
Causes and solution of forest and agricultural burning in Northern, Thailand

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Abstract The result revealed that the major causes of forest and agricultural burning concerned the modification of crop production patterns (subsistence production to commercial production), changed in the economic system, needed for the villagers to improve their quality of life under the limited availability of arable land, and beliefs and traditions. In addition, in-depth interviews with the community leaders indicated that local political bullying, conflicted with local government, negligence, foraging and hunting, and burning within the community fire barrier but being unable to control the fire which can lead to forest and agricultural burning. Furthermore, in-depth interviews with community leaders and village representatives in the Mae Chaem Model Project revealed that solutions to the problems are established in a village fire barrier, villagers' participation process, built an understanding with villagers, the government policy for 60 days without burning forest and agricultural area to reduce smog, and helping to support the government. Thus, the success of community participation is depended on good leaders, supporting and continuous remedial measures. The cooperation of parties involved in the forest and wildfire management and created the opportunities for knowledge exchange between them which is considered as a sustainable approach for wildfire management.

Keywords: Cause, Solution, Forest, Agricultural burning

Introduction

Forest is a valuable natural resource for humans and the environment. It also affects the country's development because forest resources can benefit the economy, society, and environment and people's way of life, culture, and well-being (National Reform Steering Assembly, 2016). In 2019, Thailand's forests accounted for 16,455,691.63 ha or 31.68% of the land area in the country, decreasing from 676.72 ha in 2018 (SeubNakhasathien Foundation, 2020). This decrease in forest area is caused by human actions such as forest burning, forest encroachment for agriculture and livestock, mismanagement of wildfires, etc. (WWF and Boston Consulting Group, 2020).

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Northern Thailand is an area with rich natural resources and biodiversity, supporting the way of life for people of different ethnicities. According to data for 2017, the forest area in the northern region was 5,723,503.79 ha, decreasing by 351,332.65 ha or 6.14% compared to 2008, especially in Chiang Mai, where the area covered by forest has reduced by 115,103.69 ha over the past ten years (Royal Forest Department, 2018). Human actions have resulted in forest burning for different reasons such as forest encroachment, hunting, foraging (mushrooms and vegetables), etc. In addition, agricultural land is burned after harvesting to prepare for plantation the following year (especially maize), resulting in forest reduction and smog (PM 2.5). The burning of forest and agricultural land impacts on various dimensions: economic, transportation and logistics, environmental, etc. People in the northern region of Thailand experience various health problems, especially those with low immunity, such as the elderly, young children, patients with respiratory diseases, etc. Every year, the air quality deteriorates, peaking from February to March when more burning occurs than at other times of the year. The data on accumulated heat points (Hotspot) classified from MODIS satellites from 2016 to 2020 between January 1 and May 31 for the eight provinces in the northern region, reveals that Chiang Mai tends to have more wildfires in its National Forest and agricultural area compared to the other seven provinces in Northern Thailand (GISTDA, 2020).

Chiang Mai Province is important to the economy of Northern Thailand. It is the second-largest city after Bangkok, with approximately 20,107 square kilometers and a topography of mountains and wood groves. The topography is divided into two types, a mountainous area accounting for approximately 80% of the province, and plains and hillsides, accounting for approximately 20% of the province which is a fertile area suitable for agriculture. Chiang Mai Province, with a population of about 1.76 million people, is divided into 25 districts (The Chiang Mai Governor Office, 2020). The topography of Chiang Mai Province causes it to experience smog every year. Despite government agencies in 2016 setting a time period during which no burning is permitted from March 1 to April 30 every year, the cumulative heat points have increased since 2018. According to the data, there were 2,155 heat build-ups in 2020, representing an increase of 2 times compared to 650 in 2018 (GISTDA, 2020). The research finding aimed to study the cause of forest and agricultural burning in Northern Thailand and to find a solution.

Materials and methods

The study was conducted in Mae Chaem, Chiang Mai Province because the district has a forested terrain and steep mountains, covering about 60–70%

of the total area. In addition, it is a level 1A watershed area which means settlements or agricultural activities of any kind are prohibited. The area is divided into 216,000 ha of National Forests, 51,200 ha of Conserved Forests, and only 3,680 ha of privileged area, leading to conflict between government officials and residents (Ongla and Buddharaksa, 2020). Claiming the right to manage the forest and land of villagers will lead to a change in crop production, caused by the limitation of land and water resources in the area until the problem of forest and agricultural burning in the area can be resolved. Thus, this research aims to study the cause of forest and agricultural burning in Northern Thailand and find a solution to solve the problem.

