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WHAT IS THE MINIMUM RUBBER PRICE TO STOP FARMERS CONVERTING OLD GROWTH FOREST INTO SHIFTING CULTIVATION?

A CASE STUDY FROM PASAMAN DISTRICT, WEST SUMATRA PROVINCE, INDONESIA

MAHDI and YONARIZA*

¹ Faculty of Agriculture, Universitas Andalas, Kampus Unand, Limau Manis, Padang 25161, West Sumatra – Indonesia
*E-mail: yonariza@gmail.com

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ABSTRACT

The use of shifting cultivation has been declining in recent decades as farmers moved towards sedentary farming systems. This research examined if shifting cultivation is continuing to be practiced and what factors affect farmers choosing to practice it. Using observation, key informant interviews and household surveys in an upland village of Pasaman District, West Sumatra Province, Indonesia this paper demonstrates that shifting cultivation has experienced a resurgence in recent years. The decline in global rubber price is driving ¹¹ resurgence as farmers need shifting cultivation to meet their food security needs. This is leading to negative impacts on biodiversity and the provision of environmental goods and services as old growth forest is being converted into shifting cultivation. High rice yields then drive further conversion. Unless insurance is provided to farmers to insulate them against sudden changes in the rubber price, farmers will continue to exploit vulnerable natural resources as a livelihood strategy that mitigates their income decline and food shortage.

Key words: Environmental service, livelihood, rice, rubber, upland, Pasaman

INTRODUCTION

¹⁶ Shifting cultivation is a food production ⁸ system commonly found in Asia and Africa today (van Vliet *et al.*, 2012; Wangpakapattawong *et al.*, 2010). However, shifting cultivation has experienced considerable change because of population growth, variability in market demand, and changes in public policy since the 1970s (Mertz, 2009; Padoch, 2010). Traditional shifting cultivation underwent a process of intensification, for example by becoming sedentary perennial cash crops (Raintree & Warner, 1986), which have been ¹⁴ a significant contribution to land cover change in Southeast Asia (Ziegler *et al.*, 2012). Teegalapalli and Datta (2016) claim that shifting cultivation is no longer relevant because of large population and its growing demands. Similarly, rural areas in Laos are experiencing a

⁷ rapid transformation from subsistence oriented shifting cultivation systems to more market-oriented cultivation systems (Vongvisouk *et al.*, 2014).

In other contexts, the system continues and is resurgent (Teegalapalli & Datta, 2016). The economic rationale for the persistence of shifting cultivation is that the real returns to labor originate from a higher opportunity cost and that shifting cultivation will persist for so ³ decades (Cramb, 1989; Dove, 1983). Hence, shifting cultivation should be accepted as a rational land use system (Mertz *et al.*, 2008).

Shifting cultivation has three potential environmental downsides. Firstly, it may trigger soil erosion on steep slopes. Secondly, it contributes to greenhouse gas emissions through biomass burning from conventional slash and burn techniques. Thirdly, it reduces biodiversity through land degradation and by leaving grassland (*Imperata cylindrica*) as the climax vegetation. A further

* To whom correspondence should be addressed.

significant loss of biodiversity has been caused because much of the land where shifting cultivation had been practiced has been converted into small scale rubber plantations and shifting cultivation is now practiced in newly opened old growth forest.

The world rubber price declined from \$275 US cent in 2011 to just \$0.55 US in 2016 per kg (Figure 1). Meanwhile, the rice price was stable at IDR 15,000 (\$1.5 US) per kg. This meant that farmers' incomes declined sharply and would be a shock to the livelihood security of those who had converted their land from a shifting cultivation system to rubber production.

This paper describes the resurgence of shifting cultivation and discusses what implications this has for the environment. This paper follows the logic that global change associated with the internationalization of economic activities may also have significant impacts on food systems (Leichenko & O'Brien, 2002).

