THE “CINNAMON CONNECTION” AND GOVERNMENT-FAILURE IN CONSERVATION MANAGEMENT: LESSON LEARNED FROM DEFORESTATION IN THE KERINCI-SEBLAT NATIONAL PARK[1]

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This paper shows how the world’s appetite for spices has led to extensive deforestation in a national park. Field study was undertaken in the Kerinci-Seblat National Park, the Province of Jambi, Indonesia in mid-1990s, where massive encroachment into the park was caused by land-clearing for cinnamon planting. The dynamic of international cinnamon market, as represented by export price, is shown to have strong influence on the size of cinnamon planting areas, and hence deforestation, in the district where the study was undertaken. The good performance of the ARMA (1,1) model indicates that there exist strong internal forces that govern the stochastic process of cinnamon planting areas. The results also indicate that national conservation programs implemented for more than a decade have been somehow ineffective in halting deforestation in the district studied. This problem is caused by government failure such as, firstly, over-lapping spatial planning resulting from poor inter-ministerial coordination, lack of competence and corruption; secondly, ineffective detection procedures due to poor staffing and inadequate equipment; and finally, failure to ensure that the benefits of forest conservation go mostly to individuals directly involved in forest clearing and/or whose livelihood is dependent on land cleared from a forest. This paper also discusses the case where road development provides “official legalization” for previous forest clearing.

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INTRODUCTION

This paper describes the research methods used and some result of the field-study. It begins with a discussion on site selection process and a description of the study area, i.e. Kerinci - Seblat National Park (KSNP), Indonesia. A description of the district studied, i.e. Kerinci , is also provided. Because deforestation in the district studied is associated mostly with establishment of cinnamon farming, a simple time-series analysis is undertaken to analyse trends of cinnamon planting areas in Kerinci. Given the fact that Indonesia is the world's largest cinnamon exporter (Directorate General of Tree Crops, 1994), and Kerinci is known as Indonesia's cinnamon capital, how the international cinnamon market affects these trends is of particular interest here. Finally, because KSNP has been chosen by the World Bank as the project site for its major conservation program in Indonesia, i.e. The Biodiversity Integrated Conservation and Development Project, the author also discusses conservation management issues identified during the fieldwork. Following previous discussion on deforestation mechanisms, the focus in this chapter will be on management issues related to government failure. They include issues such as poor spatial planning, the cat-and-mouse game" between forest authorities and farmers, controversy on who gets the cake from forest conservation, and the fact that road development provides "official legalization" for previous forest clearing.

SITE SELECTION AND DATA COLLECTION

KSNP was selected as the study area for three main reasons. Firstly, KSNP is a very important natural heritage for Indonesia. Covering a vast area of 1.56 million hectares, it is still characterized by thick tropical forests, with a large number of plant and wildlife species (WWF, 1993). KSNP's vegetative cover includes not only a wide ranging members of the families *Dipterocarpaceae* and *Leguminosae*, but also those families *Lauraceae, Myrtaceae, Fagaceae, and Ericaceae* (Santiapillai and siregar, 1988). Its wildlife species include important mammals such as the Asian elephant and the Sumatran tiger, as well as over 130 species of birds. More importantly KSNP is the largest remaining habitat of the endangered Sumatran rhino (*Dicerorhinus Sumtarensis*).

Secondly, despite being officially declared as a national park since 1982, KSNP is being constantly intruded on by nearby farmers. The author's preliminary fieldwork indicates that the intrusion is not only related to classical factors such as population pressure and government failure, but more importantly from the economic theory viewpoint, to a complex microeconomic decision making process. This process result from a complex interaction of factor such as capital accumulation behavior, precautionary motive for consumption, saving and deforestation decision, preference for income security, undervaluation of forest benefits, and the existing social values. Results from this preliminary fieldwork indicate the need for a more in-depth study of deforestation process in KSNP[2].

Thirdly, KSNP's conservation potential has drawn significant interests from international agencies such as the World Bank, Centre for International Forest Research (CIFOR), International Centre for Research in Agroforestry (ICRAF) and the World Wide Fund for nature (WWF).

The World Bank, for example, has established a US$ 47.2 million Biodiversity Integrated Conservation and Development (BICD) Project in KSNP, arguably one of the largest conservation project ever undertaken by an international agency in Indonesia. Moreover, the major part of KSNP lies in the Province of Jambi[3], which has been selected by CIFOR, ICRAF and WWF as one of their major research and monitoring sites, thus, selecting this national park provided extensive and valuable research networking.

