A process for community and government cooperation to reduce the forest fire and smoke problem in Thailand

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Abstract

Key issues for managing smoke are identified, along with a process developed to reduce the problem during 3 years of project implementation in a critical watershed in North Thailand. The project area is 1007 km² in Nan Province which borders the Lao P.D.R. The government forest fire management programme is being implemented through the Royal Forest Department (RFD), and a participatory community fire management programme facilitated through Community Coordinators is funded through Danish Cooperation for Environment and Development (DANCED) grant assistance. A fire calendar for Nan Province with estimates of the contribution to the smoke problem by different fire lighters shows that major cause of the smoke problem are burning of grassland by hunters and uncontrolled burning of upland fields for agriculture. Moderate causes of smoke were burning of grassland by graziers, urban and roadside fires, and burning of paddy rice straw. Forest fire legislation could not be effectively implemented as it created antagonism between forest officials and communities. However, 67% of the 45 villages of five ethnic groups already had their own regulations and fines against uncontrolled fires. These village regulations in many cases could not be enforced due to fires spreading from neighbouring villages, or being lit at night by hunters. Community contribution in 1998 to fire management in the 45 villages was considerable with almost 94 km of firebreaks and 765 village fireguards, who also helped RFD staff suppress fires. Landsat imagery of 17/3/1998 showed that 20% of the project area was burnt in 1998, mostly by graziers and hunters outside the control of the village social system. This led to conflicts between villages due to fire damage to forest plantations, orchards and other property. The Project Community Coordinators facilitated formation of Village Watershed Networks in 1999 to establish boundaries for village fire control responsibility, and to strengthen village rules on fire management. This process and key data for monitoring community fire management are described. Strengthening of rules and regulations through Village Watershed Networks in 1999 was an important factor in reducing the portion of the project area burnt to less than 2% in 1999 and 2000.

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Keywords: Managing smoke; Fire calendar; Causes of fires; Fire laws; Conflict resolution; Village Watershed Networks; Fire management and monitoring

1. Introduction

This paper reports on village networking to raise public awareness of environmental damage from uncontrolled forest fires during 3 years of project imple-

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Fig. 1. Watershed management unit boundaries and villages.
Division of the Royal Forest Department (RFD). The project area has 45 villages with a population of 20,362 people of Northern Thai, Thai Lue, Hmien, Khamu and Hmong ethnic groups (see Fig. 1). Twenty-five of the villages are located in national forest reserves, and there is a plan for 70% of the project area to be included in two national parks.

Population density is 20 persons per square kilometer and farm size averages 2.86 ha, including 0.54 ha of paddy land, 0.06 ha of orchard and 2.26 ha of upland fields and forest fallow for shifting agriculture. This farm size is representative of many watershed areas in Southeast Asia. Only 10.9% of the watershed area is used for agriculture as it is steeply sloping of marginal agricultural productivity (UNWMP, 1998a).

2. The project setting and smoke boundary

The project area is located 35–90 km north of the provincial capital of Nan, which borders the Lao P.D.R. The province is considered the boundary for the smoke problem in Thailand. The area is mostly low altitude (300–600 m above sea level) and hilly, with difficult access for fire control. The deforested area is covered with dry dipterocarp secondary forest, Imperata cylindrica grass and bamboo species, and is outside areas of primary interest to foresters and communities. There are 15 DANCED-funded Community Coordinators in the 45 villages working on improved natural resource management including community fire management.

3. Who are the stakeholders? What are their concerns?

Most stakeholders in Nan Province would like to reduce the area burnt by forest fires during the dry season, and resulting smoke pollution, for reasons that include:

Royal Forest Department wants to reduce forest fires to prevent damage to reforested areas and allow natural forest regeneration.

Village communities need to continue using fire for slash-and-burn agriculture, but most village leaders want to reduce damage caused by fires spreading to forest areas and neighbouring villages. However, the district administration estimated that in 1997 30–70% of the village population were habitual fire lighters and did not care if fires spread to forest areas.

Provincial administration wants to reduce forest fires and smoke for public health and in order to keep the airport open during the dry season.

