Guidelines for the Implementation of Controlled Burning Practices

The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967. The members of the Association are Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam. The ASEAN Secretariat is based in Jakarta, Indonesia.

For inquiries, contact:
Public Affairs Office
ASEAN Secretariat
70A, Jln. Sisingamangaraja
Jakarta 12110
INDONESIA

Phone : (62-21) 724 3372, 726 2991
Fax : (62-21) 739 8234
E-mail : public@aseansec.org

General information on ASEAN appears on-line at the ASEAN Website:
www.aseansec.org

Cataloging-in-Publication Data

Guidelines for the Implementation of Controlled Burning Practices
The ASEAN Secretariat,-
Jakarta: ASEAN Secretariat, 2004

vi, 58 p.; 17.5 x 24.5 cm

1. Agricultural – Environmental sustainability – ASEAN
2. Controlled burning – Environmental impacts – ASEAN
3. Sustainable development – Agricultural – ASEAN

I. Title

303.70959 – ddc21

ISBN: 979 – 3496 – 07 – X

Cover photographs:
- Ashing process
- Drying process
- Fire break and canal
- Water pond
- Planting on peatland in Sungai Selamat, Pontianak, West Kalimantan

Photos by Dr. Lailan Syaufina, Bogor Agricultural University

Printed in Indonesia

Message by the Secretary-General of ASEAN

Since the 1997/1998 severe haze episode, ASEAN has instituted a number of measures to prevent the outbreak of fires which contributes to transboundary haze pollution in the region. The ASEAN Environment Ministers adopted the policy on zero burning in April 1999, and agreed to promote its application by plantation companies, timber concessionaires and other relevant parties in the region. Since then, numerous dialogues have been conducted to promote zero burning practices among plantation companies and timber concessionaires in the region. The Guidelines for the Implementation of the ASEAN Policy on Zero Burning have also been published and are being disseminated to promote its application.

In March 2003, the ASEAN Environment Ministers recognised the need for guidelines on controlled burning, where zero-burn techniques could not be practiced, especially by smallholders, farmers and shifting cultivators. These Guidelines are therefore published to serve that purpose.

The Guidelines provide recommendations for the implementation of controlled burning and other related practices and alternatives for smallholders, farmers and shifting cultivators, to promote sustainable forest management and environment-friendly land management and agricultural practices. The Guidelines were developed from case studies and surveys on current best practices in Indonesia, especially in Sumatra and Kalimantan. Apart from controlled burning practices, the Guidelines also highlight the benefits, prerequisites as well as challenges in implementing controlled burning practices. I hope that these Guidelines will lead to effective implementation of controlled burning by smallholders, farmers and shifting cultivators, and thereby contribute to mitigating the transboundary haze pollution experienced periodically in the region.

I congratulate the ASEAN Working Groups on Sub-Regional Firefighting Arrangements (SRFAs) for Sumatra and Borneo and the Government of Indonesia for taking the lead in developing the Guidelines. Our appreciation also goes to the Global Environment Facility/United Nations Environment Programme and East Asia and Pacific Environmental Initiative/US Department of Agriculture Forest Service for providing financial support, and all those who have contributed to the development of the Guidelines.

ONG KENG YONG
Secretary-General of ASEAN

Message by the Chairperson of ASEAN Senior Officials on the Environment-Haze Technical Task Force

It is an honour for me to give a few words for the publication of the "Guidelines for the Implementation of Controlled Burning Practices". The Guidelines were developed following the ASEAN Agreement on Transboundary Haze Pollution, which was signed on 10 June 2002 in Kuala Lumpur, and recognising the decision of the Tenth ASEAN Ministerial Meeting on Haze in March 2003. The Guidelines are considered necessary where zero burn techniques could not be practiced, especially by smallholders, farmers and shifting cultivators.

The tendency of the causes of fire since 1997 up to present has changed. In 1997/ 1998, fires were mainly caused by open burning practices carried out by plantations. Recently, communities especially the smallholders tend to be the main causes of fire occurrence. Limited funds and technology become the reason that the smallholders are still conducting land preparation with burning. However, no guidelines have been documented so far. Therefore, developing guidelines for the implementation of controlled burning are important since fire control has become a must.

It has been recognised that most of the traditional communities depend on the use of fire in land clearing and preparation, including those in Indonesia. Since the Guidelines were developed based on intensive literature studies and field work on various burning practices in several areas in Indonesia, especially in Sumatra and Kalimantan, the Guidelines reflect the capability of smallholders in implementing the practices. Hence, I do hope the Guidelines could be a valuable reference for ASEAN member countries with some proper adjustments to accommodate each country's needs and traditional practices.

Finally, I would like to express my gratitude to all who have contributed in the development of the Guidelines. Hopefully, the Guidelines may benefit to the policy makers in further developing technical guidelines.

LIANA BRATASIDA
Chairperson, ASOEN-HTTF
Special Assistant Minister for Global Environment
Ministry of Environment
REPUBLIC OF INDONESIA

Table of Contents

List of Boxes

1. Introduction

1.1 Background

Over the past two decades, fires and haze in the ASEAN region have been influenced by rapid demographic changes, increased human activities and climatological factors. The pernicious practice of burning forests to clear land for commercial purposes and the extraordinarily dry weather combined to produce a pall of catastrophic proportions. The results have been devastating as severe droughts over the last two decades have combined with development and agricultural activities in the rain forests and indiscriminate use of fire for land clearance.

The ASEAN's Regional Haze Action Plan, which was adopted by the ASEAN Environment Ministers in December 1997, encourages formulation of policies for prohibiting open burning and enforcing strict control of slash-and-burn practices during the dry period. The ASEAN Environment Ministers at the 6th ASEAN Ministerial Meeting on Haze in April 1999 agreed to adopt the policy on zero burning and promote its application by plantation companies and owners and timber concessionaires in the region. The Ministers also committed themselves to the strict enforcement of zero burning policy. A number of dialogues have been conducted to promote zero burning practices among plantation companies and timber concessionaires. Guidelines on the Implementation of the ASEAN Policy on Zero Burning have been developed and disseminated to provide advice to plantation owners, managers, supervisory staff, and contractors on the application of zero burning techniques. The ASEAN Agreement on Transboundary Haze Pollution, which entered into force in November 2003, specifically calls for the development and implementation of legislative and other regulatory measures, as well as programmes and strategies to promote zero burning policy.

ASEAN member countries have noted the difficulties in implementing the zero burning policy at the local level, particularly by the local communities. It was therefore agreed that public awareness programmes and development of guidelines and techniques on controlled burning should be pursued. The ASEAN Environment Ministers at the 10th ASEAN Ministerial Meeting on Haze in March 2003 in particular noted the need for guidelines on controlled burning, where zero burning techniques could not be practiced, especially by smallholders, farmers and shifting cultivators. These guidelines were developed in recognition of the need and following the above ministerial-level decision.

1.2 Objective

These guidelines were developed to provide recommendations to smallholders[1], farmers and shifting cultivators in implementing controlled burning techniques, following the principles of sustainable forest management and environment-friendly land management and agricultural practices. The guidelines were based on selected controlled burning practices in Indonesia, various studies, and literatures. Field surveys were carried out in several locations in Sumatera and Kalimantan to provide further inputs for the development of the guidelines.

1.3 Scope and Methodology

1.3.1. Approach

The following were steps taken in the development of the guidelines:

- Conduct of literature search and review, field surveys, and interviews with community leaders, local NGOs, universities, relevant individuals and organisations.
- Preparation of the draft guidelines.
- Review of the draft guidelines by Ministry of the Environment, Indonesia;
- Presentation of the draft guidelines to the 13th Joint Meeting of the ASEAN Working Groups on Sub-regional Firefighting Arrangements (SRFAs) for Sumatera and Borneo (31 July - 2 August 2003).
- Revision and submission of the draft final guidelines to the ASEAN Secretariat.

1.3.2. Literature Search and Review

Literature search was conducted to review definitions, methodologies, and principles of controlled burning practices. Review of the relevant regulatory aspects of the ASEAN Agreement on Transboundary Haze Pollution and relevant regulations in Indonesia was conducted with the guidance of ASEAN Secretariat and Ministry of the Environment, Indonesia. An internet search was undertaken to find relevant definitions, methodologies, and principles of controlled burning used in other parts of the world (mostly in US and Australia).

---

1 Smallholders are defined as independent owners or legal occupiers of small areas of agricultural land. Their land preparation activities are not for commercial purposes, and they are not associated with any commercial or illegal land development activities.

1.3.3. Field Surveys

Field surveys were conducted during the periods of 22 to 30 June 2003 in Bengkulu, Sumatera and 6 to 10 July 2003 in West Kalimantan, to verify information about controlled burning techniques found in the literatures, and provide an overview of current practices, applicable technology alternatives and successful examples of controlled burning practices. The following people were involved during the surveys:

- Farmers in Pal VIII village, Bengkulu, Sumatera.
- Government officials at the Local Forestry Office, Bengkulu, Sumatera;
- Farmers in Sungai Selamat, Rasau Jaya Umum, and Rasau Jaya III villages, Pontianak, West Kalimantan.
- Shifting cultivators in Pahauman village, West Kalimantan.
- NGOs in Rasau Jaya Umum, West Kalimantan.
- Academic staff of Tanjung Pura University, West Kalimantan.
- Government officials at the Environmental Impact and Management Agency, West Kalimantan.

1.3.4. Review of Draft Guidelines

The Indonesian Ministry of the Environment organised a meeting in July 2003 to review and provide comments on the draft guidelines. The meeting involved relevant government institutions, namely Ministry of Forestry, Ministry of Agriculture, Meteorology and Geophysics Agency, Ministry of Foreign Affairs, Ministry of Health, and provincial forest and plantation services of Sumatera and Kalimantan.