Conceptual framework

The problems and research questions were identified from the trials and observations. The information for this study was obtained from various resources such as government documents, research findings, statistical information, and relevant articles to ascertain the cause, effect, and recommendations for resolving the issue of forest and agricultural burning in Northern Thailand, as shown in Figure 1.

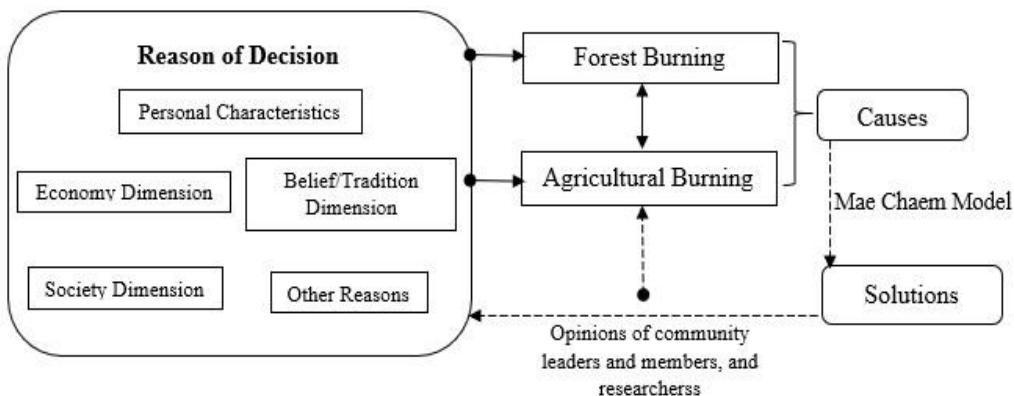


Figure 1. Flow chart of the potential causes, impact, and solution for forest and agricultural land burning in Northern, Thailand

Study site

The research finding was conducted in Mae Chaem District, Chiang Mai Province, Northern Thailand. It is a second-highest heat points of 25 districts in Chiang Mai due to its forest and steep mountainous terrain, representing more than 60–70% of the total area. The area has experienced significant problems, such as a shortage of land with ownership certificates and

a lack of water during the dry season. Consequently, most farmers in the area encroach on the National Forest and choose to grow plants using less water supply, especially maize (Chiang Mai Provincial Agricultural Extension Office, 2011). This has made to conflict between the government and locals. The study landscape is shown in Figure 2.