The next task was to select a district as the research site. The district of Kerinci was chosen because almost a half of its administrative territory falls within KSNP's boundaries (The Kerinci District Office of Statistics, 1994). Legally this mean only a half of district's territory can be utilized for economic activities such as food- and tree-crop farming. The other half has to be preserved as pristine forest. From this interpretation, the trade off between conservation and economic development means the loss of short run economic benefit gained from cinnamon and other farming.

[2] In fact the preliminary result also indicate the need for long term deforestation monitoring. But such a study is beyond the scope of this thesis.

[3] The province is of a high conservation potential because a very large portion of its area (i.e. 57 percent) remain densely forested. As a comparison, the figure for other provinces in Sumatra as South Sumatra is only 35 percent (JICA, 1991)

In addition to this, Kerinci was selected because it represents a classical case of government failure, where national forest authorities failed to clearly determine KSNP's boundaries. This administrative failure leads to the existence of cinnamon farming enclaves occupied by between 7,200 to 22,800 households[4]. Not surprisingly these enclaves become a major source of forest intrusion into KSNP.

To represent the upper region of Kerinci, the village of Kebun Baru, Kersik Tuo and Plompek of the Gunung Kerinci subdistrict were selected from subdistrict's 66 villages. The villages were selected because, according to WWF's qualitative assessment, they exhibit a more serious deforestation problem than do other villages[5]. Unfortunately, no quantitative estimates of villages-based deforestation rates are available from WWF or local government authorities.

Another important reason for selection of these villages is that they are located at the forest frontier. Thus, selecting them enables visits to *ladangs* (dry-land farms) established on recently deforested lands.

For the lower region of Kerinci, the selection was undertaken by a slightly different method. As no deforestation estimate are available, both qualitatively and quantitatively, the villages were chosen on the basis of their deforestation history. In this region, the ancient Kerincian "kingdom" was centered mostly at Lempur village in the subdistrict of Gunung Raya. Farmers of this ancient capital have for centuries been migrating to nearby forests, searching for new farming lands. This migration process result in the creation of new settlement for Lempurian farmers. From time to tome, the younger generations of farmers from the new settlement repeat the migration process to other nearby forests, creating newer settlement. Some of the earlier settlement will then become and/or commercial centres for the later ones, and the process continues over time.

[4] Estimates on the number of households living in the enclaves vary widely. Jambi's provincial office of the Ministry of Forestry (*Kanwil Kehutanan Jambi*), for example, put an estimate of 7,200 to 22,800 household with an area of 12,240 to 38,464 hectares, respectively, depending of which KSNP boundary is being used (Kanwil Kehutanan Jambi,1994). Faculty of Agriculture IPB (1994) has an estimate of 16,500 household with an area of around 50,000 hectares. Ridwan, *et. a*l. (1994), based on official maps produces by the Indonesian Coordinating Agency for Land Surveillance and Mapping (*Bakosurtanal*) suggested an estimate of 14,286 households with an area of 50,000 hectare. Extra caution is thus needed when interpreting the size of the enclaves, both in terms of household numbers and land area.

[5] Since early 1980s WWF has been running a permanent research station and representative office in the capital of Kerinci, that is, Sungai penuh.

At present, one of the latest settlements is the village of Selampaung, which was established in the mid of 1960s. Due to the administrative failure discussed before, from late 1980s to the mis-1990s newer settlements were still being established nearby Selampaung. Such is not the case for most other 1960s-settlements, where the KSNP boundary has been clearly defines. For this reason, the village of Selampaung and its forest-frontier settlements were selected as the main research sites in the lower region of Kerinci. These settlement are Air Gumuruh, Bukit Patah Pucuk, Pelayang, Renah Harapan, Talang Tengah, Talang Pauk, and Ranah Teraleh. Given the fact that Selampaung is a commercial center not only for its own settlement but also for nearby villages, farmers from neighboring villages such as Dusun Baru, Perikan Tengah and Air Mumu were also considered as potential respondent. However, this applies only to farmers who own *ladan*g(s) in Selampaung's forest-frontier settlement.