MATERIALS AND METHODS

A one week visit with a research team of 3 members was made to the case study location of Silayang village, Mapat Tunggul Selatan sub-district, Pasaman District, West Sumatra, Indonesia (Figure 2) which had previously been surveyed in 1995. Data collection relied on three techniques; observation, key informant interviews and household surveys. Key informants were the former village head, the current village head, former sub-village head, and current sub-village head. Former means the ones interviewed during the 1995 visit.

Household surveys were carried out to identify household participation in shifting cultivation during the last 5 years. A systematic cluster sampling technique was employed. The sampling frame was a population of the farmers in each shifting cultivation site (*banjar*). This study selected household samples from Banjar Matingang, Banjar Aia Tolang, and some scattered banjar in Bangkok sub-village. Sixty households used shifting cultivation in Banjar Matinggang, 50 households in Banjar Tolang, and a further 30 households in Banjar in Bangkok sub-village. Almost half of the (57) households involved in shifting cultivation were interviewed using a semi-structured questionnaire. Interviews were conducted in March 2016 or a month after the last rice harvest of 2015 shifting cultivation cycle. Our household sample was distributed among settlements and there is a pattern that households from the same settlement tend to cultivate the same shifting cultivation site (*banjar*) as shown in Table 1.

The questionnaire was designed to examine the practice of shifting cultivation over the last six years 2010-2015. Specifically, this included; whether households practiced the shifting cultivation in each year, the shifting cultivation site, the size of land, land tenure, rice yield, and other crops grown - either annual or perennial crops. Other data collected included the size of the labor force in the household, rubber tapping activities and the rubber price over the last 6 years.

The data were analyzed quantitatively. The analyzed variables were; the size of shifting cultivation land, yield of harvest, the number of households, rubber harvest, the price of rubber, other

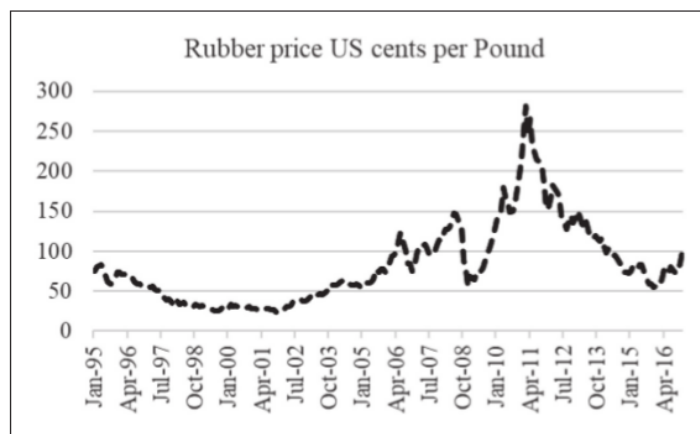


Fig. 1. Global trend of monthly rubber price 1995-2016.

Source: Singapore Commodity Exchange (SICOM)

<http://www.indexmundi.com/commodities/?commodity=rubber&months=300> access 27 Feb 2016



Fig. 2. Map of Pasaman District, West Sumatra, Indonesia showing the research site of Mapat Tunggul Selatan sub-district.

Table 1. Household sample distribution by settlement and by shifting cultivation site in Pasaman District, West Sumatra, Indonesia 2016

Settlement (<i>Jorong</i>)	Shifting cultivation site (<i>banjar</i>)						Total	%
	Aia Kukuran	Aia Tolang	Durian Dontuang	Matinggang	Rubuh	Others		
Aur Kuning	0	0	0	16	0	1	17	29.82
Titian Batu	0	15	4	0	0	0	19	33.33
Bangkok	0	0	0	0	6	2	8	14.04
Batang Silayang	0	0	0	3	0	0	3	5.26
Tigo Koto	4	0	0	0	0	6	10	17.54
Total	4	15	4	19	6	9	57	100.00
%	7.02	26.32	7.02	33.33	10.53	15.79	100.00	

Source: household survey.

sources of income, ownership of motorbike, and tree crop planting in shifting cultivation plot.