The draft guidelines were then presented to the 13th Joint Meeting of SRFAs for Sumatera and Borneo on 31 July - 2 August 2003 in Jambi, Indonesia. The meeting requested member countries to give comments and suggestions for the guidelines. Comments were received from Ministry of Development, Brunei Darussalam; Department of Environment, Malaysia; Department of Environment and Natural Resources, Philippines; Ministry of the Environment, Singapore; Ministry of Natural Resources and Environment, Thailand; and Ministry of Agriculture and Rural Development, Viet Nam. ASEAN Secretariat reviewed the draft guidelines and worked with the consultant to ensure that comments received from member countries were incorporated. ASEAN Secretariat also edited the final draft of the guidelines and provided some suggestions to improve the guidelines.

2. Overview of Controlled Burning Practices

2.1 Definition

Controlled burning[2] is the controlled application of fire to fuels in either a natural or modified state, under specified environmental conditions that allow the fire to be confined to a predetermined area and at the same time produce the intensity required to achieve pre-determined management objectives. In other words, controlled burning is the use of fire in a knowledgeable manner to fuel on a specific land area under selected weather conditions to accomplish predetermined, well-defined management objectives.

Controlled burning as defined in the ASEAN Agreement on Transboundary Haze Pollution means "any fire, combustion or smouldering that occurs in the open air, which is controlled by national laws, rules, regulations or guidelines and does not cause fire outbreaks and transboundary haze pollution."

2.2 Techniques

There are various firing techniques that can be used to accomplish a burning objective. The selected technique must be co-related closely with burning objectives, fuels, topography, and weather factors to prevent damage to forest resources. The technique can change as these factors change. Atmospheric conditions should be favorable for the smoke to rise into the upper air and away from smoke-sensitive areas, such as public roads, airports, populated areas, schools, hospitals, and factories.

Based on behavior and spread, fire either moves with the wind (heading fire), against the wind (backing fire), or at right angles/perpendicular to the wind (flanking fire). Heading fire is the most intense because of its faster spread rate, wider flaming zone, and longer flames. It has greater smoke volumes and burns faster than other kinds of fires. Heading fire burns cooler at the ground surface than backing fires or flanking fires. Containment is more critical when wind speed and fuel quantity increase. Backing fire is the least intense, having a slow spread rate regardless of wind speed. Backing fire has a narrow flaming zone and short flames. It is generally the easiest way to burn. It takes longer time to complete the burn, and the smoke density is generally less than in heading or flanking fires. Backing fire burns hotter at the ground surface and

2 The term prescribed burning is widely used in other parts of the world.

does a better job of total fuel consumption than heading or flanking fires. Flanking fire intensity is intermediate. It has moderate flame heights and speed because it moves perpendicular to the wind. It is a modification of backing fires in that lines of fires are set to burn into the wind but at angles to the wind direction. The slope of the land has an effect on rate of spread similar to that of the wind.

There are other firing techniques, such as strip-heading fire, spot fire, and centre fire. There are no additional patterns of burning. Spot fire, for example, would exhibit the three burning patterns.

2.3 Benefits

- Controlled burning could be more economical and efficient compared to other land clearing methods. It does not require a lot of funds to mobilise heavy machinery and advanced technology. Fire could also clear unwanted fuels in a relatively short period of time.
- Controlled burning could improve soil fertility. Fire recycles nutrients, making them available for the crops. Fire could increase the soil pH so that nutrients, such as phosphates, could be made available for the crops.
- Controlled burning could clear away debris, such as limbs, stems and leaves, left from the cutting and felling process, so that planting, weeding and harvesting could be done easily.
- Controlled burning could control the growth of weeds and competing vegetation.
- Controlled burning can only be done within specific weather condition. Since it can only be done during specific time of the year, farmers will have a fixed schedule for doing controlled burning. The location and size of the land area to be burned can also be determined in accordance to the farmers' capacity and needs.
- Controlled burning minimises smoke production. With proper drying, fuels could be burned completely resulting in little residual smoke compared to when the fuels are not dried properly. Scheduled burning could also minimise smoke accumulation that may happen if numerous fires occur at the same time.
- Controlled burning could help in controlling pests and diseases.

2.4 Potential problems

- Smoke as a result of the burning process consists of vapour, particulate matters, and other components. Burning could produce smoke that may affect the surrounding areas.
- Burning on peatlands may cause serious damage on the ecosystem, such as intensive drainage leading to the loss of peat resources and the loss of hydrological and carbon sink functions.
- Burning on peatlands could produce a large amount of smoke. Peat fire is dominated by smouldering process as incomplete combustion process. The smouldering process produces particulate matters ten times higher than those produced by complete combustion process. Peat fire also produces a large amount of water vapour. The particulate matters and the water vapour will converge in the atmosphere and form smoke.
- Most soil biological properties will be damaged at the temperature of 100°C. Heating between 220°C and 460°C will destroy soil structure. The extent of damage depends largely on the rate at which organic matter is replenished after fire. Soil chemical properties may be changed if the temperature exceeds 460°C.
- Fire may spread to other areas if controlled burning is not carried out properly. Therefore, controlled burning requires adequate planning and proper control.
- A weak government institution handling land and forest fire management at the local level will hinder effective coordination and cooperation between the government and the farmers.
- Concessionaries and plantation companies should not use these guidelines for development of plantations. Burning applied to a large area will produce a lot of smoke. Therefore, these guidelines are not recommended to be used by concessionaires and plantation companies. Zero burning principles should be strictly followed. In this regard, the Guidelines for the Implementation of the ASEAN Policy on Zero Burning could be used as a reference guide.

2.5 Prerequisites for effective implementation

The following should be considered by the government to ensure effective implementation of controlled burning practices:

- There should be some legal measures both at national or local level that specifically regulate controlled burning by smallholders, farmers and shifting cultivators.

- There should be some strict laws and regulations that impose plantation companies and concessionaires to apply zero burning practices.
- The government should continuously promote the change of shifting cultivation into permanent cultivation where smallholders, farmers and shifting cultivators have to settle in one place.
- Guidelines for implementing controlled burning practices should be continuously promoted among smallholders, farmers and shifting cultivators.
- The use of perennial crops that require less frequent land preparation should be promoted.
- Smallholders, farmers and shifting cultivators should be given incentives for doing proper controlled burning practices.
- Smallholders, farmers and shifting cultivators should be made aware of the impacts of uncontrolled use of fire and the resulting smoke.

3. Regulatory Aspects of Controlled Burning Practices in ASEAN and Indonesia

Recurrent episodes of transboundary haze pollution arising from land and forest fires have been and are still the most prominent and pressing environmental problems facing ASEAN today. The United Nations Environment Programme (UNEP) labelled the 1997-1998 fire-and-haze episode among the most damaging in recorded history. The total economic losses in terms of agriculture production, destruction of forest lands, health, transportation, tourism, and other economic endeavours have been estimated at US$ 9.3 billion.

Following the 1997 fire-and-haze episode, the ASEAN Senior Officials (ASOEN) - Haze Technical Task Force (HTTF) was established in September 1995 and the Regional Haze Action Plan (RHAP) was adopted in December 1997. The RHAP outlines an overall framework for guiding the process of strengthening the region's capacity to address transboundary haze pollution problem. It contains three major components: prevention, mitigation, and monitoring. Different countries have been designated to spearhead the activities that fall under each of the three components. Malaysia coordinates activities on prevention, Indonesia on mitigation, and Singapore on monitoring of fires and haze. All ASEAN member countries also undertake national-level activities related to the RHAP components.

Since the adoption of the RHAP, the HTTF under the guidance of ASEAN Environment Ministers has undertaken various initiatives, as highlighted in Box 1.

One of the most important legal measures undertaken in response to transboundary haze pollution problem is the development of the ASEAN Agreement on Transboundary Haze Pollution. The agreement was signed by all ASEAN member countries on 10 June 2002. It entered into force on 25 November 2003, following the deposit of the sixth instrument of ratification by the Government of the Kingdom of Thailand on 26 September 2003. The agreement provided for its entry into force sixty days after the deposit of the sixth instrument of ratification. As of the finalisation of these guidelines, six ASEAN member countries, namely Brunei Darussalam, Malaysia, Myanmar, Singapore, Thailand and Viet Nam have deposited their instruments of ratification/approval with the ASEAN Secretariat.

Box 1. Various initiatives under the RHAP

■ Institutional Arrangements
- ASEAN Ministerial Meeting on Haze
- Haze Technical Task Force
- Sub-regional Firefighting Arrangements (SRFA) for Sumatera, Borneo and other areas in the region
- RHAP Coordination and Support Unit within the ASEAN Secretariat
- Sub-regional Climate Review Group
- SRFA Legal Group on Law and Enforcement
- SRFA Simulation Organising Committee

■ Policy Initiatives
- Regional Haze Action Plan
- ASEAN Agreement on Transboundary Haze Pollution
- Zero-Burning and Controlled Burning Policy

■ Projects/Activities
- Guidelines for implementation of zero burning policy
- Dialogues with plantation companies and timber concessionaires
- Community-based fire management programmes through pilot projects in fire-prone areas
- Demonstrations/workshops on best management practices
- Public and community awareness programmes at all levels
- Development of ASEAN Haze Action Online website (www.haze-online.or.id) to promote implementation of RHAP
- Peatland management initiatives and strategy
- Strengthening of the ASEAN Specialised Meteorological Centre and the capacity of National Meteorological Centres
- Capacity building and development of tools for early warning system
- Development and updating of regional inventory of firefighting resources
- Development of Fire Suppression Mobilisation Plans and Immediate Action Plans in fire-prone areas
- Development of Sub-regional Standard Operating Procedures for joint emergency response
- Training and simulation exercises to strengthen coordination in emergency response and disaster relief

The agreement seeks to "prevent and monitor transboundary haze pollution as a result of land and/or forest fires which should be mitigated, through concerted national efforts and intensified regional and international co-operation." Article 4.1 of the agreement indicates that parties of the agreement "shall co-operate in developing and implementing measures to prevent and monitor transboundary haze pollution as a result of land and/or forest fires which should be mitigated, and to control sources of fires, including by the identification of fires, development of monitoring, assessment and early warning systems, exchange of information and technology, and the provision of mutual assistance." The agreement, therefore, provides a basis for the development of best practices to control sources of fires. Article 9 of the agreement indicates that "each party shall undertake measures to prevent and control activities related to land and/or forest fires that may lead to transboundary haze pollution." In doing this, the agreement, among others, encourages promotion of indigenous knowledge and practices in fire prevention and management. Article 9.f of the agreement specifically mentions the need to promote and utilise indigenous knowledge and practices in fire prevention and management.