Official data were collected from relevant government agencies including the central and provincial offices of the Ministry of Forestry and of the Ministry of Agriculture, KSNP authority, the district and subdistrict government, the district office for food-and tree-crops, and the district office of statistics. The data consist mainly of official statistics such as forestry statistic, provincial, district, and subdistrict general statistics, and food crop and tree crop statistics. Time-series data on cinnamon prices are obtained from these statistics. So are time-series price data for other popular crops such as coffee, potato, and vegetables. Other source of secondary date are the WWF, the eco-tourism centre of Mount Kerinci, and major guest houses in the Mount Kerinci subdistrict.

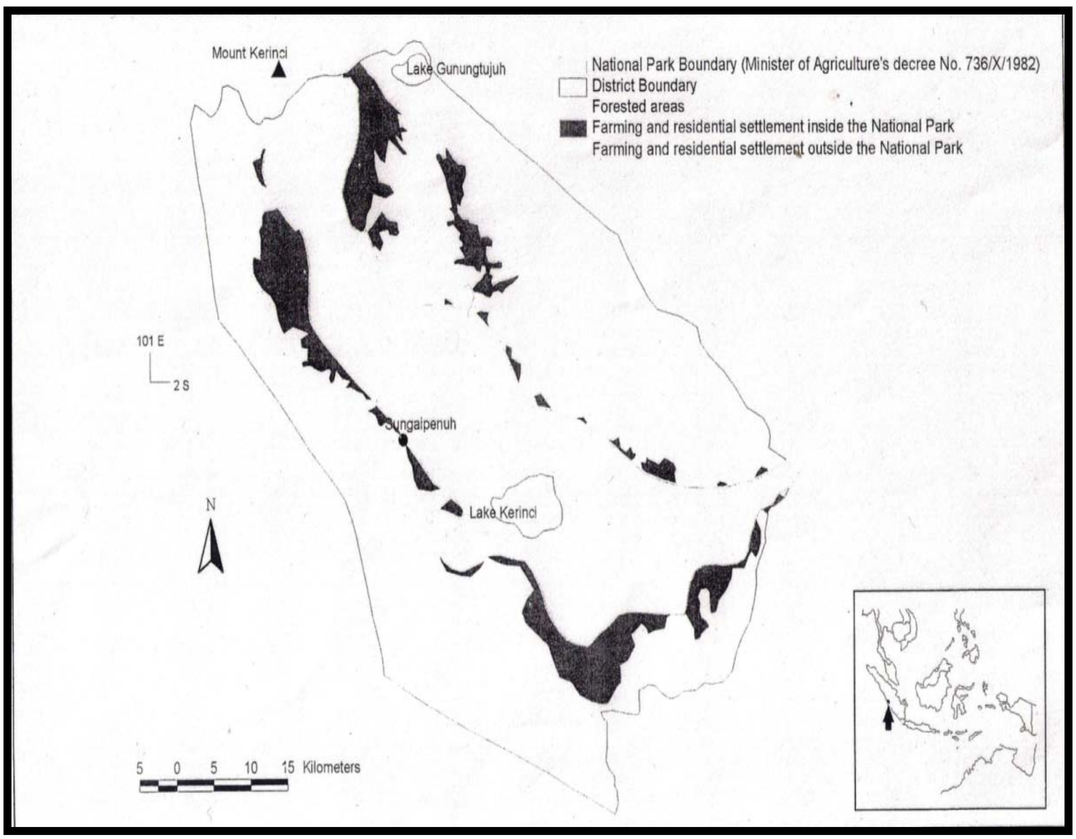
Primary data were collected from farmer interviews and visits to *ladangs* at the forest frontier. Details about this data collection, including development of household questionnaire, will be presented in the next part.

DESCRIPTION OF THE STUDY AREA

Kerinci Seblat National park

KSNP is located along the Bukit Barisan mountainous range in the southern half of the island of Sumatra (Figure 1). Administratively, the 1.56 million hectare national park falls under the jurisdiction of four provincial governments, that is, those of Jambi, West Sumatra, Bengkulu and South Sumatra. With an altitude of 400 to 3,800 meters above sea level, the park includes Mount Kerinci, which at 3,800 meters is highest mountain in Sumatra island.

Figure 1. Map of The District of Kerinci, with Its location within Indonesia indicated.



Source: World Wide Fund for Nature (WWF), Kerinci-Seblat Representative Office Reproduced by Paul Kristiansen.

