be 419 samples.

Regarding the sugarcane plantation system in Thailand, the crop is typically grown by replanting part of a mature cane stalk. It has to be replanted approximately after 2-3 harvests when grown under rain-fed conditions. In terms of sugarcane production cycles, the plant-cane cycle starts with planting and ends after the first harvest. The ratoon-cane cycle, regenerative vegetative, starts after the harvest of the plant cane and continues with successive ratoon crops until field renewal (Cheavegatti-Gianotto et al., 2011).

As sugarcane open burning is a common practice in Thailand, its occurrence and magnitude was assessed using a questionnaire survey specifically designed for this study. The selection of the locations for the questionnaire survey was based on the spatial distribution of sugarcane field burning reported for the year 2005 by the Pollution Control Department (PCD, 2006) and the amount of burned cane from each factory reported for the year 2011 by the Office of Cane and Sugar Board (OCSB, 2013). Also, the size of sugarcane plantations (cultivation areas) in each district was used to select the areas where to perform the questionnaire survey. Based on this information, data was collected from 22 provinces in 3 different regions of Thailand, including 6 provinces in the Northern region, including Nakhon Sawan, Uttaradit, Phichit, Kampaeng Phet, Uthai Thani, and Phitsanulok; 8 provinces in the Northeastern region, including Chaiyaphum, Karasin, Buriram, Udon Thani, Mahasarakham, Loei, Khon Kaen, and Nakhon Ratchasima; and 8 provinces in the Central region, including Lop Buri, Chainat, Sa Kaeo, Chachoengsao, Nakhonpathom, Kanchanaburi, Suphanburi, and Ratchaburi (Fig. 3.1).