In Indonesia, there are several government regulations related to land and/or forest fire. The most recent one is the Government Regulation Number 4, Year 2001 regarding Control of Environmental Damage and/or Pollution related to Land and/or Forest Fire. The following are main elements of the regulation:

- Prevent land and/or forest fire and environmental damage and pollution.
- Mitigate land and/or forest fire and environmental damage and pollution.
- Rehabilitate the impacts of land and/or forest fire and environmental damage and pollution.
- Provide clear responsibilities to the government at central, provincial, and district levels, as well as concession/license holders.
- Provide full authority to each province and district to develop its own land and forest fire management organisation.
- Make clear the responsibility of individual or concession/license holders in the event of land and forest fire occurrences.
- Enhance the community awareness through the development of traditional values and practices supporting land and forest protection, and the advancement of community-level organisation.

Article 11 of the regulation indicates that the traditional practices of local and indigenous communities in clearing land for farming or cultivation may result in land and/or forest fire. The same article also mentions that to prevent fire from getting outside the community respective areas, the local government should develop some preventive measures, such as improving the community awareness.

Ministry of Environment, Indonesia has recently developed general guidelines for land preparation using rotation burning, based on traditional values practised for generations. The guidelines contain burning techniques that minimise smoke accumulation and negative impact on the environment.

Local and indigenous communities practising slash-and-burn techniques for land clearing have often been blamed for the occurrence of transboundary haze pollution. Many of the indigenous communities, however, have established their own customary laws and traditional practices to protect their areas and minimise damage resulted from fires. Various studies also indicate that areas under community control experienced less burning activities. In these areas, the communities are actively engaged in managing fires and haze and developing their own management scheme for managing fires and haze. These guidelines, therefore, were developed based on selected traditional practices and values that have been used by the communities for decades. The guidelines have to be practical and simple and should not require the use of sophisticated and advanced technology.

4. Selected Controlled Burning Practices in Indonesia

For thousands of years, indigenous communities have been using fire in preparing land for farming or land cultivation. Fire has been used as a tool to clear the potential cultivated area because it is the cheapest and quickest means and it can improve soil fertility. Many of the indigenous communities have developed their own techniques to protect their areas and minimise damage resulted from fires. Such traditional techniques can serve as alternatives for the implementation of controlled burning practices.

This chapter reviews permanent and shifting cultivation systems used by local and indigenous communities in Indonesia, particularly in Sumatera and Kalimantan. For the purpose of discussion, these farming/land cultivation systems are divided into two large categories, namely: (i) farming/land cultivation systems for peatland, and (ii) farming/land cultivation systems for dry land. The systems include site selection, stages in land preparation, burning techniques, and planting techniques.

4.1 Farming/land cultivation system for peatland

4.1.1. Permanent agriculture practices in Sungai Selamat, Pontianak district, West Kalimantan

a. Land preparation

- Site selection: Land area with bushes and scrubs, with a flat topography and size of 1,000 - 5,000 m^2.
- Slashing: Slashing shrubs and undergrowth and felling trees that have a diameter up to ± 10 cm using machete. Fuels produced from slashing and tree felling are laid out evenly over the planting area.
- Drying: Drying of fuels is conducted in 5 days - 1 week, depending on weather condition. The drier the weather, the faster the drying process.
- First burning: Burning is preceded with constructing a firebreak of 1 to 2 m wide around the selected area. Fuels along the strip are cleared to make sure that fire will not escape. Burning is scheduled between 14:00 - 15:00. The firing technique used is ring firing as shown in the following figure:

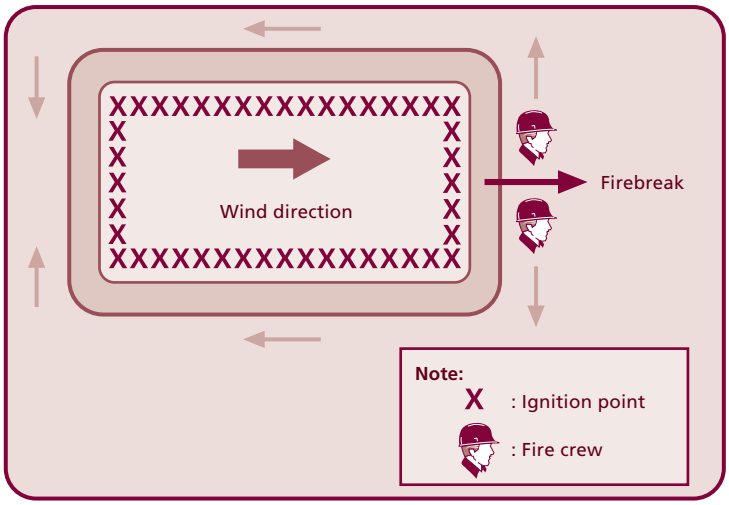

Figure 1. Ring firing technique

- Hoeing: The burn area is subsequently hoed to loosen the soil clods. Weeds and other remaining plants are collected and put in one location called the ash house.
- Construction of beds: For planting purpose, beds are constructed with a size of 1.5 m x 10 m x 15 cm.
- Second burning: Weeds and remaining plants collected in the ash house are burned into ashes.
- Ash spreading: Ashes left after burning are spread over the beds to improve soil fertility of the planting area.

b. Planting

- Sowing of seeds: Seeds of secondary crops, such as: *sawi* (Brassica sp), lettuce, *kangkung* (Ipomoea, sp.), spinach and *kucai*, are spread over the beds. To protect the growth of seeds, beds are covered with *alang-alang* (coarse grass) or palm leaves.
- Planting: Seeds which have become seedlings are then transplanted to another bed which has been covered by ashes. Additional fertiliser, i.e. manure (chicken manure) or shrimp heads is applied to every hole. Seeds of *kangkung* or spinach do not require transplanting, and the seedlings are allowed to grow in the seedbeds.
- Planting period: Conducted throughout the year.

Pictures and flow chart of permanent agriculture practices for peatland in Sungai Selamat, Pontianak, West Kalimantan are shown in Figures 2. a - c and Figure 3.

(a) Ashing process

(b) Seedbeds

(c) Planting on peatland in Sungai Selamat, Pontianak, West Kalimantan

Figure 2.

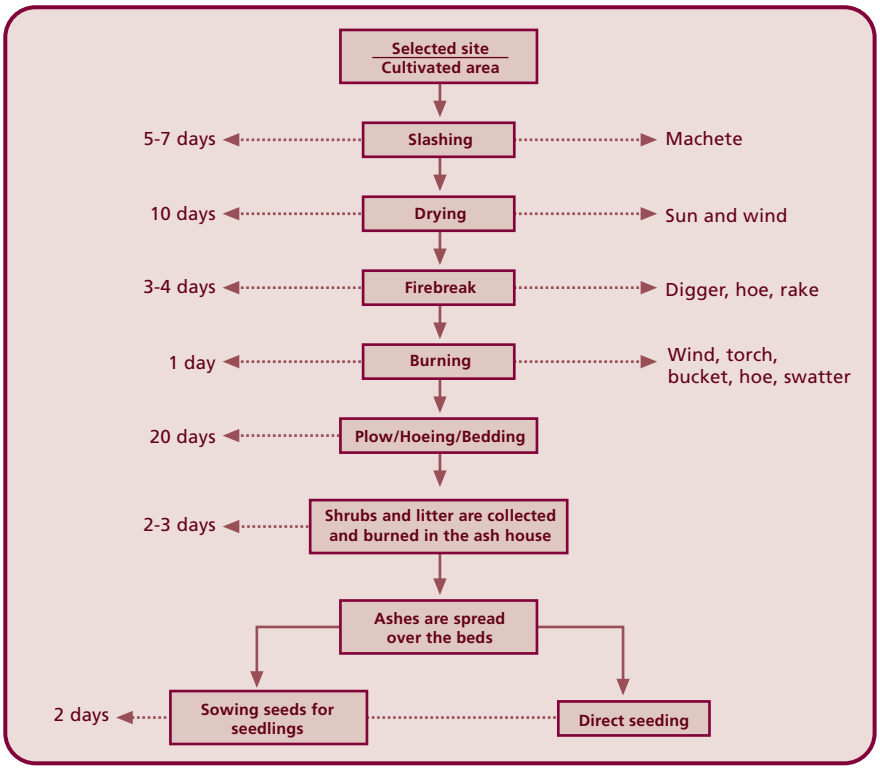

Figure 3. Flow chart of permanent agriculture practices in Sungai Selamat, Pontianak district, West Kalimantan

4.1.2. Permanent agriculture practices in Rasau Jaya Umum village, Pontianak district, West Kalimantan

a. Land preparation

- Site selection: Land area with bushes and scrubs, with a flat topography and size of 1 - 2 ha.
- Slashing: Slashing shrubs and undergrowth and felling trees that have a diameter up to 10 cm using machete. Fuels produced from slashing are laid out evenly over the planting area. Slashing is usually conducted between July - August.
- Drying: Fuel drying process is conducted approximately in 10 days, depending on weather condition. The drier the weather, the faster the process of drying.

- Construction of firebreak: Firebreak of 1 - 2 m wide is constructed along the boundary of the planting area.
- Construction of ditch and water ponds: Ditch of 50 cm wide and about 60 cm deep is constructed to maintain the water table. Every 10 m, water pond with the size of 1 m x 1 m x 1 m is constructed to serve as a water reserve to water the plants during dry season.
- Burning: Burning is scheduled between 14:00 - 16:00 and usually conducted in August. Burning is conducted in stages, not simultaneously. If there is a 2 ha-land area to be burned, the area will be divided into four sections. Burning is conducted together with the other community members. Each group consists of ± 30 people.
- Hoeing: Area that has been burned is then hoed to loosen the soil clods. Hoeing is necessary for planting of aloe vera, pineapple and yams.
- Construction of beds: For planting purpose, beds with the size of 1.5 m x 10 m x 15 cm each are constructed.
- Dibbling: For corn planting, holes for the seeds are made using a dibble.
- Firing technique used is back firing as shown in the following figure.