In addition to its biodiversity value, KSNP performs important ecological functions. For example, the upper reaches of two of Sumatra's largest rivers, i.e. the Musi and Batang

Hari rivers, are located in the pristine forest of KSNP. So are those of about 25 or so smaller rivers that flow to the south-western coasts of Sumatra (Ditjen PHPA, 1985). Moreover, the water catchment area of KSNP is estimated to be in order of 0.89 million hectare, with its hydrological functions thought to have supported the life of 3.3 million people in the southern half of Sumatra (WWF, 1993). The WWF (1993), in collaboration with other professional with other professional consultants, estimated the economic value of KSNP's hydrological functions at US$ 31.2 billion per year. Given the fact that attempts to quantity the full benefits of forest reserve often produce controversial result, this estimate should be interpreted with caution. Nonetheless, the estimate can be used as an indication of why KSNP's forest need to be preserved.

During the Dutch colonial era (i.e. prior to 1945), forest in KSNP areas were designated as natural reserves. However, since the 19th century subsequent Dutch administrations still allowed or even encouraged limited extractions of non-timber product from the forests. For example, in order to meet the European demand for cinnamon, especially that from England, the administrations encouraged traditional extractions of cinnamon barks from the forest (Ridwan *et. al*., 1994). At the time, local communities had traditionally been extracting barks from *Cinnamomum Burmanni*, a native cinnamon species in KSNP.

In 1927, local communities in the district of Kerinci began to establish traditional forest reserves or *hutan adats*[6], including *hutan adats* of Hiang, Keluru, Lempur, and Pangkalan Jambu in the lower region of Kerinci. These *hutan adats* were then given native title rights by the Dutch administration (Faculty of Agriculture, 1994), which remained uncharged during the Japanese occupation from 1942 to 1945.

With this development, after Indonesian independence in 1945 areas consisted mainly of natural reserve and traditionally protected forest. Nonetheless, many part of the reserves had been converted into cinnamon plantations by local farmers following the Dutch administration's compulsory farming policy in late 19th century[7]. This policy marked the beginning of *Cinnamomum burmanni* cultivation in the northern side of KSNP, especially in the district of Kerinci and n the south east parts of West Sumatra

[6] A *hutan adats* is a commonly owned and managed forest considered to be sacred by a traditional society (e.g. a tribe)

[7] Under instructions from the Dutch government, a system of compulsory farming was imposed on Indonesia in late 19th century. The aim was to boost agricultural exports in order to help the ailing Dutch economy.

province. During the Great Depression of 1930s, cinnamon cultivation expanded very rapidly (Ridwan *et. al*., 1994). Cultivated under a multicropping system with potatoes or coffee as the secondary crop, cinnamon plantation became a major route of forest encroachment in these parts of KSNP. A similar process of encroachment also occurred in the southern side of the park, i.e. in the provinces of Bengkulu and South Sumatra, with coffee as the main plantation.

On October 14, 1982 the Kerinci-Seblat area was declared as a national park by the Minister of Agriculture's decree No. 736/Mentan/X/1982. Under this decree, the size of KSNP was said to be 1.48 million hectare, with almost 17 percent of it (that is, 0.25 million hectare) is located in the district of Kerinci. The decree also specified that 0.59 million hectares, or almost 40 percent, of the park is located in the province of Jambi. But the 1985, under a process called the "consensus classification of forest function" (Tata guna Hutan Kesepakatan or TGHK[8]), KSNP's size was reduces to 1.06 million hectare. Kerinci's share to KSNP area jumped significantly to 23 percent, while that of Jambi declined to 37 percent.

This so-called "consensus" was however not the end of the matter. Amid confusions among local governments, in 1993 relevant central, provincial and district governments, including representatives of the Ministry of Forestry, reached an agreement on KSNP's official boundaries within each individual district. The agreement, known as the "Boundary Agreement" (Trayek Batas Kesepakatan or TBK), established KSNP's size at 1.56 million hectares, including 1.21 million hectare (13 percent) in the district of Kerinci, and 0.58 million hectare (37 percent) in the province of Jambi.