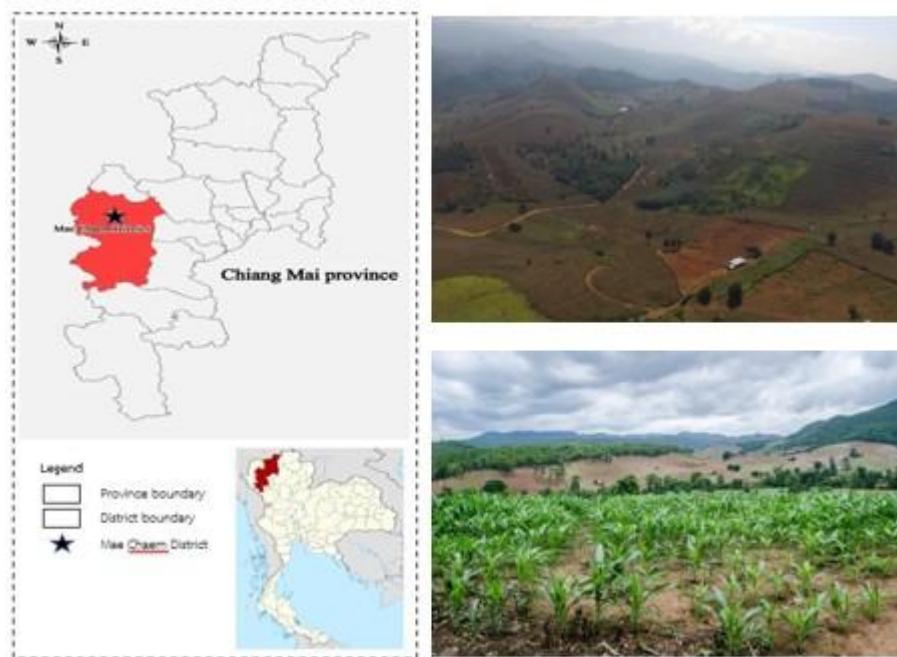


Figure 2. Map and landscape of the study site

Data collection and analysis

Both primary and secondary data were collected. The primary data were collected by visiting and observing the areas and conducting in-depth interviews with community leaders of the 11 villages in the Mae Chaem District participating in the Mae Chaem Model Project. The secondary data were collected from the relevant annual reports of the government group on the study site, documents, and statistical reports on forest and agriculture land burning. The data were collected between January 2018 and June 2019 to ascertain the causes and investigated a solution for forest and agricultural burning from the perspective of community leaders and members who voluntarily provided information. In addition, the researchers continued to collect data by visiting the area and observing the changing situation through the implementation of various research projects. The researchers were

conducted the study in Mae Chaem District from 2018–2020. Data were analyzed from in-depth interview, focus group discussion, observation, and documents. The data were used for content analysis and interpreting the findings (Lincharearn, 2020). Moreover, the research also considered the importance of data collection based on the principle of human and interpreting the findings (Lincharearn, 2020).

Results

Causes of forest and agricultural burning

The results revealed that the main reasons for some villagers in the area burning forest and agricultural land were recorded.

Personal characteristics

The psychosis and insanity of villagers were found to cause the burning of forest and agricultural land from 2017–2018. In the village territory, groups were designated the task of monitoring wildfires and agricultural burning. However, the ability of the villagers to monitor, control, and prevent fires from spreading has not been fully achieved due to limitations such as a lack of firefighting equipment, shortage of workers, budget, etc. Moreover, each village covers a wide area, most of which is near the National Forest, making effective monitoring and control impossible.

Economic status

About 60–70% of Mae Chaem District is covered by forest and steep mountains, making it suitable for cultivation by a small number of farmers (10%) with certificates of ownership. Most of the area in Chang Keng Subdistrict is lowland with some cliffs, this resulted to those without permission to cultivate. The way of farmers who can obtain an area for cultivation was to infringe on the forest, and an easy and convenient way of doing this is to burn it down. The data on forest encroachment in Mae Chaem District recorded from 2002–2010, revealed that the total forest area was 161,706 rai which infringed, while in 2011–2020, forest area was totally 86,359 rai which encroached. Most of the forest encroachment had planted for maize plantation since this crop is used less water supply and needed little maintenance. The price of maize may decrease in some years, resulting in the villager losing money and falling into debt but they are still continued planting maize in the coming year as a result. According to the in-depth interviews, most villagers expressed in positive views toward maize plantation, despite they

faced the potential loss. Maize crops were still provided them with cash flow for family expenses and to pay off their debts to the Bank for Agriculture and Cooperatives each year. Agricultural burning resulted from a large amount of waste produce of corn plants, corn stubble, and corn husks, all of which are dried materials and quickly burned. Most farmers burn the land after harvesting due to the limitation of space, labour, and costs involved in moving agricultural waste from the area. Consequently, the limited available agricultural area was a controversial issue for the villagers, especially those living in the highland Northern Thailand. It correlated in the same direction according to each family's economic conditions. For example, a family with significant expenses was strongly motivated to seek a suitable agricultural area.

Socio-cultural aspects

Social changes concerned the population growth, development of rural areas into urban, and increased in convenience facilities affected the villagers' culture. During the in-depth interviews, the villagers explained that they had to change from subsistence to commercial farming, placing greater emphasis on monoculture crop that did not require the investment but it provided the produce in large quantities.

Beliefs and traditions

Most of the population in Mae Chaem District belong to five ethnic groups. The indigenous Thai people live in a lowland agricultural area along the Mae Chaem River, which is famous for cultivating rice, baby corn, and potatoes. Karen, Hmong, Lua, and Lisu tribes live and do farms in the highlands where they have cultivated the upland rice and maize using water and rainwater as the primary resources. However, only the Hmong tribe in the Pang Hin Fon Subdistrict decided to cultivated tomatoes in greenhouses with the help of the Highland Development Royal Project (Pang Hin Fon).

Upland rice cultivation

Tribal villagers in the highlands prefer to grow upland rice. Primarily for household consumption. Each year in April, the villagers are tended to burn the farm areas to dispose of weeds, even it is prohibited by the government. The belief has passed from the villagers' ancestors and become a part-time occupation for several tribal groups living in the highlands. It resulted in the villagers burning with the permission of the government. The interviews with the villagers revealed that they often burned to prepare the fields for upland rice and sometimes could not control the fire, resulting in the forest burning, as shown in Figure 3.