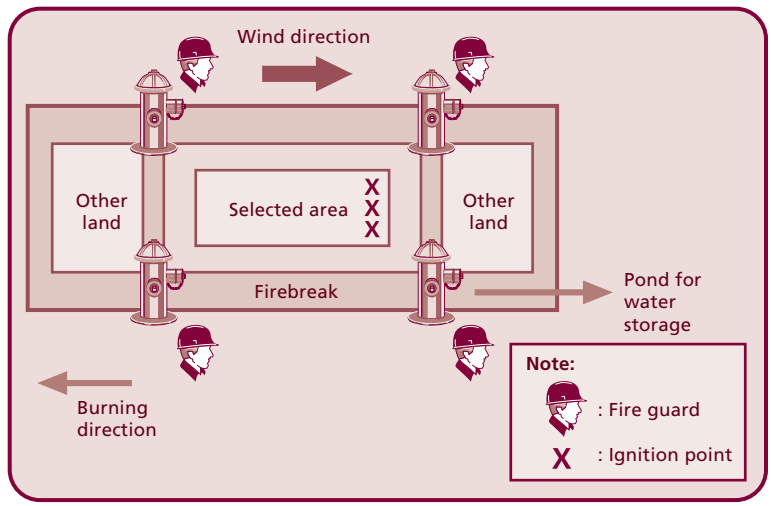

Figure 4. Controlled burning technique using back firing for peatland with canal

b. Planting

- Corn seeds are planted in the holes that have been dibbled. Corn is harvested three times in a year.
- Seedlings of aloe vera, pineapple and yams are planted in the beds.

Flow chart of permanent agriculture practices for peatland in Rasau Jaya Umum village, Pontianak district, is shown as Figure 5.

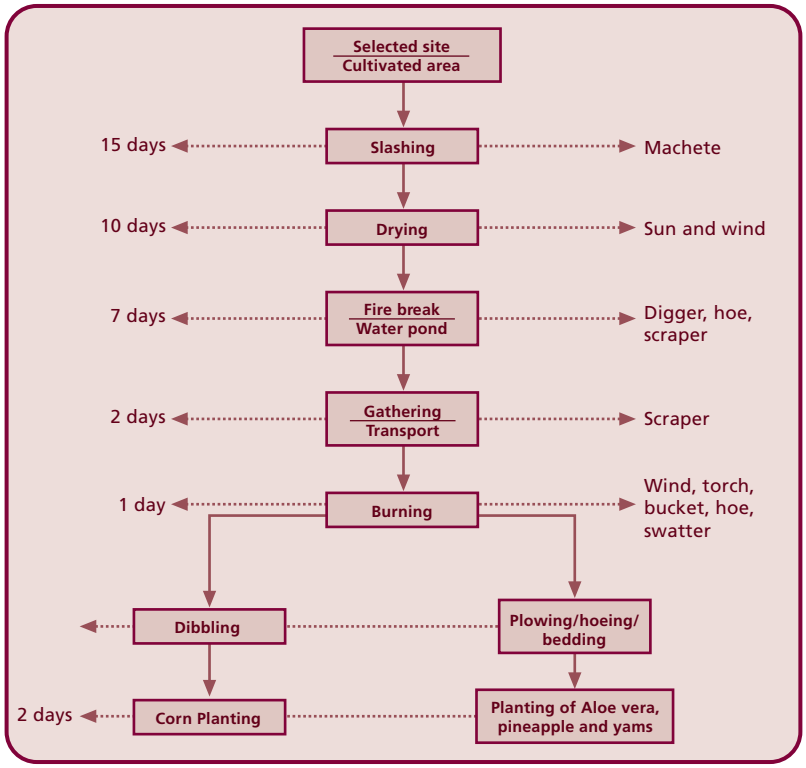

Figure 5. Flow chart of permanent agriculture practices for peatland in Rasau Jaya Umum village, Pontianak district, West Kalimantan

(a) Smoke produced through land preparation by burning

(b) Water pond

(c) Firebreak and canal

(d) Aloe vera grown on peatland in Rasau Jaya Umum, Pontianak, West Kalimantan

Figure 6.

4.1.3. Permanent agriculture practices in Rasau Jaya III village, Pontianak district, West Kalimantan

a. Land preparation

- Site selection: Land with bushes and scrubs, with a flat topography and size of 1 - 2 ha.
- Slashing: The migrants (from Java island) initiates land preparation by slashing shrubs and undergrowth and felling trees that have a diameter of up to ± 10 cm using machete. This process is conducted in ± 3 days. Fuels produced are spread over the planting area. This process is usually conducted in July - August.
- Herbicide application: Unlike the migrants, indigenous people apply herbicide (polaris and round-up) to clear the area from weeds.
- Fuel drying: Drying of fuels is conducted in ± 10 days, depending on weather condition. The drier the weather, the faster drying process.
- Construction of firebreak: Firebreak of 1 - 2 m wide is constructed along the boundary of the planting area.
- Construction of ditch and water ponds: Ditch of 50 cm wide and about 60 cm deep is made to maintain the water table. Every 10 m, water pond with the size of 1 m x 1 m x 1 m each is constructed as a water reserve to water the plants during the dry season.
- Burning: Burning is scheduled between 14:00 - 16:00 using backing firing technique as shown in Figure 3. Burning is conducted in August. Burning is conducted in stages, not simultaneously. If there is a 2 ha-land area to be burned, the area will divided into four sections. Burning is conducted together with the other members of the community. Each group consists of ± 30 people.
- Hoeing/plowing: The burn area is subsequently hoed/plowed to loosen soil clods.

b. Planting

- Rice seeds are planted in the seed holes. Planting is conducted once in a year.

Flow chart of permanent agriculture practices for peatland in Rasau Jaya III village, Pontianak district is shown below:

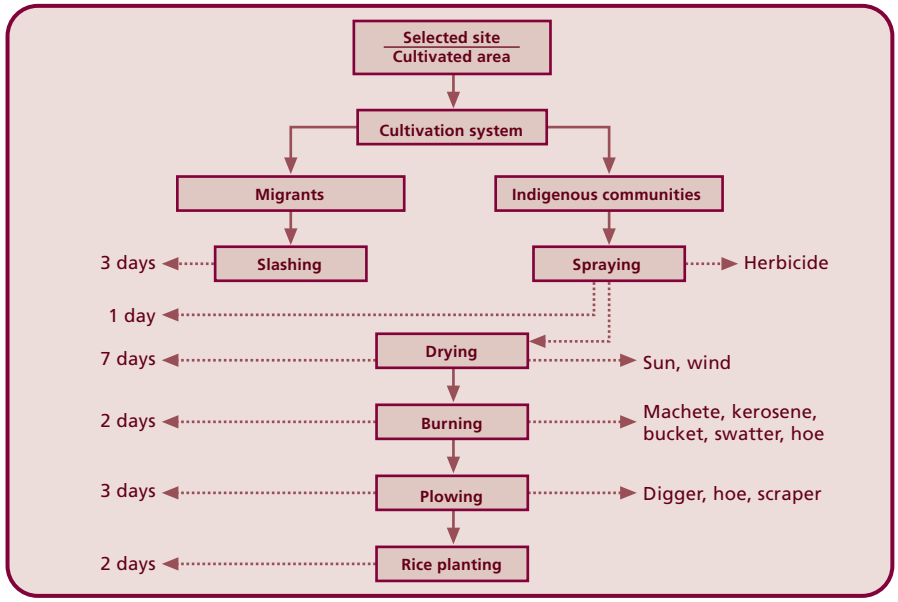

Figure 7. Flow chart of permanent agriculture practices for peatland preparation in Rasau Jaya III village, Pontianak district, West Kalimantan

4.1.4. Controlled burning techniques on peatland originated from secondary forest in Pelalawan village, Riau province (Nurhayati, 2002)

During the case study conducted in 2002, the following controlled burning techniques in secondary peat swamp forest were used:

- Site selection: Secondary peat swamp forest with a size of 0.04 - 1 ha.
- Slashing: Slashing shrubs and undergrowth and felling trees that had a diameter up to ± 10 cm using machete. Fuels produced from slashing were spread over the planting area.
- Tree felling: Cutting down trees that had a diameter of more than 10 cm. Trees with a diameter of > 15 cm were removed from the planting area so that they would not obstruct the burning process and could be used for other purposes.
- Drying: Drying of fuels took about 1 month, depending on weather condition. The drier the weather, the faster the drying process.
- Construction of ditch/canal: Ditch of 50 cm wide and 60 cm deep was constructed to maintain the water table and serve as a firebreak.

- Burning: A fire crew consisting of 4 torch people was needed to set the fires. Two people were positioned in one corner (C and D), where the other two (A and B) were positioned across C and D. Ignition started simultaneously under one command at the two different points. A and B moved in opposite direction while igniting fires along the perimeter. C and D also did the same thing. At the end, B and D would meet at one corner, while A and C would also meet at one corner across B and D. This technique is referred to as ring firing (Figure 8).