Hotel and tourist sector want to reduce smoke so more tourists will visit during the dry season from February to April.

DANCED wants to make a Danish contribution to a cleaner world.

Two main impacts of the smoke problem reported during the 1998 dry season were closure of the Nan airport by smoke, and an increase in respiratory diseases due to smoke (Provincial Public Health Officer, March 1998, personal communication). Daily passenger jet service was disrupted once during 1998, and seven times during March 1999. At special meetings with village and local administration leaders convened by the Provincial Administration after the 1998 and 1999 fire seasons had begun, blame was placed on upland farmers, but no follow-up action to solve the problem was made.

4. Causes of the smoke problem in Nan Province

The first step in the process to address the smoke problem was to construct a fire calendar for Nan Province. The fire season begins in October at the end of the 7-month rainy season. The calendar in Fig. 2 shows the time of burning, together with an estimate of the contribution of the various types of fire lighters to the provincial smoke problem. During the cool season from December to January, there is little wind to disperse the smoke, whereas during the hot season from February to April light to moderate winds help disperse the smoke (Hoare, 1998).

4.1. Urban pollution and household burning

Burning of rubbish and vegetation continues throughout the year and contributes significantly to the dry season smoke problem near the provincial capital. Much household burning is burning of leaves, which could be used for composting.
4.2. Roadside burning by the Highways Department

Roadside burning began in 1998 and 1999 as soon as roadside vegetation became flammable, and continued through the dry season. Fires were lit in an approximately 20 m strip along either side of main roads, and often escaped into surrounding forest and farm land. This problem was greatly reduced in 2000 by planting of trees along highways and an agreement between leaders of the Highways Department and the Forest Department not to burn road-sides.

4.3. Lowland paddy farmers’ burning of rice straw

Straw burning begins in December after the rice harvest. It is an important source of smoke problems in smaller regional centres such as Nan, where paddy areas are close to town and the airport. This smoke disperses slowly due to light winds and inversion temperatures during the cool season.

4.4. Burning by cattle grazers

Burning to open grazing areas is important where there are considerable areas of Imperata grassland. Mature Imperata has low nutritive value for cattle, whereas new shoots produced on burnt areas have good feed value. Grazers burn from December to March and their fires often escape into forest areas.

4.5. Hunters

Hunters light some of the most damaging fires during the period from December to March. These fires are often lit in more inaccessible hilly areas, and often

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**Fig. 2. Fire calendar for Nan Province, North Thailand.**

<table>
<thead>
<tr>
<th>Cause of Fire</th>
<th>Month</th>
<th>Number of Months</th>
<th>Estimate of Contribution to Smoke Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat burning and pollution</td>
<td></td>
<td>4 months</td>
<td>Moderate</td>
</tr>
<tr>
<td>Roadside fires</td>
<td></td>
<td>4 months</td>
<td>Moderate</td>
</tr>
<tr>
<td>Lowland farmers burning</td>
<td></td>
<td>4 months</td>
<td>Moderate</td>
</tr>
<tr>
<td>Cattle grazers</td>
<td></td>
<td>3 months</td>
<td>Moderate</td>
</tr>
<tr>
<td>Hunters</td>
<td></td>
<td>3 months</td>
<td>Major</td>
</tr>
<tr>
<td>Controlled oxeniden burning</td>
<td></td>
<td>1 month</td>
<td>Major</td>
</tr>
<tr>
<td>Uncontrolled oxeniden burning</td>
<td></td>
<td>2 months</td>
<td>Major</td>
</tr>
<tr>
<td>Smoke transported from neighboring province counties</td>
<td></td>
<td>3 months</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

**Note:** 1. The rainy season is from April to October and the peak month for fires is March.
2. The characteristics of controlled oxeniden burning are: (a) fire breaks made before burning; (b) village committees informed before burning; (c) burning in late afternoon; (d) extra labor and water containers taken to field to stop fire spreading.
3. The factors in the contribution to the smoke problem include: (a) the month of burning; (b) the weather condition; and (c) the area and type of fuel burnt.
at night. People who light these fires are often outside the social control of local communities.