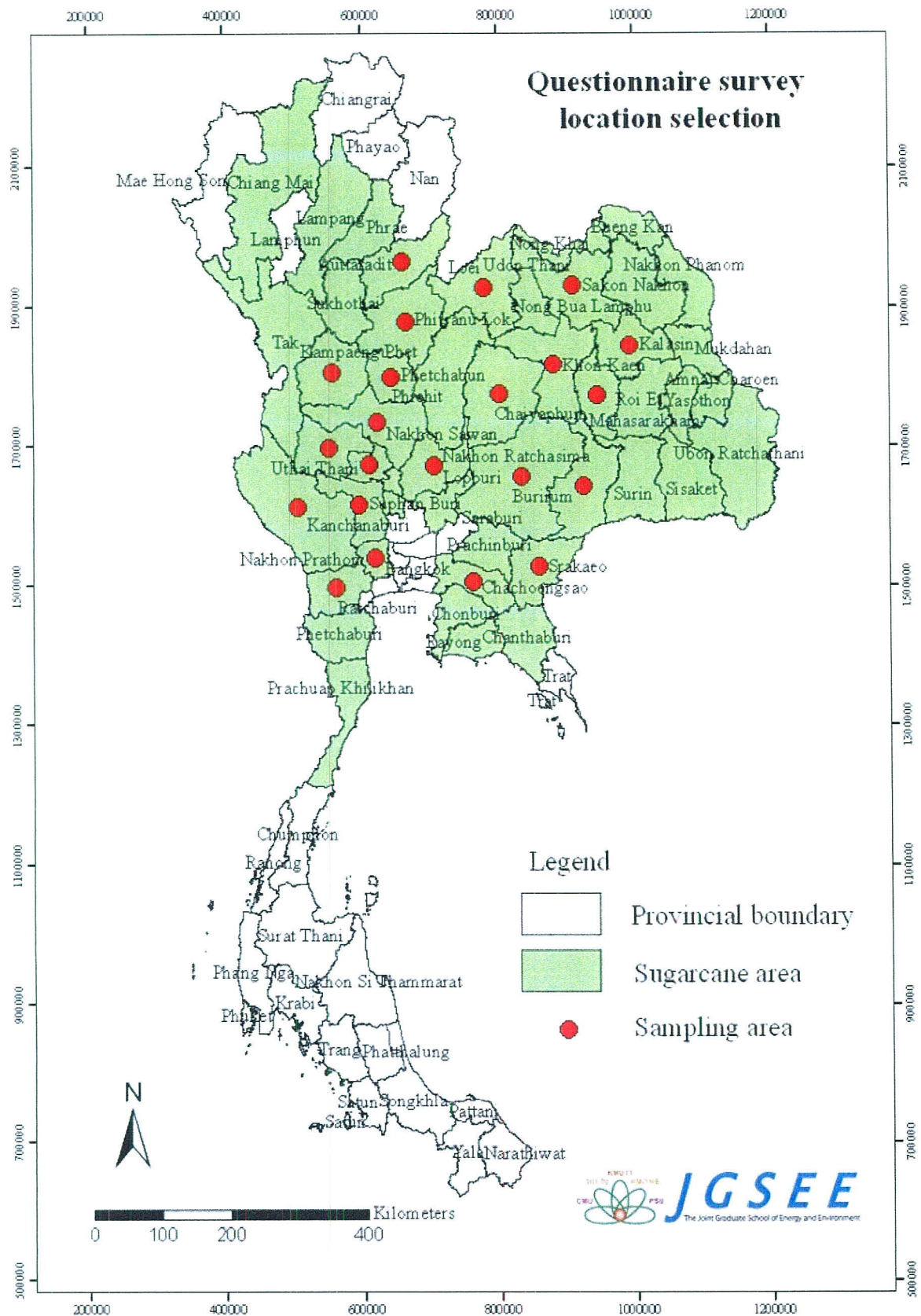


Figure 3.1 Study area for questionnaire survey

3.1.2 Questionnaire design

This study used a questionnaire as a tool to investigate the fraction of sugarcane plantation subject to open burning. The questionnaire was specifically designed to collect primary data from farmers on sugarcane cultivation, in particular, on the open burning practices. The content of the questionnaire is detailed in sugarcane field open burning as follows.

(1) Background information of interviewees including names, addresses, and contact numbers;

(2) Location of sugarcane field sites;

(3) The size of a farmer's field for sugarcane harvested areas. The total areas of plant crop and ratoon crop;

(4) Management of sugarcane residue. Did farmers burn the sugarcane field? If yes, how many areas which sugarcane was open burnt? The burning periods and the purpose of burning;

(5) Water sources for sugarcane plantation

3.1.3 Data collection and processing

Prior to the survey, the questionnaire was pre-tested with 30 farmers in 3 different provinces of Thailand, including Nakhon Sawan, Nakhon Pathom, and Khon Kaen. Following this pre-test, the questionnaire was re-adjusted and finalized. The final questionnaire survey was then used for the actual survey to collect data from a total of 441 farmers in the 22 provinces targeted in the study (see Fig. 3.1 and Table 3.2). The areas of sugarcane plantation sampled in this research covered a total of 4,543 ha spread over the 3 regions of Thailand, as shown in Table 3.1.

Table 3.1 Number of samples and sampling areas for questionnaire survey

Regions	Sampling number (samples)	Sampling area (ha)
Northern region	134	1,152
Northeast region	179	1,169
Central region	158	2,222
Total	471	4,543

Based on sugarcane farming practices in Thailand, this research considered three common practices of sugarcane open burning, including pre-harvest burning to facilitate manual harvesting, reduce labor and harvesting cost (B1), post-harvest burning to protect the ratoon-cane of the next crop cycle from being burned by fire (B2), and post-harvest burning to clear the land before soil preparation (B3).

For data processing, the statistical analysis in this study was mainly based on a descriptive method. The total area burned was estimated based on the area of sugarcane harvested and the fraction of the area burned, as shown in Equation 3.2.

$$TAB = HA \times \left(\frac{\%AB}{100} \right) \quad (3.2)$$

where TAB is the total area burned (ha), HA is the harvested area, and %AB is the percentage of sugarcane area burned out of the total area harvested.

Information about the area of sugarcane harvested was obtained from a report by the Office of Agricultural Economic (OAE, 2013). The percentage of area burned was determined based on the data collected from the questionnaire survey.

3.2 Results and discussion

Based on information collected from the questionnaire survey on sugarcane burning practices in Thailand, Figure 3.2 shows the percentage of sugarcane area that was burned out of the total area of sugarcane harvested in different regions of the country, as well as contributions from pre and post-harvest burning systems. It was observed that 77% of the total area of sugarcane plantation harvested is subject to open burning and that pre-harvest burning is contributing the largest share with 82%, post harvest-burning contributing the remaining 18%.