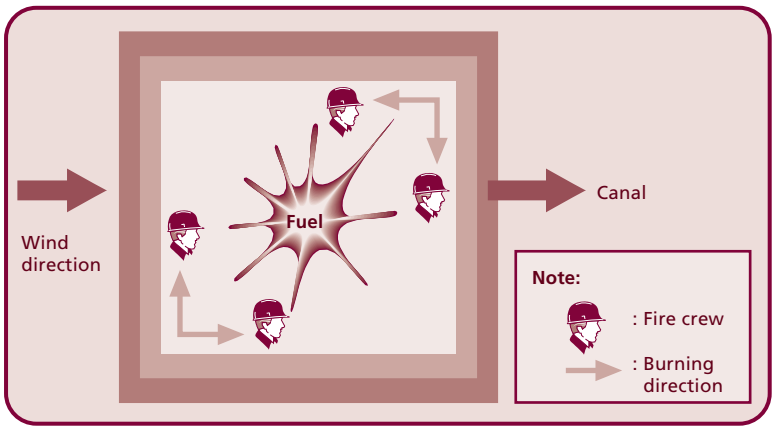

Figure 8. Controlled burning technique in secondary peat swamp forest in Pelalawan, Riau

4.1.5. Burning method in Rantau Rasau village and Sungai Rambut village, Jambi (Otsuka et al., 1997)

a. Site selection

Rantau Rasau village and Sungai Rambut village are two villages bordering Berbak National Park, Jambi. The case study was conducted in canal 5, Dusun Rantau Rasau, which has relatively thick layers of peat. The size of burn area is normally 30 m x 10 m.

b. Fuel preparation

Land preparation starts with slashing the existing shrubs and bushes in the selected area. Slashing is often combined with the application of herbicide.

c. Burning method

Burning method used in this village is quite simple (traditional). Burning is conducted shortly before the rainy season. Some farmers construct firebreaks prior to burning, while others do not. This second method has a greater risk as it may result in uncontrollable fires.

The firing technique used in the first method is backing fire. This technique is used so that weeds and litter can be burned completely. This will make planting and seeding easier. Burning is scheduled after 12:00 when the wind is blowing from the forest (prior to rainy season). Burning of 1 ha-land area takes less than one hour. After burning, the farmers check the flames by mop up to ensure that there is no smouldering material left. When using the technique, fires sometimes escaped to the buffer zone of the Berbak National Park and burned the trees. Firing technique against the wind direction (backing fire) in Rantau Rasau village, Berbak National Park, Jambi, is shown in Figure 9.

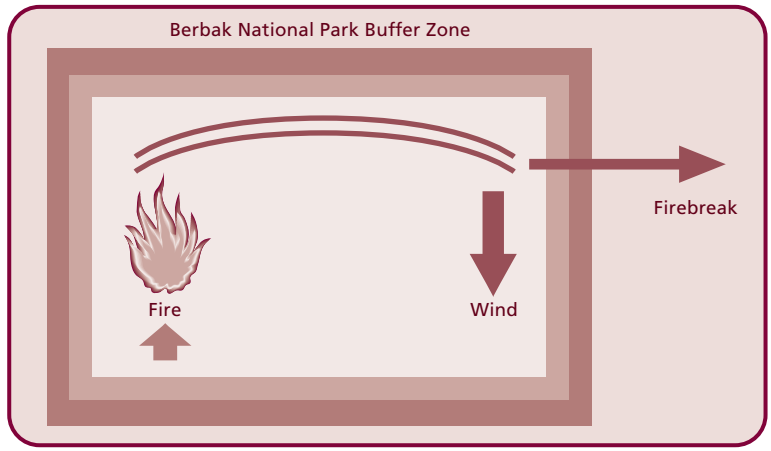

Figure 9. Burning technique against the wind (backing fire) in Rantau Rasau village, Jambi (Otsuka et al., 1997. Picture is modified by the author)

The firing technique used in the second burning method is backing fire. Ignition starts from one point and the fire is allowed to move perpendicular to the wind. This method is applied to potential cultivated areas that are connected. When one's land area (B) to be burned is located adjacent to the other land areas (A, C, D and E),

firebreak is constructed along the boundary of the area to be burned. This method works well due to cooperation among the land owners, i.e. by protecting their areas together during burning. This burning method is shown in Figure 10.

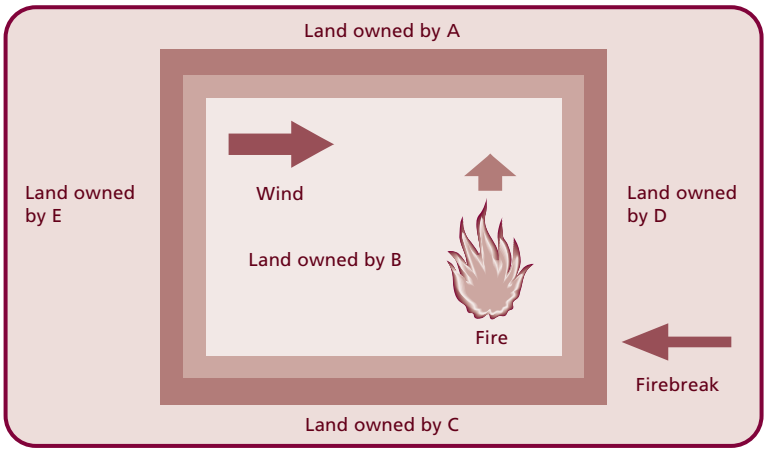

Figure 10. Burning pattern on an area connected to other areas in Rantau Rasau village, Jambi (Otsuka et al., 1997. Picture is modified by the author)

For an area separated by a small lane/road, the ignition starts from the side of the road, and the fire crew moves toward both sides of the area. The burning is conducted simultaneously. Fire moves from the side of the road towards plot A and plot B. There is a risk of uncontrollable fires using this method, unless firebreak is constructed (Figure 11).

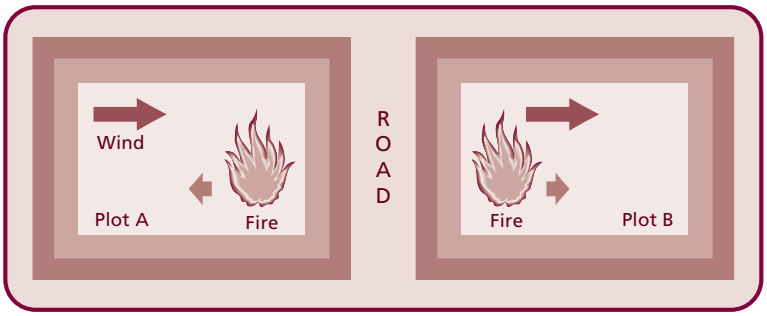

Figure 11. Burning pattern on areas divided by road in Rantau Rasau village (Otsuka et al., 1997)

Other burning method is pile burning or stack burning as shown in Figure 12. Prior to burning, dried fuels are collected into one or several piles at the centre of the selected area. The piles will be burned after they are completely stacked. Burning using this method is concentrated only at the centre of the selected area, so that the fire will not spread out of control. The method is relatively safe and effective, although burning takes longer compared with other techniques. It also requires more people to collect the fuels. This technique is used by farmers in Dusun Sungai Palas, which is part of Rantau Rasau village.

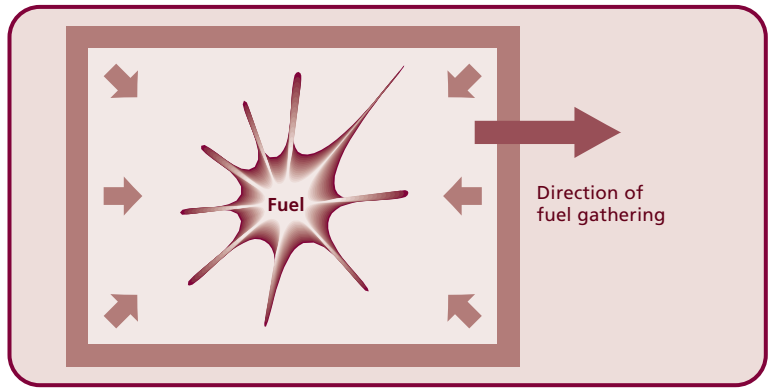

Figure 12. Burning pattern proceeded by piling the fuels at the centre of the selected area (pile burning) (Otsuka et al., 1997)

4.2 Dry land farming/land cultivation system

4.2.1. Land cultivation by Dayak Kanayank tribe in Pahauman village, Landak district, West Kalimantan

a. Land preparation

- Site selection: The sites selected as potential cultivated areas are primary forest and secondary forest located at the slope and flat landscape.
- Size of cultivated area: The size of forest area to be cultivated is at least 8 gentangs (1.28 ha) and at most 15 gentangs (2.4 ha).
- Slashing and tree felling: Slashing of shrubs and felling of trees are conducted in July. Ten people are involved in this process.

- Drying: Drying of fuels takes about 1 month for old forest, and 2 - 3 weeks for young forest.
- Burning: Before burning, firebreak is constructed around the selected area. The width of firebreak is ± 5 meter. The firebreak is then bordered by trees (intermediate trees), such as rubber and jack fruit. Burning is scheduled at 15:00. Fire is ignited by 1 torch person. Burning usually takes place in August. Burning at the slope starts from the upper to the lower side. However, after half of the area has been burned, burning starts again from the lower side. This burning method is shown in Figure 13. The village head will give a penalty if fires spread out of the selected area. The penalty could be in the form of a fine of Rp 5,000 per crop. The total amount depends on the area burned by the uncontrollable fires and at the discretion of the owner of the burnt area.

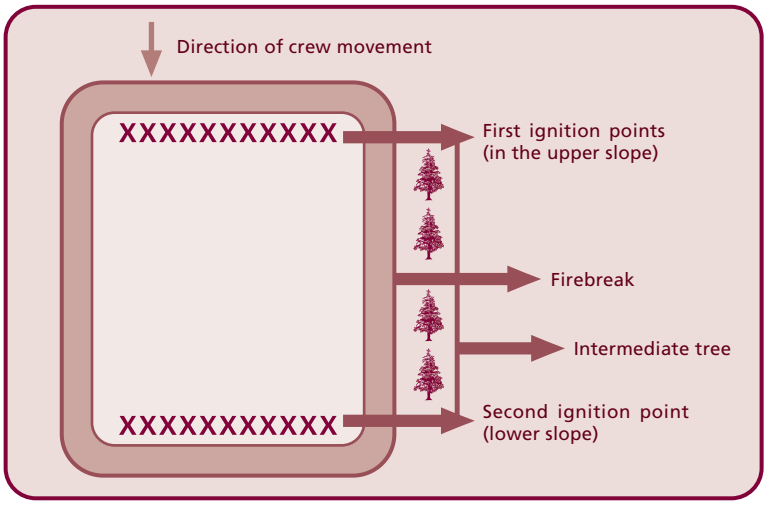

Figure 13. Burning method at the slopes of Pelalawan village, Landak district, West Kalimantan (picture is modified by author)

b. Planting

- Dayak Kanayank tribe in Pahauman village has a good knowledge of various crops cultivation. Main crops cultivated include among others rice, vegetables, cucumber and *keladi* (Colocasia sp.). Farming tool normally used is dibbles. Planting is usually conducted in October.