We measured factors influencing households re-engaging in shifting cultivation using a correlation between rubber price and household engagement in shifting cultivation from 2010–2015. We used 2010 as a benchmark since the global rubber price showed a major decline. To analyze the impact of rubber price on the resurgence of shifting cultivation we correlate rubber price each year with the number of households practicing shifting cultivation.

We further analyzed factors associated with the size of land cleared for shifting cultivation per household during the 2015 cultivation cycle using linear regression. Table 2 presents suspected variables associated with the size of land clearing for shifting cultivation. We ran a linear regression analysis using SPSS ver. 17 to test factors influencing the size of land clearing for shifting cultivation. Among variables tested were; size of the labor force in the household, number of dependents, and number of motor bike.

Table 2. Variables tested associated with the size of land cleared for shifting cultivation in Pasaman District, West Sumatra, Indonesia 2016

Variable	Explanation
Dependent variable	
Y	Size of shifting cultivation plot
x1	Household size
x2	Labor force at household
x3	rubber harvest yield per week (kg)
X4	Number of motorcycles

RESULTS AND DISCUSSION

Resurgence of Shifting Cultivation and Food Security

Figure 3 shows the trends and resurgence of shifting cultivation from the percentage of household involved in shifting cultivation from 1995 to 2015. In 1995, a study by Yonariza (1996) found out that shifting cultivation was prevalent in the sub-district of Mapat Tunggul, Pasaman District. The farmers practiced a dual economy where they cultivated rubber for cash crops and shifting cultivation for rice as their staple food. In 2003, Dendi reported that the number of households involved in shifting cultivation declined to 70-80 per cent. In 2010 the authors had been informed that shifting cultivation was only practiced by very few households. Farmers focused on their smallholder rubber plantation or jungle rubber. They bought rice from the market for food in exchange for rubber. However, by 2014 almost all households had returned to the forest and re-practiced shifting cultivation. This is what we call the resurgence of shifting cultivation

Household surveys revealed that only a quarter of households practiced shifting cultivation in 2010 but the number kept increasing over the following years. The resurgence of shifting cultivation as shown by the number of households practicing shifting cultivation increased sharply from 15 to 57 households. Table 3 reveals the number of household practicing shifting cultivation since 2010. The average size of land cleared for shifting cultivation is more than one ha per household and the land size variation is low as shown by the standard of deviation.

The main harvest from shifting cultivation is rice as the staple food. Rice is normally for personal consumption because selling rice from their harvest is considered a taboo. The mean rice consumption per household from the harvest is 7 months per year (Table 3) meaning that local people still depend on rice from outside for the rest of year. In addition, the farmers grow some vegetables and spices in their shifting cultivation land such chili.

Rubber price declined sharply from 2011 onwards but, the villagers felt the sharpest decline in 2014. However, due to a low labor opportunity cost, farmers continue tapping rubber despite declining price. Because rubber tapping does not use much time, farmers continue tapping rubber and it does not incur them any cost. Table 4 presents a production of rubber per two weeks.

Factors associated with the resurgence of shifting cultivation

The resurgence of shifting cultivation was mainly triggered by the decline of rubber price as previously rubber was their main source of income. Figure 4 illustrates rubber price decline and the

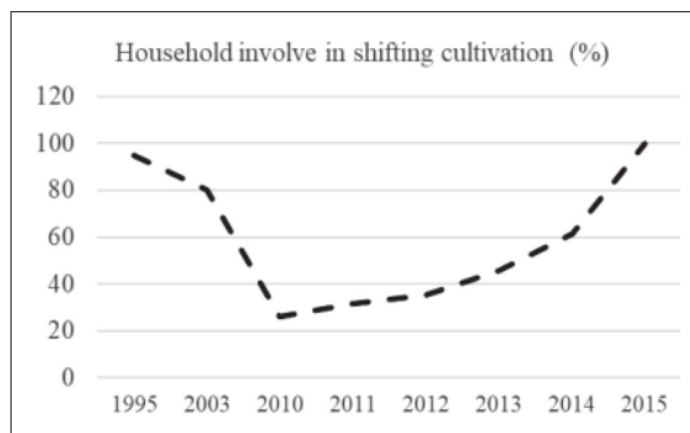


Fig. 3. Trend analysis on percentage of household involved in shifting cultivation in Pasaman District, West Sumatra, Indonesia 1995–2015.