For the post-harvest burning system, the main reason for burning in 89% of the cases was to protect the next crop from fire, with the remaining 11% being related to clearing the land before preparing the soil for the next crop cycle. On a regional basis, it was noticed that field burning practices dominate in all regions, with the highest proportion in the Northern region (88% of the total area of sugarcane harvested), followed by the Northeast (74%), and Central (72%) regions, respectively.

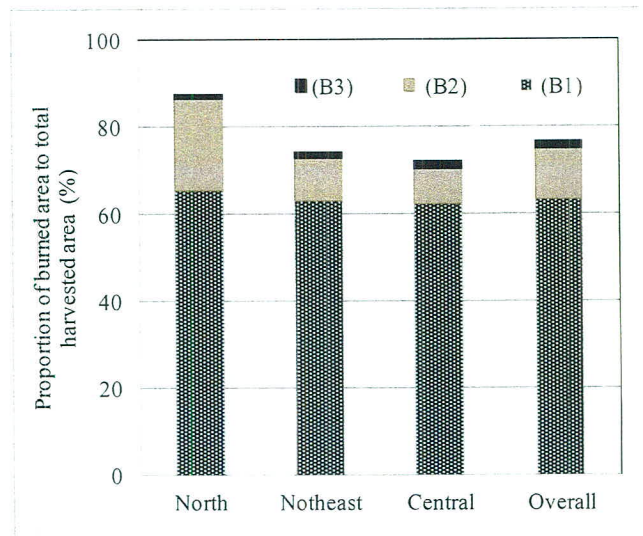


Figure 3.2 Proportion of sugarcane area burned in relation to total sugarcane area harvested in Thailand (November 2011-April 2012)

Following Equation 3.2, based on the percentage contribution of pre- and post-harvest burning systems to total harvested area of sugarcane burned, the corresponding burned areas were determined for each region of Thailand, as reported in Table 3.2. As already observed in Figure 3.2, Table 3.2 also reveals that 63% of sugarcane fields in Thailand are burned before harvesting. This is also consistent with a report from the Office of the Cane and Sugar Board providing an estimate of about 66% for the year 2012 (OCSB, 2013). Table 3.2 also shows that the region where the largest area of sugarcane is burnt is the Northeast. This region contributes to 39% of the total area of harvested sugarcane that is burned in Thailand, followed by the Northern region with 31% and the Central region with 30%. The main reason for a lower contribution from the Northern region, despite having the highest fraction of sugarcane burned (see Fig. 3.2), is its lower area of sugarcane plantation.

In order to investigate the spatial distribution of areas burnt in sugarcane cropping areas in Thailand during the harvesting season in 2012, a map was drawn, as displayed in Figure 3.3. It was found that Nakhon Sawan was the top first province in the burned area (86,002 ha), followed by Nakhon Ratchasima (80,480 ha), Kanchanaburi (80,107 ha), Khon Kaen (66,653 ha), Kampaeng Phet (61,617 ha), and Suphanburi (56,540 ha) as shown in Appendix D.