(a) Burn area to be used for farming

(b) Ex-shifting cultivation in hilly area in Landak district, West Kalimantan

Figure 14.

4.2.2. Land cultivation by Dayak Kantu tribe in West Kalimantan (Dove, 1998)

a. Land preparation

- Site selection: Sites selected are mostly close to the river and normally are not too near from the long house. The selected sites are primary forest and secondary forest. During the case study, the size of the selected area originated from primary forest was approximately 3.43 ha, while the size of the selected area originated from secondary forest was approximately 2.63 ha.

- Fuel preparation: Clearing of the selected site starts with slashing and tree felling. Tool used for slashing is machete, while the tool used for felling trees is Dayak axe called *beliyong*. The following stage is cutting the branches and tree stems into smaller parts (called *ngaredak*). Dayak Kantu people usually cut branches from the main stems if the selected area is originated from secondary forest. If the selected area is originated from primary forest, such cutting is often not required, because big branches frequently are broken to pieces after tree felling. Duration of drying period in a selected area originated from secondary forest is an average of 38.6 days, while drying period in a selected area originated from primary forest is about 87.3 days.

- Firing technique: Firing technique used in the area of Kulit Tuba (West Kalimantan) is head firing. This firing technique is shown in Figure 15. Torch is used to ignite fires. One tract of land is burned by one torch person or a group of up to 4 torch people, who usually are neighbours. After everything is ready, the fire crew light the torches and walk along the perimeter of the selected area. They ignite fires every several meters using their torches. The forward movement of the fire crew is determined by wind direction. Dayak Kantu people always start the burning from the side of the land where the wind is blowing. Firstly, they ignite the whole side, and then they burn the two sides which are in the same direction to the wind. This technique is called ngerantai by Dayak Kantu people. The fire crew should always check the wind direction because wind direction will significantly affect fire spread and determine success of the burning. Burning in Kulit Tuba area is usually conducted at noon between 11:30 - 12:30, and each burning can be completed within one hour. The advantage of burning at noon compared with burning in the morning is the fuels have been dried enough due to sunlight exposure of 5 - 6 hours since the morning time. Besides, at noon, the wind starts to blow, and this will help increase the fire spread and the chance of burning success (Dove, 1998).

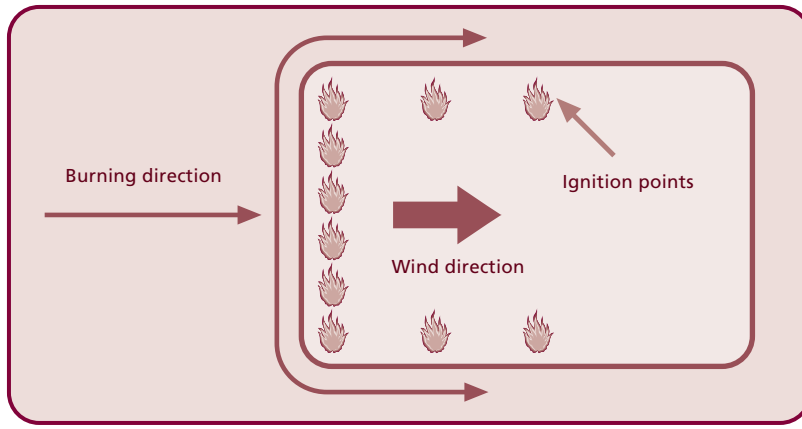

Figure 15. Burning pattern of *ngerantai* used by Dayak Kantu tribe in West Kalimantan (Dove, 1998. Picture is modified by the author)

A modification of this technique is called *ngelayang*. One fire crew moves away from one side of the selected area and walks towards the centre while igniting the fuels. The purpose is to minimise the maximum distance of the fire spread and to ensure that fire burns all parts of the selected area. *Ngelayang* is carried out if there is a change in the wind direction (Figure 16).

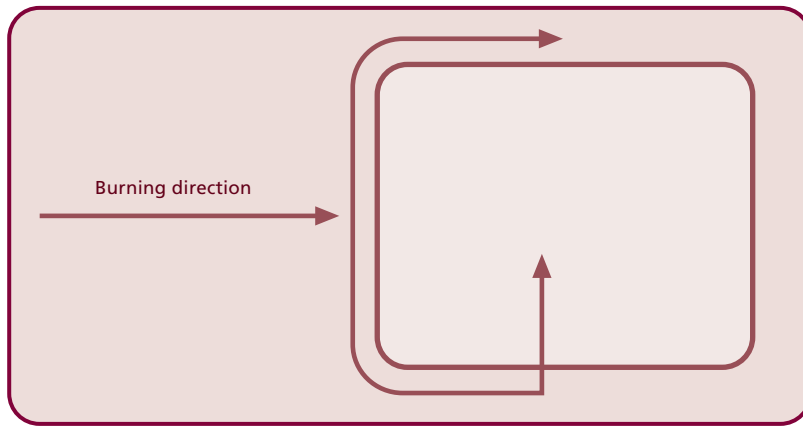

Figure 16. *Ngelayang* burning pattern used by Dayak Kantu tribe in West Kalimantan (Dove, 1998, picture is modified by the author)

b. Planting

- The kinds of crops usually planted in the cultivated areas of Dayak Kantu tribe are rice as main staple, squash, watermelon and cucumber.
- Rice seeds are soaked in water prior to planting to accelerate the growth of seedlings. To make it more efficient, the rice seeds are mixed with other seeds (squash, watermelon and cucumber).
- Planting consists of two steps, i.e. dibbling (making holes in the ground with a dibble), and putting in the seeds to the holes. Dibbling is conducted in lines by making holes of 5 - 7 cm deep and an average distance of 37 cm between the holes. Seed planting is also conducted in lines with a distance of 2 - 4 m. The quantity of seeds planted is 7 holes per m^2 at the average.

4.2.3. Burning method in Gemawang, South Sumatera (Rohasan, 1998)

a. Site selection

The sites selected for cultivation can be secondary forest, old garden, or bush land. Local farmers are not accustomed to opening a cultivation area in more than one location. The size of the selected area is generally around 2.5 - 4 ha (usually the sites are far from each other).

b. Fuel preparation

Land clearing starts with slashing undergrowth, shrubs, bushes and felling trees using machete. Trees with a large diameter are cut with axe. Slashing and felling take place in 1 - 3 weeks. This will allow the fuels to dry. Trees with a diameter of more than 50 cm are removed to be further processed into sawn timber. There is no slicing of fuels as only the ends and twigs are cut. This process usually takes place during dry season in August - September when the rainfall is low. Drying of fuels takes place in 30 - 40 days.

c. Burning technique

There are 3 types of burning techniques used by the local communities:

(1) Modification of spot fire

This technique was used by 9 out of 20 sampled farmers (45%). Firebreak of 4 - 6 m wide is constructed around the selected area. The area is divided into 3 sections. Each section is separated by a narrow firebreak of 0.5 - 1 m wide. This burning technique requires 6 torch people (apart from the fire guards) to ignite the fires. These 6 people are grouped into three groups of 2 people as shown in Figure 17. One group is positioned in the middle of firebreak no. 1, one group in the middle of firebreak no. 2, and the third group at the side opposite to the wind direction. Ignition is conducted simultaneously by the three groups, with burning direction opposite to each other. Ignition points are made along the narrow firebreaks and at the upwind line with a distance of about 1 m. After igniting the fires, the fire crew joins the fire guards to monitor the fires. For an area of 1 - 1.5 ha, it takes 1 - 2 hours to complete the burning.

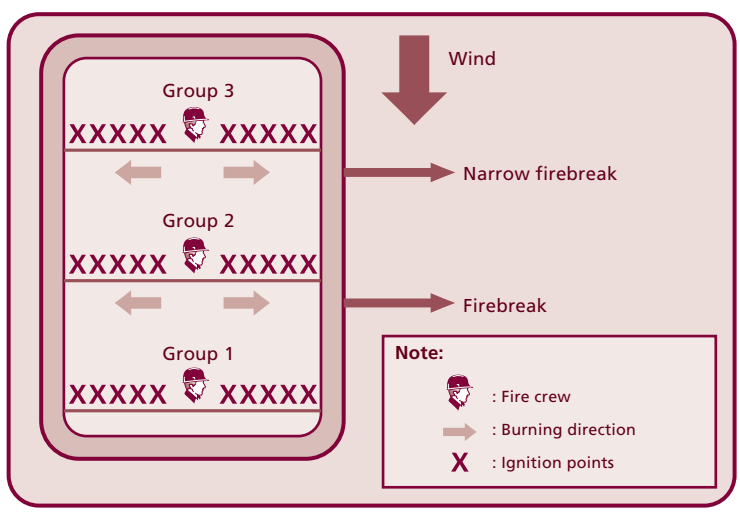

Figure 17. Burning technique against the wind (Rohasan, 1998)

(2) Combination of back firing technique and ring firing technique

This technique was used by 5 out of 20 sampled farmers (25%). This technique requires 4 fire crew who then are grouped into two groups of 2 people (apart from the fire guards) (Figure 18). One group (Group 2) is positioned at the side of the area where the wind is blowing and the other group is at the side opposite to the wind direction (Group 1). Ignition starts from the side opposite to the wind direction. Ignition points are made with a distance of around 1 m in opposite direction. If one sixth of the area has been burned, Group 2 starts to burn the ignition points at the downwind line and along the sides that are opposite to one another until finally the sides are surrounded (circled) by fires. It takes about 1 hour for 1 - 1.5 ha-land area to complete the burning.

