Effects of shifting cultivation on soil and vegetation succession and techniques for the rehabilitation of shifting cultivation areas in Sarawak, Malaysia

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In Sarawak, Malaysia shifting cultivation remains one the most important agricultural activities for rural farmers. It is estimated that about 50,000 households or 38.5 % of the total agricultural households in Sarawak are still engaged in this traditional form of agricultural practices and it provides about 70% of self-sufficiency in rice among the shifting cultivators. However, the practice of shifting cultivation has now spread into the permanent forest estate and threatens the hill forest resources in Sarawak. It is estimated that about 3.0 million hectares or 24.4% of the total land area in Sarawak is currently affected by shifting cultivation.

A study to evaluate the effects of shifting cultivation on soil and vegetation succession. was conducted from 2001 to 2004 at Sabal F.R., Balai Ringin P.F., Niah F.R. and Bakam Experimental reserve in Sarawak. This study indicates that shifting cultivation conducted on clayey soil is found to be sustainable and can maintain soil fertility as long as the rice is cultivated for only one year on the same piece of land. When burning is conducted with the fuel amounting more than 100 Mg ha^{-1}, sufficient ash addition can improve soil fertility and reduces soil acidity. A flush of NH_4-N caused by heat during burning (Fig.1) is found to be important for N supply to rice plants.

The result obtained from this study also supports the sustainability of the traditional shifting cultivation. The use of chemical fertilizer instead of ash may cause water pollution due to low ability of the weathered soils to retain nutrients. On the other hand, some farmers are forced to cultivate infertile land. Forest land with sandy soils including those lands located on steep slope and with insufficient aboveground biomass, should not be used for shifting cultivation because of severe loss of nutrients and soil organic matter which may lead to severe land degradation. Instead, such forest may be

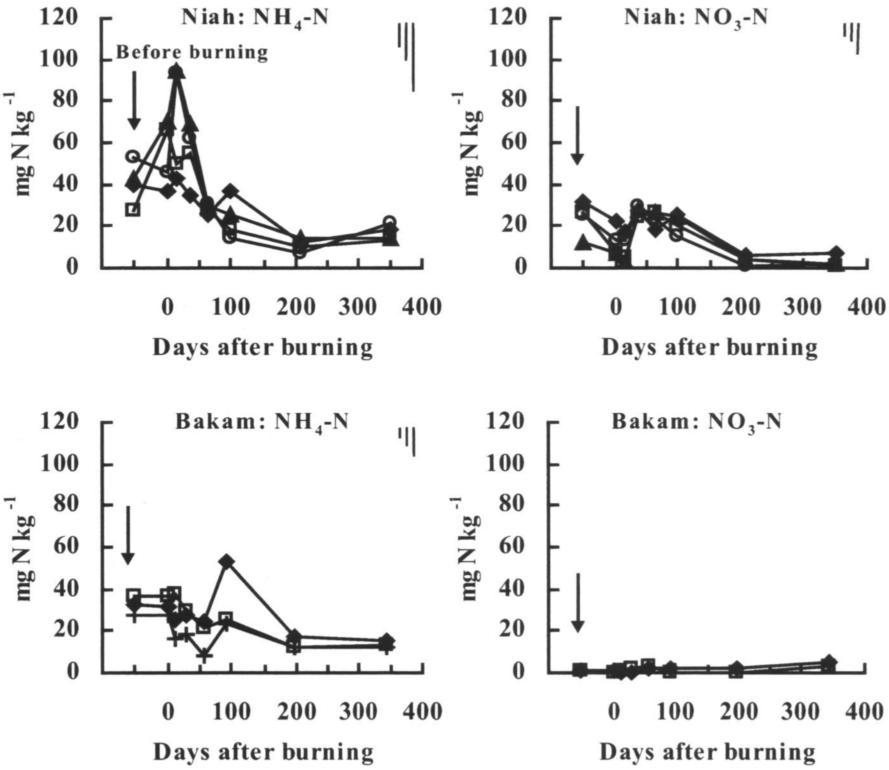

Fig. 1 Changes in the level of NH_4-N and NO_3-N of the soils at a depth of 0-5 cm at Niah and Bakam sites. ◆, control; +, 20 Mg ha^{-1}; □, 100 Mg ha^{-1}; ▲, 200 Mg ha^{-1}; ○, 300 Mg ha^{-1}.

retained for conservation and protection function.

It is also evident from this study that there is no significant difference in rice yield at the Balai Ringin and Niah sites irrespective of the amount of fuel burned (see Table 1).

Table 1 Rice yield (Mg ha^{-1}).