While the agreement appears to have settled previous disputes between local governments and central ministries, confusion about KSNP's boundaries continues between government official and local communities. Until 1994, only about 60 percent of KSNP's 3,137.8 kilometer-boundaries had been clearly marked by KSNP authority (WWF, 1994). Officially, these marked-boundaries are called "definite boundaries". But from the author's field work in 1995 it is clear that local farmers were either unaware of the markers, or if they were, they would do whatever they could to find any "loopholes" to ship the boundary. For example, it is not uncommon to find a marker missing,

[8] The TGHK is an Indonesian government's spatial planning process aiming to identify and allocate those forms of forest use that are economically sound and ecologically sustainable for a certain forest, given the forest's specific local environments.

destroyed or even moved deeper toward the forest so that local farmers can still claim that the forests they cleared are outside KSNP boundaries. In addition to increasing land demand, poor staffing on the part of KSNP authority[9] *vis-à-vis* the vast area to be supervised is a major cause for this problem. Under such circumstance, it should not then come as surprise to find the park is still being intruded on by local farmers.

The District of Kerinci

The District of Kerinci lies between 1°41' and 2°08' south latitude and between 101°08' and 101°50' east longitude. From figure 1 we can easily see that the entire Kerinci district is in fact surrounded by KSNP. Thus the district of Kerinci itself can be seen as an enclave of residential, farming, industrial and other-uses areas encircled by KSNP's forest. This is in addition to the cinnamon farming enclave that actually lie inside the forests.

Kerinci's population in 1993 was 283,495, with a male female ratio of 100 to 104.during the period of 1971-1980, Kerinci experiences a rapid population growth of 2.88 percent. This growth has decline to 1.61 percent for the 1981-1990 period. Of special interest here is the fact that our research subdistricts, i.e. Gunung Raya and Gunung Kerinci, recorded the fastest population growth in the district during these periods. Gunung Raya had a growth of 4.81 and 3.06 percent for the 1971-1980 and 1981-1990 periods, respectively, while the corresponding figures for Gunung Kerinci were 3.22 and 2.53 percent. This rapid growth gives an indication about the trend of population pressure in the research areas.

The proportion of labour force in Kerinci was 59 percent of the population, while the population density was 67 persons per square kilometers. In Gunung Raya subdistrict, the population density was below district average (i.e. 49 preson/sq.km), while in Gunung Kerinci was above (i.e. 80 preson/sq.km).

Kerinci has a total area of 0.42 million hectare, of which about 49.4 percent (=0.2075 million hectare) is declare as part of KSNP. The most common land types are andosol and latosol. Which make up about 65 and 21 percent of the total land area, respectively. While Kerincian lands are generally fertile, their bio-physical condition

[9] See Section "The Cat-and-Mouse Game" for details on staffing level

restrict extensive agricultural uses. Only 6.2 percent of the lands can in fact be categorized into land class I, that is, fertile lands suitable for virtually all types of agricultural uses (Faculty of Agriculture IPB, 1994). About 5 percent of the lands falls into the category of land class II, that is, fertile lands in need of treatments such as chemical fertilizing and high quality seeding. The land class III which includes less fertile lands requiring special treatments such as the supply of lime, accounts for 31 percent of the lands. The rest of 58 percent is considered unsuitable for agricultural use due to its unfavorable topography, landslide and erosion risk, and land texture[10].

As expected, state forest dominate the district's land use pattern, accounting for 49 percent of the total land area. The next most common land use is drying farming and mixed gardening, making up about 31 percent (0.31 million hectare) of total land area. Included in this category are 46 thousands hectares of cinnamon plantation, both inside and outside KSNP[11]. Wet land paddy accounts for less than 4 percent of the total land use.

Statistics on the land-use pattern also reveal the existence of a sizeable are of "unutilized agricultural land" in Kerinci. It amounts to about 23,350 hectares according to official data. Unofficial estimates however double this figure to 45 to 50 thousand hectares (Faculty of Agriculture IPB, 1994). This means, while on the one hand farm households tend to move deeper into the forest in their search for new farming lands, on the other hands there are unutilized lands throughout Kerinci equal in size to at least a half of that of the cinnamon farming enclaves.

The author observes a number of factors that may lead to the existence of these unutilized lands. Firstly, in the case of newly cleared lands, the owner(s) usually leave the unutilized temporarily for around a year to let the fallen trees dry out and to wait for a tenant (*anak ladang*) to sharecrop the land(s). Secondly, ownership of the lands have been sold to non-farmer capitalists residing in the capital of Kerinci (i.e. Sungai Penuh) or even in as far as the Indonesian capital (i.e. Jakarta). New owners who purchase the lands for speculative purpose tend to leave the land unutilized. It should be note however that is phenomenon occurs mostly in the urban fringe of Sungai Penuh, not in