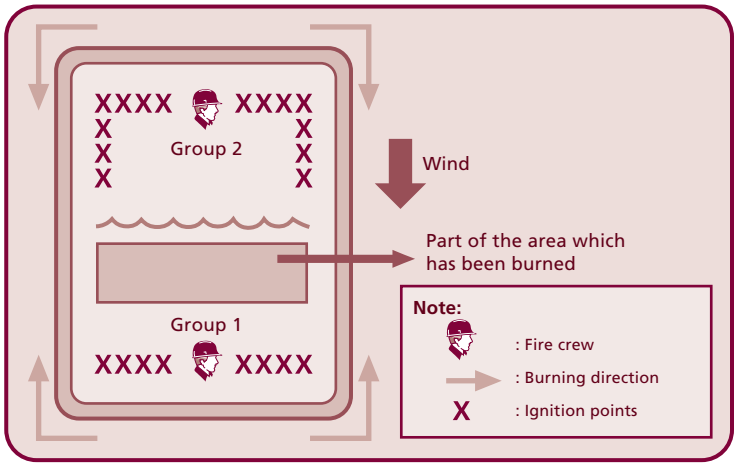

Figure 18. Combination between back firing and ring firing techniques (Rohasan, 1998)

(3) Combination between head firing and ring firing

This technique was used by 6 out of 20 sampled farmers (30%). This technique requires 4 torch people to ignite the fires. Two people (A and B) are positioned at the side when the wind is blowing. The other 2 are positioned at the sides in the same direction as the wind (C and D). A and B start to burn from their

side by burning the ignition points at the opposite direction. A is igniting fires and moving towards C, while B is igniting fires and moving towards D. When A is moving closer to C and B is moving closer to D, C and D will start to burn the ignition points along the perimeter until finally they meet at one point. This burning technique is shown in Figure 19. This technique takes less than 1 hour in 1 - 1.5 ha-land area. Burning is usually scheduled at 15:00 - 17:00.

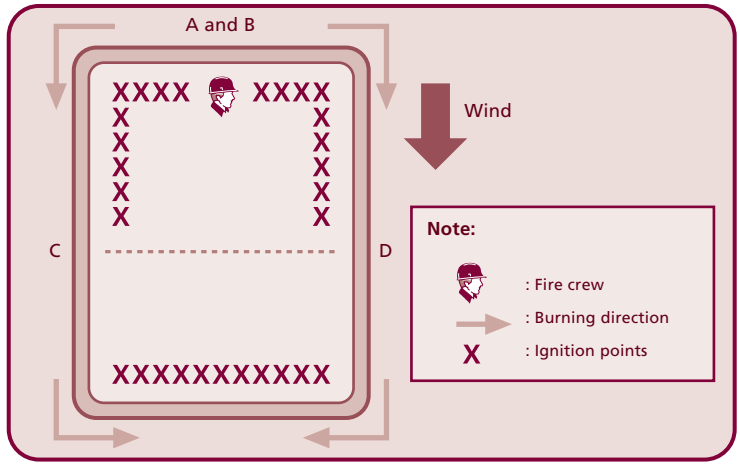

Figure 19. Technique combining head firing with ring firing (Rohasan, 1998)

4.2.4. Burning technique in Subanjeriji, South Sumatera (Saharjo et.al., 1998)

a. Site selection

There following were two burn areas selected for the study:

- Potential cultivated area with the size of 20 ha owned by 13 cultivators.
- Potential cultivated area with the size of 4 ha owned by one cultivator.

b. Fuel preparation

All bushes and undergrowth were slashed, while trees with large and small diameter were felled with chain saw. Trees with a diameter of more than 50 cm were removed from the selected area to be

further processed into sawn timber. Trees with a diameter of ≤ 40 cm, bushes and undergrowth which had been slashed were left on the selected area to be used as fuels. Drying of fuels took 2 - 3 weeks before burning.

c. Burning technique

The technique used was allowing fire head to move to the centre of the selected area. The flame fronts originated from ignition points around the borders were allowed to converge at the centre. With this technique, the possibility of fire to escape could be reduced to minimum (Saharjo et.al., 1998). When applying this technique, the fire crew should examine and calculate the wind speed and direction, and land topography (slope).

(1) Burning of 20 ha-land area

Before burning, fire break of 2 - 3 m wide was constructed around the area. Fuel energy was 15 tons per ha. Fuels were dominated by tree stems with a diameter of 10 - 20 cm. The rest of the fuels were twigs, branches, shrubs, bushes, litter and alang-alang (coarse grass). Fuel depth was 0.5 m, with moisture content of 5.2 - 25.2%.

Ignition started from the edge. Fire crew consisted of 3 people (A, B, and C) positioned at different places as shown in Figure 20. Distance between each torch person was approximately equal. Ignition started simultaneously under one command. While moving in semi running speed, each person ignited the fuels with an interval of 1 m, in the same moving direction i.e. clockwise. This burning technique took only 56 minutes, starting from first ignition up to the moment when the fire was completely extinguished. Maximum temperature of the fire was 760°C with an average flame height of 2.75 m (maximum of 8 m) and fire intensity of 2,568 kW/m.

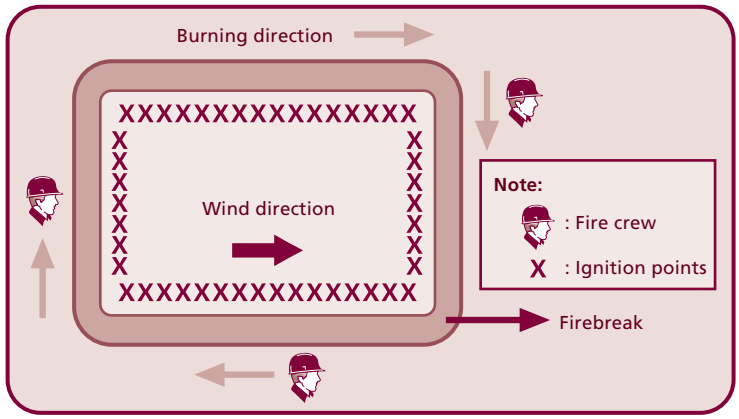

Figure 20. Technique of ring firing on 20 ha-land area with a slope level of < 8% (Saharjo et.al., 1998)

(2) Burning of 4 ha-land area

Fuel energy in this case was 40.3 tons per ha, comprising tree stems with a diameter of 20 - 30 cm. The rest were twigs, branches, slash from shrubs, and alang-alang. Fuel depth was 0.6 m with moisture content of 7.1 - 35.3%. Burning technique was the same as the burning technique conducted on the 20 ha-land area. It was slightly modified because there were some slopes with a slope level up to 30% (Figure 21).

Fire crew consisted of 3 people. Two people were positioned at the same point, but they moved in opposite direction (A and B). C was positioned at the oblique angle and started to burn downward. Burning took place in 25 minutes, maximum fire temperature was 1,000°C, average flame height was 3.13 m with maximum of 12 m, and fire intensity was 3,962 kW/m. Burning was scheduled at 15:00 - 17:00.

The above burning technique can be categorised as ring firing or circle firing technique.

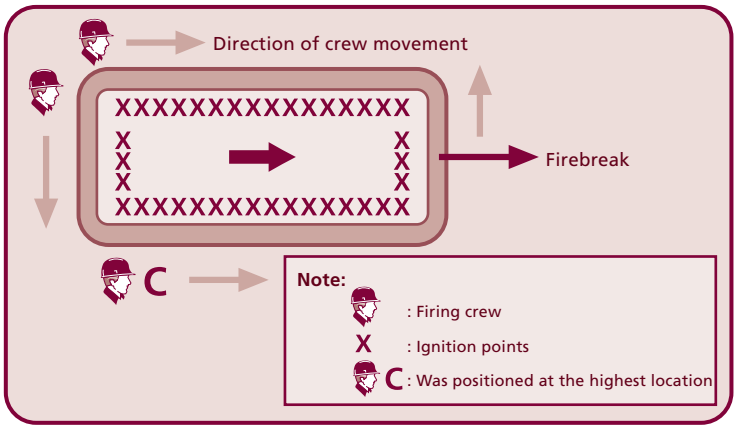

Figure 21. Burning technique of 4 ha-land area with a slope level of 7 - 30 % (Saharjo et al., 1998)

4.2.5. Burning method in Rejang Lebong district, Bengkulu province

a. Site selection

Clearing of potential cultivated area in Pal VIII village, Rejang Lebong is conducted in protected forest, secondary forest, and bush. Size of the selected area is between 1 - 2 hectares.

b. Fuel preparation

Slashing of the undergrowth and bushes by using machete is done at the height of 15 cm above the ground so this process can be completed quickly. For 1 ha-land area, the process takes about 30 days. Farmers usually work individually. The next stage is tree felling using machete or axe. Trees are cut 1 - 1.5 m above the ground. There are cases when trees are cut at the body height. Trees that are too tall (more than 30 m) or buttressed are felled at the height of more than 5 m. Time interval between slashing and tree felling is around 4 weeks. It is then continued with trimming or cutting branches and twigs. Fuels produced from slashing and tree felling are dried under the sun for 30 - 60 days.

c. Burning technique

Before burning, a strip of ± 2 m wide is made around the area to ensure that fire will not escape. This technique is called *kekas*. Burning in Dusun Talang Kedurang is conducted around 12:00 - 13:00, coinciding with the time when the sun is in its full intensity and the wind starts to blow so burning can be done faster. Wind direction can be determined by observing the movement of tree foliage. Torch is made of dry coconut fibre and kerosene is used as the fuel. There are two burning techniques used in the village of Pal VIII, particularly in Dusun Talang Kedurang, i.e. ring firing technique and pile burning technique.

(1) Ring firing technique

This technique is the first and most commonly used technique by farmers in Talang Kedurang (80%) because it is simple. Fire crew consists of two people who are positioned at the corners. Ignition starts from the edge or side of the land area. Ignition starts simultaneously at these two different points under one command. Each torch person moves in the same direction. Fires are allowed to converge at the centre. This will ensure that fires will not escape. This ring firing technique is described in Figure 22.