4.6. Controlled swidden burns

Swidden burning starts from February and continues to May. Most of these fires are lit during mid-March, when temperatures are high and relative humidity low (Fig. 3). Controlled swidden burning is a traditional practice of Karen hilltribe farmers. But for most other ethnic groups awareness raising and intensive training and extension efforts are required in order to persuade farmers to introduce practices such as making fire breaks around swiddens before burning, burning in the late afternoon, and imposing village fines on those farmers who do not comply and allow fires to spread to forest.

4.7. Uncontrolled swidden fires

Uncontrolled swidden fires, which spread to surrounding agricultural and forest areas, are blamed for most of the smoke problem by urban dwellers, and are a major target for an extension programme to manage smoke.

4.8. Other factors

Smoke in Nan Province can be observed to an altitude of 3000 m by early February before the main burning season. It is not known how much smoke and dust is transported from neighbouring countries by prevailing northeasterly winds.

5. Strategies to reduce the smoke problem

Analysis of the causes of smoke in Nan Province (Fig. 2) shows that the first three causes of fire in areas close to the Provincial centre include: (1) “Urban fringe” burning; (2) Roadside burning; (3) Lowland farmers’ burning. Causes (1) and (2) are each estimated to account for about 30% of the smoke problem. This burning contributes to human health problems and closure of the provincial airport by smoke. At present there is no Provincial Administration programme to reduce this smoke problem.

In the project setting, fires which contribute to the smoke problem are lit by: (1) Cattle grazers; (2) Hunters; (3) Farmers’ controlled upland burning; (4) Farmers’ uncontrolled upland burning. These
combined sources are estimated to contribute about 70% of the provincial smoke problem. The Upper Nan Watershed Management Project activities on fire management are directed at reducing fires from these causes (UNWMP, 1998b).

5.1. Government forest fire acts and legislation

There is no specific forest fire control act in Thailand. A few sections concerning forest fires are included in four current forestry acts. (1) Forest Act of 1941, section 54; (2) Wildlife Conservation and Protection Act of 1960, section 24; (3) National Park Act of 1961, section 16; (4) National Forest Act of 1964, section 14. Penalties concerning forest fire under all acts can be summarized as “whoever violates the laws should be punished with fine of between 5000 baht and 150,000 baht or imprisonment between 6 months and 15 years, or both”.

Using these laws for community fire control is counterproductive because it is likely to create antagonism between forest officials and rural people. Furthermore, the Royal Forest Department lacks manpower to enforce such laws, and it is very difficult to gather evidence on which to base charges. Law enforcement is still needed, however, and a forest fire act emphasizing preventive measures could be an effective approach if it is used as a guide for protecting the forest, and not as a threat (Samran and Akaakar, 1996). As another alternative, the Upper Nan Watershed Management Project (UNWMP) used a participatory approach to create awareness of damage to forests and private property caused by uncontrolled fires, and to strengthen rural communities’ own rules and regulations on fire control.

5.2. Village fire rules and regulations

Royal Forest Department staff estimate that people start more than 99% of forest fires, so that understanding attitudes of the project population toward forest fires is important for developing strategies for fire control. Indeed, it was found that all 45 project villages have developed their own social and natural resource management rules and regulations, which were collected in 1997 and published in Thai and English (UNWMP, 1997). The regulations and fines relating to fires are summarized in Table 1.

As Table 1 indicates, there was already community awareness and fines for damages caused by uncontrolled fires in 67% of the project villages when the project began in 1997. In 33% of these villages there were also fines for burning without a firebreak, and for failing to inform the village committees before burning. Twenty-seven percent of the villages had fines for hunters not controlling fires.

However, there are a number of reasons why these fines may not be collected in many cases, such as: (a) fires started in one village and spread to neighbouring villages; (b) shortage of fire guards to detect fire lighters; (c) hunters from outside the project area lighting fires at night. In addition, some younger people who left villages to work in Bangkok during the early 1990s returned to their villages following the economic crisis of 1997, and many of these people do not observe these community rules.