[10] Note however that the lands are not necessarily infertile.
[11] These data however appear to be in contradiction to the estimates of cinnamon enclaves size mentioned earlier. For example, the official mapping suggested an estimate of 50,000 hectares of cinnamon farming inside KSNP. Thus, caution is needed when interpreting all these data.

the rural areas of Kerinci. Thirdly, the lands are under traditional communal ownership. This traditional ownership gives utilization rights to each household within the tribe/kinship on a rotation basis. For some reasons, however, the family(s) who currently hold the rights to utilize the lands are unable to so do. It may be due to causes such as lack of working capital and/or family labour, the availability of more attractive economic opportunities elsewhere, the land's productivity has declined in such a way that it is uneconomical to utilize it, the length of the rights is considered too short and unsuitable for the family's inter temporal planning horizon, and/or the failure of the kindship's leadership to organized an effective roster. Note however that it is external factors that work through traditional ownership that cause the problem, not the traditional ownership itself.

Average landholding in Kerinci in 1993 was 3.02 hectare per household, much higher than the national average of less than 0.5 hectare per household. Gunung Raya has a landholdings of 3.72 hectare per household, while Gunung Kerinci 2.03 hectare per household. This landholding includes mostly residential land, mixed garden and cinnamon farming.

The agricultural sector continues to be the main economic sector in Kerinci, contributing to over 50 percent of the district's regional gross domestic product (RGDP) from 1987 to 1992. the sector also grew relatively strongly, that is, by 7 to 11 percent during the period. This growth is comparable to the overall economic growth of 7 to 10 percent recorded by the Kerincian Economy. The importance of agriculture for Kerinci's economy is also underline by the fact that almost 30 percent of the district's 68 thousand household rely on cinnamon plantation as their main source of income.

THE "CINNAMON COLLECTION"

Indonesia is the largest cinnamon exporter in the world, contributing 66.6 percent of the world cinnamon exports over the period of 1984-1991 (Directorate General of Tree Crops, 1994). On average, about 40 percent of Indonesia's cinnamon production in the same period came from Kerinci, slightly lower than average of 43 percent for the 1967-1991 period (Table 1 of Appendix). Kerinci's share in the national production of cinnamon even rose to 52 percent during the 1988-1991 period. If Kerinci's share of national exports is assumed to be equal to its production share, these figures imply that about 26 percent of the world's cinnamon export during 1984-1991 was produced from the lost forest of Kerinci.

To give a clearer picture of the pressure which cinnamon production places on Kerinci's remaining forests, let us briefly review Myers' case of the hamburger connection[12] (Myers, 1981). Myers's crucial example of the connection, i.e. Costa Rica, has a land area of about 12.5 times larger than Kerinci, with about 1.66 million hectare of forest (Reppeto and Gillis, 1988). Yet Costa Rica's share of the world's beef market is almost negligible. On the Contrary, Kerinci's important share of the world's cinnamon market has to be shouldered by a much smaller area of 0.4 million hectare, with only million hectares of forest. Thus in relative terms, judging from their size of forested areas and share of the world market, Kerinci's "cinnamon connection" appears to be much stronger than Myers' hamburger connection.

Based on this assessment, attempts to emulate Myers' work with a more technical time-series analysis are undertaken. The aim is to investigate whether deforestation in Kerinci can somehow be explained by the dynamic of the international cinnamon market. The first major obstacle, unfortunately, comes from lack of accurate and reliable deforestation data. Time-series data on deforestation trends in Kerinci are virtually non-existent. What is available are deforestation estimate at some points of time, derived from analysis of satellite photos[13]. But, these estimates very widely from one government office to another, depending on *inter alia* their official interpretation of KSNP's boundary. Thus, one needs to find another set of data that could better present time-series deforestation in Kerinci.

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[12] Myers (1981) used the term "the hamburger connection" to explain the connection between hamburger consumption in North America and Deforestation in Central America. He argue that forest clearing in Central America result mostly from cattle raising activities, with consumerism in developed nations (especially in north America) a major stimulant for these activities. To support his argument, Myers compare the trends of Central America's cattle-raising areas, beef production, domestic consumption, and beef export to North America. He found that cattle raising areas and beef production in Central America increased significantly since 1950s, but domestic consumption was steady or declining. In other word, a large share of Central America's beef production was exported overseas, especially to north America. Because these exports came from ranches built on deforested land, it means that some of Central America forests have been transformed into beef and hamburger consumption in North America, and hence the term "the hamburger connection".