(Sources: Yonariza 1996; Dendi 2003, and household survey 2016).

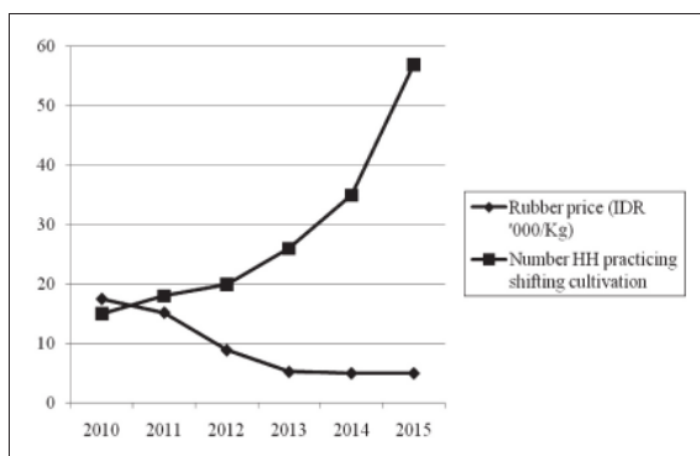
Table 3. Characteristics of shifting cultivation area cleared by farmers and mean of the month in rice consumption from shifting cultivation harvest in Pasaman District, West Sumatra, Indonesia 2016

Item	2010	2011	2012	2013	2014	2015
Number of household involved	16	17	20	26	35	57
N %	28.07	29.82	35.09	45.61	61.40	100.00
Mean of shifting cultivation area (ha)	.9469	1.0706	1.0875	1.0981	1.1229	1.1886
Std. Error of Mean	.11632	.08745	.07538	.08825	.12887	.09104
Mean of month of rice consumption	7.7187	7.1389	7.1632	7.4423	5.7571	7.8070
Std. Error of Mean	1.26159	1.60463	.97318	1.85479	1.04628	.81820

Source: household survey.

Table 4. Rubber production per household per two weeks Pasaman District, West Sumatra, Indonesia

Item	2011	2012	2013	2014	2015	2016
N	44	45	49	50	53	54
Mean (kg)	100.45	88.37	86.26	123.94	119.15	87.59
Std. Error of Mean	31.82	30.08	27.68	46.91	44.31	25.65

**Fig. 4.** Rubber price and the number of households practicing shifting cultivation in Pasaman District, West Sumatra, Indonesia 2010-2015.

increasing number of households engaged in shifting cultivation.

During 2010, when the rubber price was high, many households could afford to buy a motorbike and the motorbike reduced their time to reach the shifting cultivation site and increased their time to work in the field. Table 5 shows possession of motorbike and year of purchase. A fifth of households has more than one motorbike and this increased forest clearing for shifting cultivation.

The regression analysis (Table 6) demonstrated some unusual results including a negative correlation between the size of the labor force with

the land area of shifting cultivation and a positive correlation between the number of motorbikes owned by households with the size of cleared land for shifting cultivation. These findings reveal two things. Firstly, with regards to the labor force, it seems there is a change in a mode of land clearing. Trees are no longer cut down manually, but with chainsaws. In addition, farmers continue with communal work for planting. Secondly, motorbikes have become common on the site. With a motorbike, farmers save time to reach the banjar and make more time available to work on the field. In addition, a number of the labor force at household level may

Table 5. Motorbike possession and year of purchased by household in Pasaman District, West Sumatra, Indonesia 2016

Year of motor bike purchased	Number of motor bike			Total	%
	1	2	3		
< 2000	0	0	1	1	1.96
2000–2004	4	1	0	5	9.80
2005–2009	12	3	2	17	33.33
2010–2014	22	4	0	26	50.98
>2014	2	0	0	2	3.92
Total	40	8	3	51	100.00

Table 6. Result of linear regression analysis in Pasaman District, West Sumatra, Indonesia 2016

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.501	.331		4.533	.000
	Number of labor force	-.078	.096	-.107	-.813	.420
	Number of dependents	-.109	.061	-.236	-1.773	.082
	Number of motor bike	.282	.133	.273	2.124	.038

a. Dependent Variable: size of shifting cultivation plot in 2015 (ha).

not represent the actual labor spent in fieldwork. Hence, possessing motorbike increased forest clearing.