<table>
<thead>
<tr>
<th>Village Rule or Regulation</th>
<th>Fine ($)</th>
<th>Number of villages (45)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whoever burns a field without controlling fire and allow the fire to spread into neighbouring forest</td>
<td>Mostly in the range of $13 to $132 depending on damage and area. In one village 1316 maximum and another 16 centia burnt</td>
<td>30</td>
</tr>
<tr>
<td>Whoever burns a field without making a firebreak</td>
<td>Maximum fine $1316</td>
<td>15</td>
</tr>
<tr>
<td>Whoever burns a field without informing the village committee</td>
<td>$26–$105</td>
<td>14</td>
</tr>
<tr>
<td>Whoever burns for hunting and allows the fire to spread</td>
<td>$13 to $26</td>
<td>12</td>
</tr>
</tbody>
</table>

6. Role of government agencies, local organizations and the project in controlling fire

6.1. The Royal Forest Department (RFD) fire management programme

The RFD maintains 85 km of firebreaks at a cost of $98/km per year in the project area. These are located around new forest regeneration areas, as well as a reforestation area planted before 1987. However, these firebreaks only protect 10% of the watershed area.

Policy of the RFD Watershed Management Division now emphasizes natural forest regeneration within a period of 4–5 years. In some areas, there is supplementary planting of a minimum of 156 trees/ha. To control wildfires and protect regenerating forest, a grid of 8–12 m wide firebreaks is maintained. Natural firebreaks, occurring in humid creeks in the form of palm and banana vegetation are also included in firebreak network design. Part of the budget to maintain natural forest regeneration areas is used for firebreaks and fireguards. The RFD budgets $94/ha for the first year; and $66/ha during years 2–6.

6.2. The community fire management programme

Community Coordinators (CCORD) hired by the project in 1997 are the direct link between the project and the villagers, and they conduct extension work related to community organization and awareness raising on fire management. Raising awareness and cooperation from the 30 to 70% of villagers who are habitual fire lighters is the most important factor in reducing the number of and damage caused by fires. Awareness was raised by in-village screening of videos on fire management followed by discussion sessions. After training in fire fighting about 12 village fire volunteers in each village were equipped with knapsack sprayers and rakes for fire fighting.

Fire survey data from 1998 showed that 93.6 km of community firebreaks were prepared in 28 villages, in addition to 85 km made by the RFD around reforestation and forest regeneration areas. The number of village fire volunteers (765) exceeded the number of hired RFD fireguards (140). Training and awareness programmes in fire management were also held in schools, villages and for village leaders. The first fire started on 2 January 1998, and the last on 8 May. The incidence of fires was highest in mid-March when daily maximum temperatures are highest and relative humidity lowest (Fig. 3).

6.3. Results and area burnt in 1998

Analysis of Landsat TM5 imagery taken on 17 March 1998 showed more than 20% of the project area was burnt. Since images are only available at 14 day intervals, they were used to map area burnt rather than occurrence and progress of fires. Satellite data used in this study were obtained from Landsat TM5 which has a pixel size of 30 m × 30 m and can project images of multispectral wavelengths, making it possible to classify data on land use in greater detail. Satellite imagery recorded on 17 March 1998 was selected because cloud formation over the study areas was minimal. Later in the fire season, a CCORD survey in May 1998, estimated that just over 21% of the project area was burnt. These figures do not include controlled burns on swiddens, mostly less than 1 ha, which did not spread outside the slashed area. Over half the area under two watershed units was burnt, with most damage due to early season fires started by hunters and graziers. Average area burnt per fire was also high in these two units; at over 350 ha per fire.