[13] An example of these estimates is Bakosurtanal's figure of 50,000 hectares of cleared forest in early 1990s (Ridwan *et. al*., 1994).

All government an non-government officials interviewed, including those of the district government, KSNP authority and the WWF hold a common view that establishment of cinnamon farming is the main (if not the only) route to deforestation in region. They also consider cinnamon expansion the single most important threat to KSNP's forest, and argue that virtually all cinnamon plantations in Kerinci are grown on deforested land. Thus, it seems that time-series data on (cumulative) cinnamon areas might provide a good indication of deforestation in Kerinci

A close look of the data, however, shows that such is not the case (see table 2 of appendix). The data recorded negative trends between 1977 and 1884, indicating a decline in cinnamon areas during this period. While planting areas may have decline. Such does not seem applicable for (cumulative) deforested areas unless a large reforestation program takes place. During this period, however, no reforestation program was undertaken on areas where cinnamon was previously grown. Consequently, the data are not good approximations of deforestation trends in Kerinci, and thus cannot be used to empirically test how deforestation is linked with the international cinnamon market.

Nonetheless, because forest are cleared for the purpose of establishing cinnamon farming, understanding how the dynamic of cinnamon market affects cinnamon planting areas could give us a better picture about deforestation mechanism in Kerinci. For this reason, a simple econometric analysis of cinnamon areas is performed.

A Simple Econometric Analysis of Cinnamon Areas

The models tested use the size of areas cultivated by cinnamon, termed henceforth as the "cinnamon planting areas", as the dependent variable. Data for this variable are available on an annual (not seasonal) basis, for the period of 1969 to 1994. data on the explanatory variables however are available only from 1971 to 1993. Thus we have a sample size of between 23 to 26 observations.

With such a very small sample size, option for econometric sophistication are very limited[14]. For example, the author does not have the luxury of being flexible in testing of

[14] One may argue that given this small sample size one needs not bother with econometrics at all. However,, such a data problem is common in Indonesia, especially when one deals with microeconomics

the length of the time lags. This is because adding one time-lag would mean a significant loss of the degree of freedom. Option to apply the techniques of cointegration are also limited[15]. Experience shows that in cointegration tests the time lags required to ensure white noise can be *relatively* large. A time lag of three for one variable, for example, would reduce the degree of freedom to 18 at most, if the model has *only one* lagged explanatory variable. Loss of the degree of freedom would be greater if more lagged variables are involved. Facing this trade-off, the option was adopted of performing simple time-series techniques such as the auto regressive-integrated moving average (ARIMA), autocorrelation and distributed lags models.

To represent the dynamic of the world cinnamon market, export prices (free-on-board) are used as one of the explanatory variables. Even though world price data would theoretically reflect the dynamics of the market more directly than do export price data, they are not used here because of their "far distance" from farm-gate price. Export price, on the contrary, is in "the middle" world price and farm gate price. For this reason, export prices are preferred to world prices.

Following the Neo-Malthusian approach, population is also including as one of the explanatory variables. The *a priori* expectation for this region is that increased population would lead to a larger cinnamon areas. To see whether the trend of cinnamon expansion is affected by the government's decision to declare the area as a national park, a dummy variable is used. Time dummy is valued zero for the period of 1971 to 1882, and one 1983 onward. Table 2 of appendix presents the full data set used in this analysis.

The general model is then specified as follows:

$$Arko = f\ (arki,\ popn,\ fobj,\ dumy), \qquad (1)$$

Where

arko = cinnamon (deforestation areas in hectare,

arki = *arko* with a lag length of *i*,

popn = population,

fobj = free-on-board price (US$/kg) with a lag length of *j*

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time series data. Ascribing to this view would then preclude the application of econometrics can still be applied, but one needs to be extra careful when making inferences from the result.

[15] In a time series analysis, co-integration tests are needed to see if the time series behavior of the data satisfies the statistical conditions required for a long-run equilibrium. Examples, of these tests are Johansen maximum likelihood and augmented Eagle-Granger tests.

dumy = the dummy variable of KSNP declaration,

and *i, j* = 0,1, … , *n*

to see the stochastic process governing cinnamon expansion follows an auto regressive (AR) and/or a moving –average (MA) process, an ARIMA model of *arko* is performed for the period of 1969 to 1994. in this case only two of the three phases of ARIMA modeling are undertaken, that is, the identification and estimation phases the forecasting phase is not performed because forecasting is not the goal of the analysis.