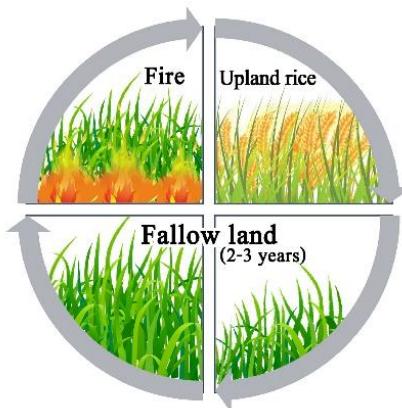


Figure 3. Rotation cycles of land use in upland rice production

Maize cultivation

Most of the farmers in Mae Cheam cultivate maize instead of other crops due to the steep terrain that caused the shortage of agricultural water during the dry season. After harvesting, a significant amount of agricultural waste such as dried corn stalks, stubble, and corn husks, remained on the farmland. Since its cost-effectiveness and convenience, villagers burned agricultural waste. It is also believed that burning corn stubble helped to eliminate diseases and killed insects in the farming area, as shown in Figure 4.



Figure 4. Farmers' maize production cycle

Other causes

In-depth interviews with the community leaders also identified other causes: local political bullying, conflicted with local government, negligence (for example, throwing cigarette butts on the sidewalk and burning household waste or leaf litter), foraging and hunting, and burning within the community fire barrier but unable to control the fire.

Solutions for forest and agricultural burning

The in-depth interviews with community leaders and village representatives from 11 of the 15 villages participating in the Mae Chaem Model Project (73.34%) revealed that a solution for forest and agricultural burning involved the creation of a model encompassing all divisions. The villagers' participation in the area was the key to solve the problem in a very effective way. The solutions for forest and agricultural burning are explained.

Establishing a village fire barrier

The problem of wildfires and the burning of maize stubble by farmers, either naturally or by human action, usually occurs between late February and late April every year. It created air pollution (smog), impacting on eight provinces in the upper north. Therefore, in February, the community leaders of each village must ask for the villagers' cooperation in constructing fire barriers to reduce the risk of wildfires spreading into the village area. This suggestion is well-received by the villagers.

Villagers' participation process

Each village should encourage its members to participate in preventative measures, such as forest fire surveillance, monitoring and helping to extinguish wildfires, and informing government officials in the event people are seen setting wildfires, etc. Such action would result in the levels of heat accumulated (hotspots) decreasing every year.

Build understanding with the villagers

Local administrative organizations in the area, such as municipalities and subdistricts, needed to improve the knowledge and understanding of villagers about the impact of forest and agricultural burning. Specifically, the effect on the health of people living in northern areas resulting from the release of small dust particles (PM 2.5) into the atmosphere. Community leaders at all levels; provincial governors, district chiefs, subdistrict headmen, and village headmen must build understanding in their communities. The village headmen

in each village are campaigned to reduce burning during the prohibited period and made the villagers to understand the government regulations. They used public broadcasts in the village to call for meetings in each group, while some villages focused on the youth of the village.

60 Days without burning forest and agricultural area to reduce smog

The government has announced a prohibited burning period of 60 days from late February to late April, in open spaces and agricultural areas. Whenever, the forest and agricultural burning problems tended to occur in the upper northern provinces. As a result of the announcement, the villagers changed the burning period to January when the wind direction changes in Chiang Mai. According to the interviews with village leaders, at a meeting of the Mae Chaem District Administration, the burning period for each subdistrict was determined to alleviate smog, especially from the burning of maize fields in preparation for rice cultivation by the Karen tribe. The determination of a burning period for each subdistrict has dramatically alleviated the smog issue.

Help and support from the government

One of the problems of forest and agricultural burning are caused the area to cover in smog, and affected the entire population in the upper northern region. Therefore, all divisions come to support every aspect, providing technology, budgeting, market research knowledge, etc. The main goals were reduced maize cultivation and encouraged the growing of fruit trees and perennial plants. This would dramatically reduce the amount of emissions which caused by the burning of fields. In addition, it would also restore the ecosystem in Mae Chaem District. All relevant divisions are committed to improve the quality of life for villagers through the implementation of several projects and activities designed to promote fruit and coffee plantations to replace maize agriculture, agricultural tourism, occupations for housewives (weaving groups), and animal husbandry. It is essential that the villagers in the area are encouraged to follow other occupations to replace the cultivation of maize.