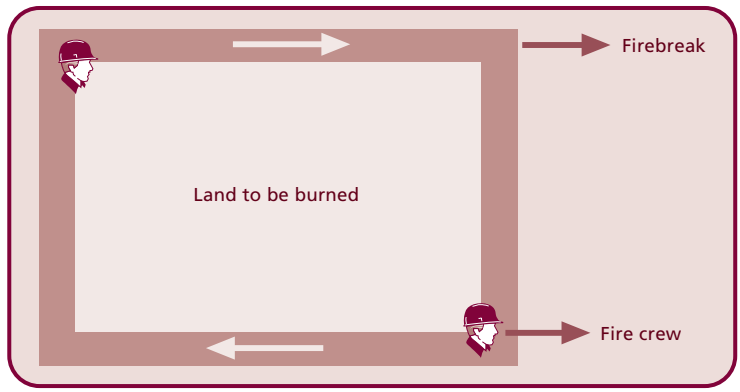

Figure 22. Ring firing technique used in Dusun Talang Kedurang, village of Pal VIII

(2) Pile burning technique

Pile burning or stack burning technique is shown in Figure 23. Before burning, dried fuels are collected in one or several piles at the centre of the potential cultivated area. After the fuels are collected, the piles are burned. Burning is confined only at the centre, and therefore the fires will not escape. This type of burning is relatively safe and effective, although the burning period takes longer than the other techniques and more people are required to collect the scattered fuels.

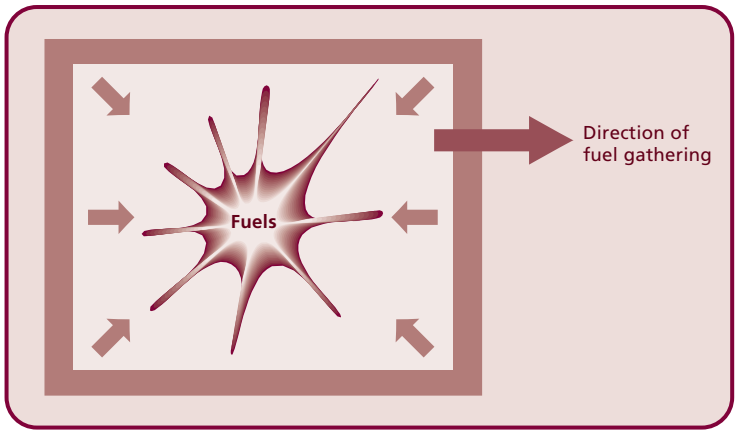

Figure 23. Pile burning technique

One day after the first burning, a second burning or a repeated burning (*manduk*) is conducted by collecting remaining fuels after the first burning. These remaining fuels are collected into piles and subsequently burned. In one hectare area, there are 100 piles of fuels. Intensity of repeated burning is relatively low because the remaining fuel is around 35% of the total fuels. Time schedule of land cultivation in Pal VIII village, Rejang Lebong, Bengkulu is shown in Table 1.

Table 1. Time schedule of land cultivation in Pal VIII village, Rejang Lebong, Bengkulu.

No.	Activities	J	F	M	A	M	J	J	A	S	O	N	D
1.	Site selection			X									
2.	Slashing				X								
3.	Tree felling					X							
4.	Fuel drying						X	X					
5.	Burning								X				
6.	Repeated burning (*manduk*)								X				
7.	Dibbling for main crop (coffee)									X			
8.	Planting (coffee)										X		
9.	Planting secondary crops: groundnuts, corn, soybeans, vegetables, crop rice (gogo), yams and cassava										X		

(a) Drying process

(b) Land preparation

(c) Burn area

(d) Coffee farming in hilly dry land area in Bengkulu, Sumatera

Figure 24.

5. Guidelines for the Implementation of Controlled Burning Practices

5.1. General provisions for controlled burning

5.1.1. Preparation of crew and equipment

Before burning, each group of farmers should prepare fire crew within the group and the necessary equipment. The crew consists of fire crew who will conduct the burning, and fire guards who will monitor and extinguish the fires. Equipment should consist of tools to ignite fires, such as torches, and the following simple tools to extinguish fires, which can be made or provided by the local communities themselves (see Figure 25):

a. Water sprayer
b. Machete
c. Axe
d. Shovel rake hoe
e. Fire rake
f. Bucket
g. Hoe
h. Shovel
i. Flapper
j. Fire broom
k. Backpack pump
l. Chain saw or hand saw
m. Portable water pump
n. Water drum

5.1.2. Fire management

a. Maximum area allowed to be burned

The maximum size of area to be burned for crop cultivation should be not more than 2 hectares on every tract or family land in every growing season to avoid high fire intensity and large amount of smoke.

Figure 25. Samples of traditional fire extinguishing equipment of indigenous people in East Kalimantan

Source:

- *Aspiannur, U. Bato, H. Abberger.1997. Metoda Tradisional Pembersihan Lahan pada Salah Satu Suku Dayak di Kalimantan Timur. IFFM. Samarinda.*
- *Dove, M.R. 1998. Sistem Perladangan di Indonesia; Suatu Studi Kasus dari Kalimantan Barat. Gajah Mada University Press, Yogyakarta.*
- *Prosiding Lokakarya Teknologi Tradisional Pengendalian Api, Kerjasama Bioma- AusAID dan WWF Indonesia Sundaland Bioregional.*

b. Distribution of burn areas (scattered or concentrated)

In one day, burning should not be concentrated in the same area or same tract of land to avoid smoke accumulation in the surrounding areas. Burning can be done in turn (rotation burning), conducted together with and monitored by the other community members.

c. Schedule of burning

Burning is usually conducted at noon (at 14:00 - 16:00) and at the end of dry season prior to the beginning of rainy season. In Indonesia, the end of August will be the best time to burn since fuels are dry enough and it is also the right period for planting. Burning during dry period that may result in transboundary haze pollution should not be allowed. The critical period is June and July to the middle of August. Decision on the burning schedule varies, depending on weather, fuel dryness, air quality and smoke intensity in the surrounding areas. Burning is best conducted when the fuel is dry enough and the wind is not so strong, so that fuel will be burned easily and fire spread can be controlled.

When the ASEAN region is experiencing transboundary haze pollution or when the air quality reaches unhealthy level or when the number of hotspots detected in the region has shown significant increase, all burning activities should be stopped immediately.

d. Fire monitoring

When doing burning for the potential cultivated area, farmers normally do not wish to have fires spread to areas outside the intended area because forest around the cultivated area may provide source of income for the farmers, farmers are afraid of penalties given to them if they break the customary laws, and the smoke arising from the fires will affect their health causing respiratory problems and other haze-related ailments. To ensure that fires do not escape, farmers should do the following before, during, and after burning:

i. Constructing firebreak around the selected area.
ii. Monitor the area when burning is conducted.

iii. Extinguish smouldering material after the fire is put out.
iv. Cutting down the stems, twigs and branches into small pieces.
v. Burn the selected area in turn, particularly when the cultivated areas are located close to each other.

Fire spreading outside the selected area may happen because of the following:
i. Burning is conducted at noon, when the temperature is high, the humidity is low, and the wind blow is strong.
ii. The burning technique is not appropriate to the local conditions.
iii. Occurrence of spot fire causing fires in other areas.
iv. Firebreak is not constructed around the area to be burned.
v. Burning is left unattended.

5.1.3. Burning Arrangements

a. Organisational arrangements

1) Burning should be conducted by a farmer together with the other community members.
2) The local or indigenous communities are expected to form a group of 10 - 20 families, headed by a group leader.
3) Prior to burning, the group leader should provide burning plans to the tribal chief/community leader.
4) The tribal chief/community leader should regulate the burning, including giving sanctions to those breaking the rules in accordance to the customary law.
5) The head of the village will help facilitate the process and respond to the needs of the group through the tribal chief/community leader.
6) The head of the local government (Head of Regency and District) should conduct general monitoring and supervision.

The organisational chart for controlled burning is shown in Figure 26.

b. Reporting and evaluating

All controlled burning activities conducted by community members should be reported to the tribal chief/community leader. The tribal chief/community leader should make a periodic presentation at the meetings held among tribal chiefs/community leaders. The report should, at the minimum, include information regarding the date, time, location, size of burn areas, number of community members/ farmers involved, group leader, and burning condition. The format of the report is shown in Table 2.

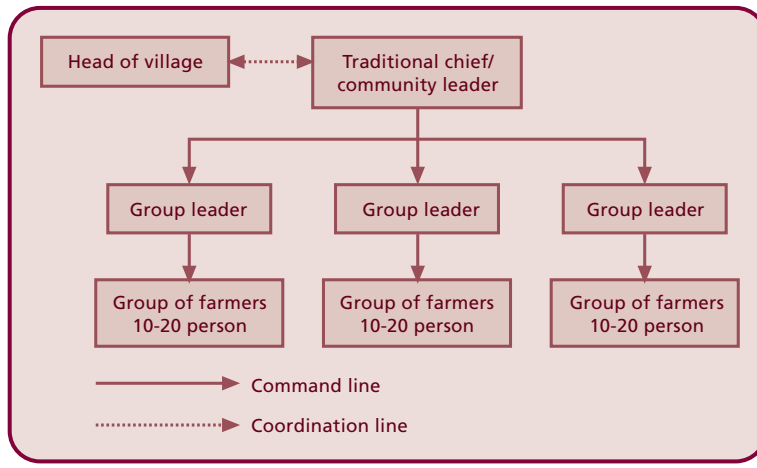

Figure 26. Organisational structure for controlled burning

Table 2. Form for reporting controlled burning

Date	Time	Location	Total burn area	No. of farmers involved	Group leader	Burning condition*)

*)Burning condition:
- Complete (if all fuels are burned)
- Incomplete (if only some parts of the fuels are burned)
- Controlled fire
- Fire spread to other areas