6.4. Analysis of strengths and weaknesses of the 1998 fire control programme

Although considerable resources were used for fire management during 1998, results indicated many weaknesses in the programme. Main deficiencies included: (1) RFD budget for firebreaks was not released until after the fire season began, due to the 1997 economic crisis; (2) only one of the six RFD Watershed Management units completed the detailed fire management plan requested by the fire consultant; (3) 33% of villages did not have fines against uncontrolled fires; (4) the CCORD did not have a radio communication system; (5) village rules could not be enforced in many cases where (a) fires spread from neighbouring villages, (b) the fire lighter was not caught in the act and (c) the fire lighter was a "temporary" resident working in Bangkok who fled the village after lighting the fire.
Moreover, the average area burnt per fire in the project was relatively high at 183 ha, and the largest average of the six WMU was 409 ha. This was due to a number of factors, including: (a) lack of preparedness, (b) poor communications system, (c) limited road access and (d) weather conditions with moderate winds during the maximum fire danger period. Due to weather conditions, lack of access tracks and limited equipment, it was not possible to suppress many fires in remote areas.

At the provincial level, the main weakness was limited provincial support. An emergency meeting was called by the Governor of Nan on 24 March 1998 after more than 30% of the province had been burnt. Plans for 1999 were discussed, but no follow-up action was taken after the Governor moved in the middle of the year. “El Nino” weather conditions with below average rainfall, and cyclical build up of fuel after 3 or 4 years without serious fires, were also factors contributing to the large area burnt.

7. The formation of Village Watershed Networks for improved fire management

The large project area burnt spurred complacent RFD Watershed Management Units to consider improvements to their fire management strategies, and also created a number of conflicts between villages over damages caused by spreading fires.

7.1. The network formation process

A 1997 study tour by project staff to the Thai–German project area in Mae Hong Son had convinced them of the benefits of informal Village Watershed Networks for conflict resolution and improved natural resource management. There was a consensus among heads of RFD Watershed Management units and CCORD that priority should be given to facilitating immediate formation of Village Watershed Networks. The process developed to facilitate the formation of Village Watershed Networks to strengthen community fire management is shown in Fig. 4.

7.2. Demarcating village boundaries

The project area was classified into six areas by interpreting aerial photographs taken in January 1996, using a mirror stereoscope and ocular interpretation, supported by field checks. This analysis indicated 0.3% of the area was orchard, 2.3% paddy rice fields, 8.3% upland agriculture, 10% reforestation and natural forest regeneration with fire protection, 28.1% existing forest, 50.2% deforested and 0.8% village residential area.

The RFD budget for fire management focused on reforestation and forest regeneration areas, which covered 8.3% of the project area. Community fire management focused on village residential areas and agricultural land, or 10.9% of the project area. Some of the most damaging fires in 1998 were lit by hunters and graziers in the remaining 80.8% of the area, which then spread to RFD and village agricultural areas, causing considerable damage to reforestation areas, orchards and existing forest.

The first and most important step in the Village Watershed Network conflict resolution process was to agree on village boundaries for responsibility for fire control across the entire project area. Such boundaries had no legal standing, since more than half the area was in national forest reserves. However, after two or three network meetings informal boundaries were agreed between RDF and the 45 villages leaders.

7.3. Resolving conflict over fire damage and Village Watershed Networking

This bottom-up process started with a number of meetings where village leaders in the same sub-watershed were invited to discuss conflicts over fires, and other issues such as disputed claims to non-timber forest products. These meetings were facilitated by the Community Coordinators and led to drafting of uniform rules and regulations against uncontrolled fires which were taken back to the villages for public hearings, discussion and revision. After consensus was reached, rules and regulations were approved by the sub-district Tambon Administration and the District Office.

The following regulations are an example from Saen Tong network, which have now been agreed upon through meetings in all eight villages in Saen Tong sub-district, including three villages located outside the project area. Key rules for fire control include a fine of 500 baht/rai for fires spreading for the following causes: (1) anyone lighting a fire for hunting; (2) the
Village Development Committee must be informed at least 5 days before burning upland fields and an 8 m wide firebreak must be made before burning; (3) the fire lighter is responsible if a fire crosses a firebreak or boundary; (4) if a fire starts and the fire lighter cannot be found, the person whose field is nearest is responsible; (5) any village resident who sees a fire starting must report it to the Village Development Committee and will receive half of any fine. The identity of the informant will not be revealed (Saen Tong, Sub-district Administration, UNWMP, 1999a).