In addition, community leaders and village representatives suggested that the important factors for solving the problems of forest and agricultural burning depended on the following factors.

Leadership

Most of the villagers in Mae Chaem District belong to tribal societies (Karen, Hmong, and indigenous people) in that community leaders play an

important role; therefore, strong, and open-minded leaders can motivate villagers to follow the new process. High-ranking government officials in the area dedicated themselves to solving the problem and provided an opportunity for community leaders to participate in a committee on countermeasures against fire. This cooperation gave a concrete solution to the problem of forest and agricultural burning.

Management

Community participation is the key to resolve the issue of forest and agricultural burning. All divisions, such as public, private, and communities in the area would be given opportunities to participate in preventive measures against fire and to benefit by working together to form a tightly knit community.

Support and assistance from the government

The implementation of measures to prevent forest and agricultural burning in the area would not be successful without support and assistance from the public sector, such as Royal Irrigation Department, Royal Forest Department, and Department of Agricultural Extension Department of Land Development; and the private sector, such as Kasikorn Bank, CP Company, and Chiang Mai Private Division Joint Committee. Foundations, such as the Foundation for Sustainable Development in the North and Thai Rak Forest Foundation Royal Project and institutions, such as Chiang Mai University, Maejo University, and the Rajamangala University of Technology Lanna, must be involved. The primary goal was the consistent implementation of the project. In the future, the villagers would concern the result of the project and receptive to compliance.

The villagers

The interviews with leaders and representatives of each village revealed that villagers become more aware of the problems such as smog (caused by dust particles) resulting from the forest and agricultural burning. Some villagers are started to change their farming methods, for example, refraining from burning maize stalks and making fermented cattle feed using maize stalks or decomposing maize. Since the price of maize had significantly decreased, and most of the villagers are discouraged from growing maize.

Discussion

Forest fires and agricultural burning in Northern Thailand are caused by human actions. Communities in the region need more land resources for

monoculture farming, especially maize since access to such land and the utilization of resources are currently limited. It leads to conflict between the government and the local community. However, the cause of forest fire and agricultural burning also involves other factors, such as personal characteristics, socio-economic conditions, beliefs/traditions, and the carelessness of villagers. A similar pattern was reported by Hoare (2004): the top three causes were burning in suburbs, on roadsides, and agricultural land. Pochanart (2016) found that the main causes of smog in Chiang Mai were agricultural burning, burning roadside weeds, and forest burning. According to Wongkongsak (2015), most wildfires were often occurred by the human intention to burn rather than negligence or ignorance. The motives for the fire were to expand the agricultural area by burning forests, to clear weeds, and to prepare for the plantation of certain crops that could be sold at a high price.

In 2015 the Mae Cheam Model was implemented using participation as an important tool for solving the problem. Various divisions, such as community organizations, NGOs, education institutions, and private organizations, were involved in project applying, collective thinking, collaborative planning, cooperation, and benefits using the three main approaches as forest resources management (separating people from the forest) and land management (issuing Certificates of Utilization), modification of the production system to make it relevant to the area and providing alternative or additional occupations for the locals. Boonsarawang (2018) reported that a short-term solution for smog and wildfires would develop the occupational skills of people living in communities near the forests, providing them with an alternative career and thus reducing forest burning. Long-term measures would involve to build the knowledge and understand through organizing a forum to exchange knowledge among those, such as local leaders, community leaders, and villagers involved in solving the burning issue. Such a forum would allow those involvement to find a common approach and made people in the community to be a part of the solution, leading to standard practices and action to solve the problem of burning sustainably. The success of the three main approaches are largely depended on the leadership, management, and support from other divisions. The most crucial factor is the villagers, especially participate. According to Thongloe and Srisontisuk (2012), community leaders and villagers should be encouraged to participate in the local government organizations, provided the implementation of measures to prevent smog through continuous action to make people in the community aware of the present and future issues to reach a sustainable solution together. Therefore, the process of understanding the relationship between the community and forest included the ways of utilizing the fire and folk wisdom of the community to

manage wildfires and enlisted their participation in solving the problem. The success of community participation depended on good leaders, support, and continuous remedial measures. The cooperation of parties are involved in the forest and wildfire management and created opportunities for knowledge exchange between them which considered as a sustainable approach for wildfire management.

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