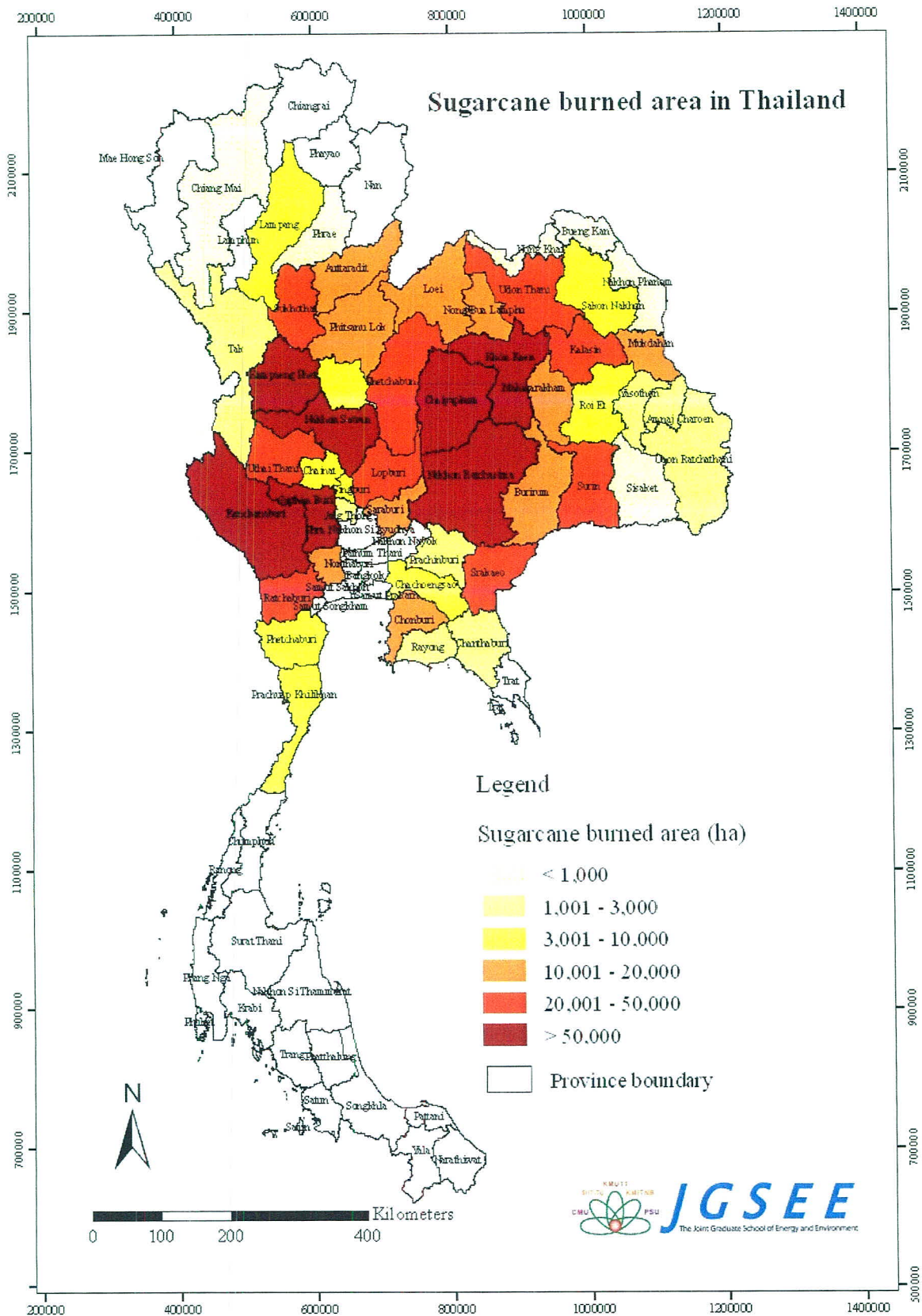


Table 3.2 Distribution of burned sugarcane areas in Thailand during harvesting season (November 2011-April 2012) in year 2012

Regions	Harvested area (ha)	Burned areas (ha)			
		B1	B2	B3	Overall
Northern region	348,770	228,081	73,314	4,117	305,512
Northeast region	518,395	325,548	51,705	6,809	384,062
Central region	414,939	258,706	32,514	8,278	299,497
Whole Kingdom	1,282,104	812,335	157,533	19,204	989,072