A comparison with the forest laws listed in Section 5.1 shows that these sub-district rules may be stronger, can be enforced, and should act as a deterrent to
hunters, graziers and upland farmers. Another subdistrict, Na Lai Luang has made its own sketch maps to show the location of all upland agricultural fields in order to help the sub-district with enforcing fire rules and fines (UNWMP, 1999a).

7.4. Village fire prevention competitions

It was also decided to provide an incentive for village fire volunteers by providing prizes to villages with the best fire management during 1999 and 2000. Prizes included a $79 first prize, $53 second prize, and $36 third prize, in each of the six watershed management units. A score sheet with 10 criteria for judging was prepared by the fire management consultant, and winners will be decided in June 1999 (Ploadpliew, 1999). While most field staff agree with the prizes, there was some concern that the competition could encourage some unbalanced people to light fires in the areas of competing villages.

8. Conclusions and lessons learned

Less than 2% of the project area was burnt during both 1999 and 2000, as assessed from Landsat images and ground surveys (Fig. 5). This was a large reduction from more than 20% revealed by Landsat images in 1998. If the area burnt can be kept at less than 5% for a period of 5 years, natural forest regeneration strategy should succeed (UNWMP, 1999b).

8.1. Analysis of strengths and deficiencies

Village Watershed Networking is a win-win strategy, as community cooperation in fire management makes work of the RFD and district administration much easier. Village property damage from fires is reduced, as well as environmental damage from fire and smoke. Necessary inputs include a facilitator and a budget for meetings.

In the project context, ground mapping is the most feasible method for measuring area burnt, given the present level of satellite technology and cost. Community fire management awards are an effective incentive for reliable data on areas burnt. Landsat images appear too expensive for monitoring burnt areas, since two strips are needed to cover the entire project area, at a cost of $2105 plus $1842 for analysis and ground checks. It is also doubtful that a suitable image during mid-March or early April can be obtained every year, due to fog and cloud cover. NOAA environmen-
tal satellites also detect fires and smoke in the visible, near infrared and thermal wavelengths, and allow frequent monitoring. However, AVHRR data stored on tape at the Chiang Mai Computer Center, with a resolution of about 1 km² would be of limited use for monitoring fires as the average area burnt per fire in the project area in 1998 was only 183 ha.

8.2. Other factors

Project support is provided to Village Development Funds that help decrease areas under shifting agriculture by increasing paddy area, tree crop planting, and in-village income generating activities. By reducing area of shifting agriculture the risk of uncontrolled forest fires is reduced. Also, steady increase in the area planted to the jungle spice “Makwaen” (Zanthoxylum limonella) as a cash crop in some villages will reduce fire risk. Since this tree is very susceptible to fire damage, village fines for fire damage are very high in some villages-up to $132 per mature tree (Hoare and Maneeratana, 1997).

8.3. New opportunities for reducing smoke through empowerment of sub-districts

The recent empowerment of sub-district administrations and rural communities under the Tambon Administration Act of 1995 and the 1997 national constitution to have an increased role in managing natural resources presents new opportunities for reducing the smoke problem. In 1999, a government guideline was issued that 20% of the sub-district budget should be spent on natural resource management projects. These legislative changes can support the Village Watershed Network process for developing community fire and natural resource management plans at the sub-district level.

8.4. Research needs

The lack of reliable data for policy makers is a major constraint to planning to reduce the smoke problem. Official RFD statistics on area burnt are often much less than the actual area, as they focus on reforestation areas. There is a narrow window of opportunity to conduct field surveys to collect more reliable data on areas burnt and causes of fires during March and April, before the rainy season begins, and rapid appraisals of areas burnt during this period are difficult due to poor visibility. This is a major impediment to efforts to improve the reliability of official data. Landsat images are only of limited use as cloud cover often exceeds 20% from mid-March onwards, precisely when images are needed to monitor areas burnt. Improved satellite technology at lower cost is needed before it can be useful at the provincial or district level for monitoring fires. Early burning or prescribed burning strategies need to be field tested as a strategy for “El Nino” years. One constraint, however, is that much of the project area is in a National Forest Reserve where burning is illegal.

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