Environmental implications

Shifting cultivation serves as a safety valve for the farmers during the rubber market shock for food security. Households achieve good harvests since shifting cultivation is practiced in long fallow or old growth forest. Farmers are encouraged to repractice shifting cultivation, at least, until the ratio between rubber price and rice price is 1:1 or 1:2, (2 kg rubber = 1 kg rice). Average rubber production per household was relatively low and if the rubber price falls, small holders return to shifting cultivation to fulfill their need for staple food. This response threatens forest sustainability and the environmental service provision of the forest. It also indirectly reveals the price of environmental services should the farmers maintain forest by discontinuing forest clearing for shifting cultivation. In other words, farmers would stop clearing forest if the term of trade between rubber and rice is at least 2:1. If the forest is to be preserved, there should be compensation for the farmer of falling rubber price in order to save the forest from clearing.

The transformation from shifting cultivation into sedentary rubber cultivation was seen by many as a sustainable livelihood as compared to shifting

cultivation system (Vongvisouk *et al.*, 2014). However, with declining of rubber price, shifting cultivation has returned. Since most of the former shifting cultivation land have been converted into rubber plantation, they have to clear old growth forest for shifting cultivation. Such dynamics of land use system is not an isolated case, however. Phoumphon *et al.* (2011) also reported similar finding in a watershed in Lao PDR where shifting cultivation land increase due to population change, migration, and land market.

The resurgence of shifting cultivation is a real threat to forest sustainability as it increases deforestation and forest degradation, which the local community has been fighting through REDD+ reducing emission from deforestation and forest degradation and includes the role of conservation, sustainable management of forest and enhancement of forest carbon stock]. REDD can be both challenge and opportunity for shifting cultivators (Mertz, 2009). This is because the clearing of the old forest only gave a small return in term of rice which is only enough for six-month of rice consumption. Shifting cultivation on old forest has a very high environmental cost. Hence, with the decline of rubber price due to the stagnation of the global rubber market, domestic rubber consumption must be increased and price subsidy should be provided.

What is the minimum rubber price to make smallholders cease shifting cultivation? Farmers quote a price above IDR 8,000 (\$ 0.62 US) per kg is sufficient to provide them enough food and cash.

The same also holds true for payment environmental service (PES). If farmers are to be rewarded for not shifting cultivating, the formula is simple, the rubber price must be insured. The subsidy is provided if the rubber price declines below IDR 8,000 per kg.

CONCLUSION

This paper has shown that the transformation of shifting cultivation into the sedentary agricultural system is not permanent and it also shows that the transformation is not a linear process, rather cyclic. Since the transformation was driven by market force and the market fluctuates, there is a possibility to return to shifting cultivation especially if the market cannot provide food security.

The resurgence of shifting cultivation as a consequence of the declining rubber price is characterized by clearing old growth forest. Since this type of forest has higher biomass contents, the yield of harvest is also satisfied which further encourages farmers to clear more old forest. The size of land cleared is affected by possession of a motorbike, since the motorbike reduces time to access the field. But, the harvest of shifting cultivation is on average still not enough for all year round rice consumption which make them still depend on the market for rice and rubber as the only source of cash for exchange. It is also time for the farmer to diversify their crops to anticipate market shock of a particular commodity.

When farmers clear old growth forest for shifting cultivation, it has a serious effect on the environment as it reduces environmental services in terms of carbon stock and increases carbon emission. But, it also gives an indication of the price of environmental services that farmers need to be compensated for maintaining old growth forested land.

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