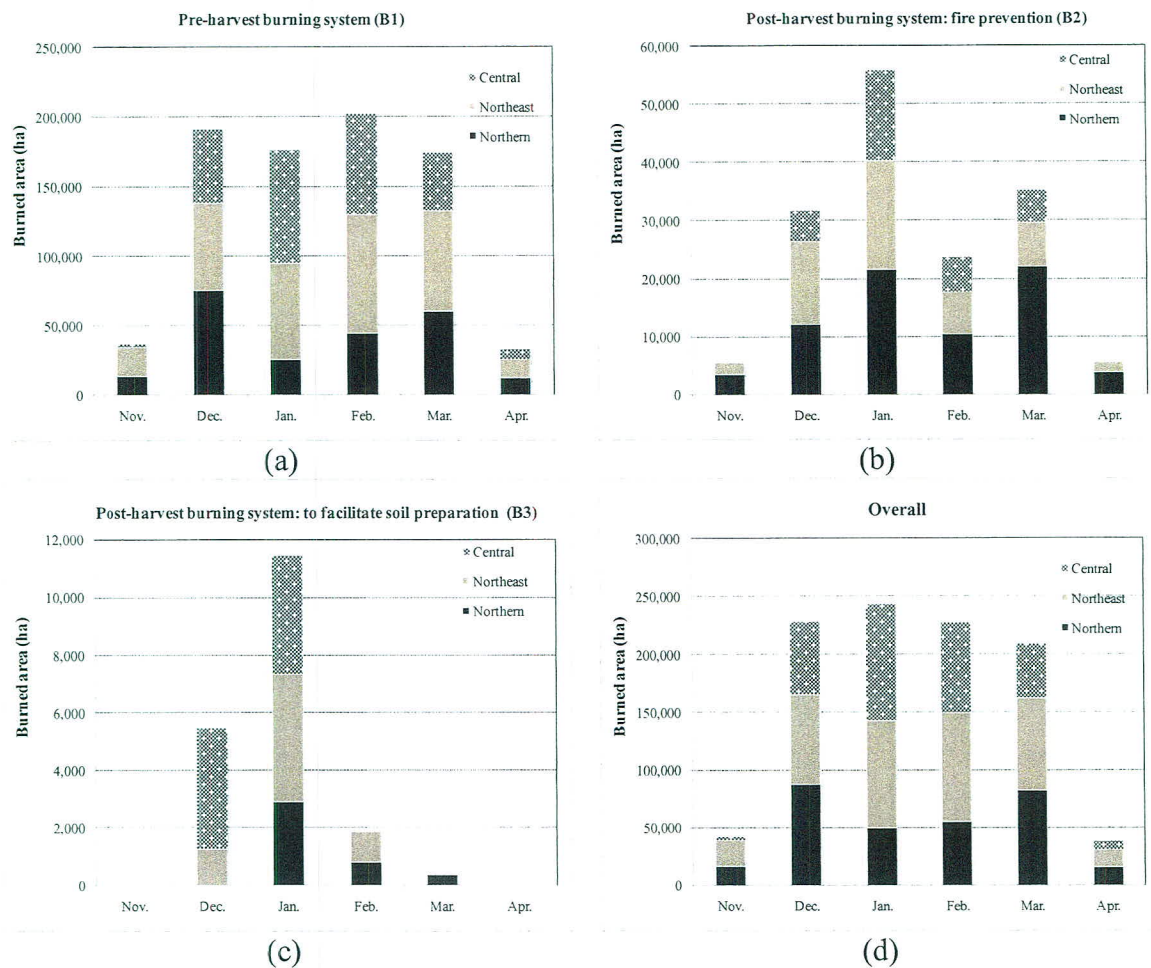


Figure 3.4 Monthly distribution of sugarcane area burned in Thailand classified based on harvest burning systems: (a) pre-harvest burning, (b) post-harvest burning to protect new crop cycle from fire, (c) post-harvest burning to facilitate soil preparation, and (d) summary of all burning systems.

Considering more closely the periods during which sugarcane is burned, Figures 3.3(a) to (d) show that the season of sugarcane field open burning runs from November to April. The month where burning activities peak is January, with 25% of the total area of sugarcane being burned at that time. Lowest contributions are found at the beginning of the sugarcane harvesting season in November and at the end of the harvesting period in April of the following year with approximately only 4% of contribution for each month.

Overall, these results indicate that the pre-harvest burning during the dry season (November-April) processes the highest share of the overall open burning of sugarcane in Thailand. This practice is used as farmers consider it as the most convenient, quick, and economical tool to facilitate manual harvesting. For manual harvesting, the harvested of burned cane has a lower cost than the harvested of green cane approximate 25% to 50%. Due to a limitation of labor, the green cane harvesting system is still not practical in Thailand.

3.3 Summary of findings

The sugarcane field open burning in Thailand was studied during the harvesting season over the period of November to April. The area of plantation subject to fire was evaluated based on a questionnaire survey. The results of these investigations showed that 0.99 million ha of sugarcane areas are burned in the cropping season 2012 in Thailand. This represents 77% of the total area of sugarcane harvested. Pre-harvest burning has the highest share of the total burning with 63%. The Northeast is the region where the largest areas of sugarcane is open burnt (39% of total burned areas), followed by the Northern (31%) and the Central regions (30%). These results constitute an important input to the current state of knowledge on open burning of sugarcane biomass materials and their contribution to the overall emissions from such agricultural practices in Thailand.