Fuel (Mg ha^{-1})	Control	20	100	200	300
B. Ringin	0.13 a		0.86 b	0.80 b	0.90 b
Sabal	0.00 a		0.10 b	0.29 c	0.30 c
Niah	0.22 a		0.92 b	1.1 bc	1.2 c
Bakam	0.05 a	0.14 a	0.41 b		

Different letters in each line indicate a significant difference at 5 % level by Duncan's multiple range test.

The result suggests that under certain environmental conditions such as at the Balai Ringin or Niah site, a large amount of fuel is not necessarily required to obtain an average yield in a single rice production. This may give some indication on how to modify shifting cultivation. Result obtained from this study strongly indicates that it is impossible or even difficult for shifting cultivators to cease the current burning practice during site preparation because burning is indispensable for maintaining rice production. One possible modification to shifting cultivation practice is to shorten the fallow period. In terms of rice yield it may be practicable, even on clayey soils to reduce the fallow period but this should be done when the aboveground biomass of the secondary vegetation reaches to about 100 Mg ha^{-1}.

From the study on vegetation succession, it is observed that burning decreases the percentage of germination and affects species composition of secondary regrowth during the early stage of fallow as shown in Fig. 2. Buried seeds are severely affected with increasing fire severity. However, fire can be controlled and with proper burning practices and with intermediate fire severity, it can promote vegetation recovery and reduces weed growth in upland rice cultivation.

Rehabilitation of degraded shifting cultivation areas is a difficult and challenging task. Various planting techniques have been experimented on in Sarawak with varied success. Ultimately, it requires a more scientific approach including the use of appropriate modelling tools.

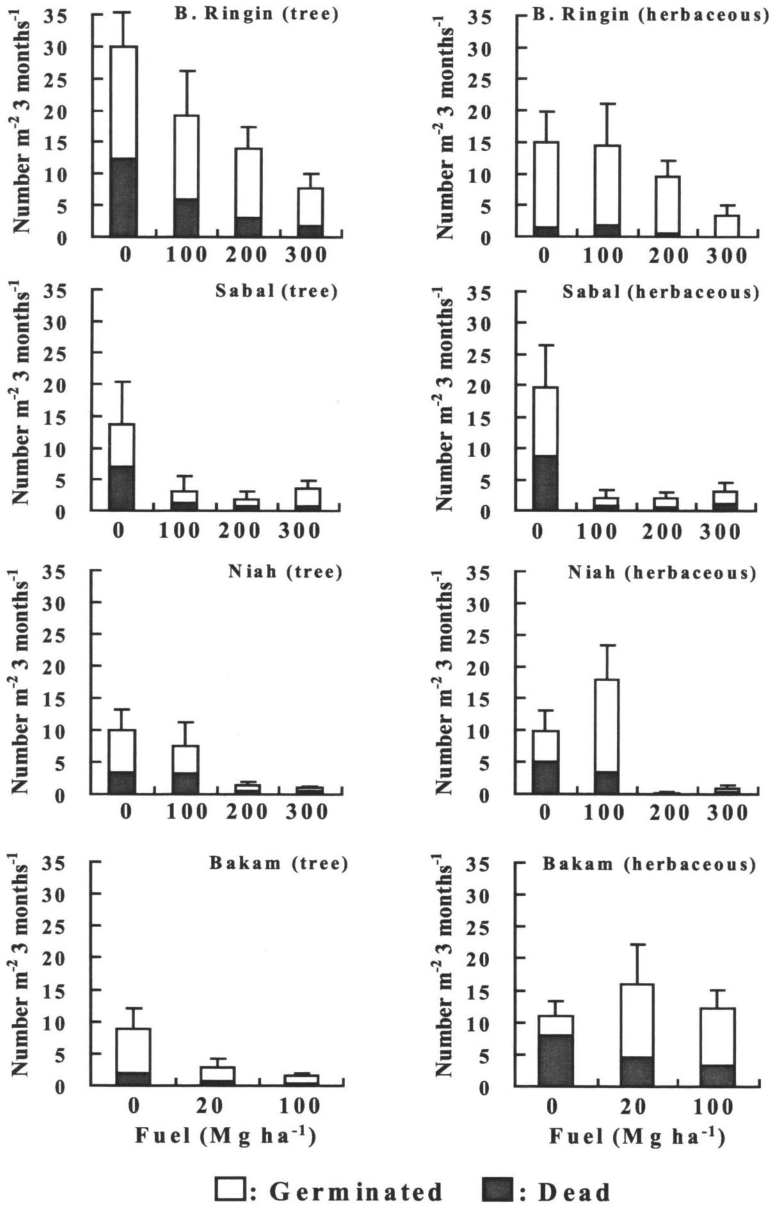

Fig. 2 Number of germinated and dead seedlings at 3 months after burning with SE.