The autocorrelation and the distributed lags models for equation (1) are examined for the period of 1971 to 1993. At this stage, result from the ARIMA's identification phase are used as a guide in deciding the length of the lag for the dependent variable (not for the explanatory variable). Nonetheless, because in this analysis different sample sets are used, result of the ARIMA models are not included as restrictions on the autocorrelation and distributed lags models.

The ordinary least square (OLS) and the maximum likelihood estimations of a linear model are also examined. But as expected, they produce very poor result and are not presented here to save space.

For these simple analysis, Shazam 7.0 is used. For brevity, details of the econometric techniques applied here are not discussed. Readers unfamiliar with the terminologies and techniques used should consult Enders (1995), Griffits *et.al.* (1993), Johnston and DiNardo (1997), Judge *et.al.* (1998), and Pindyck and Rubinfiled (1991). White *et.al.* (1998) present the users' manual of Shazam.

ARIMA Models

The general form of an ARMA(p,q) model is

$$y_{\mathrm{t}} = \theta_1\, y_{t-1} + \ldots + \theta_{\mathrm{p}}\, y_{t-p} + e_t + \alpha_1 e_{t-1} + \ldots + \alpha_{\mathrm{q}} e_{t-q} \qquad (2)$$

Where *p* and *q* are the order of the AR and MA process, respectively, and e_t is white noise error.

One way to identify the order of an AR process is to choose an AR(p) such that

$$\hat{b}_{kk} = \begin{cases} \neq 0 & for k = p \\ = 0 & for k > p \end{cases}$$

Where $\hat{b}_{kk}$ is the *k*th-partial autocorrelation estimators of an AR process of order *k*. If $\hat{b}_{kk}$ falls within the $\pm\bar{c} = \pm 2/\sqrt{T}$ standard error bounds, where T is the sample size, we say $\hat{b}_{kk}$ = 0 at the 95 percent confidence intervals.

The order *q* of an MA process can be determined by checking a maximum *k* for which the autocorrelation estimators $\hat{a}_k$ is nonzero. As in the case of $\hat{b}_{kk}$, the two standard error bounds $\pm\bar{c}$ can be used to determine whether a particular $\hat{a}_k$ is statistically nonzero.

Table 1. Sample Autocorrelations and Partial Correlation for the *arko* Variable

k	Autocorrelation	Partial Autocorrelation
1	0.71	0.71
2	0.45	-0.11
3	0.27	-0.03
4	0.02	-0.26
5	-0.15	-0.06
6	-0.20	0.03
7	-0.23	-0.05

Note: N = 26

An arbitrary $1 \leq k \leq 7$ is chosen to compute the sample autocorrelations and partial autocorrelations of the variable *arko*. If $\hat{a}_k$ and/ or $\hat{b}_{kk}$ taper off very slowly with *k* = 7, then the value of *k* needs to be increased. The values of $\hat{a}_k$ and/ or $\hat{b}_{kk}$ are presented in table 1.

With a sample size of 26 for *arko*, we have $\bar{c}$ = ± 0.3922. Comparing $\hat{a}_k$ and $\hat{b}_{kk}$ to this value, the author found that, firstly, the maximum *k* for which $\hat{a}_k \neq 0$ is *k* = 2, and secondly, $\hat{b}_{kk} \neq 0$ for *p* = *k* = 2 but $\hat{b}_{kk}$ = 0 for *k* = 2 and *p* = 1. It is then concluded that the stochastic process governing *arko* follows an ARMA (1,2) process. But because the value of $\hat{a}_k$ for k = 2 is not very far from the upper bound 0.3922, ARMA (1,1) models are also analysed during the estimation process.

Table 2 present results of the model selection test. The indicators used are the adjusted-R^2 ($\overline{R}^2$), the Akaike Information Criterion (AIC), the Schwarz Criterion (SC), and the Box-Pierce-Ljung Portmanteau test of residual autocorrelation (Q(K)). The general rule is to find a model with the highest $\overline{R}^2$ and the lowest AIC and SC. Moreover, the residual autocorrelation of the model should fall within $\overline{c}$ = ± 0.3922, or in other words, the value of Q(K) should not significantly differ from zero, at a degree of freedom of K – p – q[16]. note however the Portmanteau test is often not powerful in small samples.

Table 2. Performance of Alternative ARMA (p,q) Models for the arko Variable

	R^2	AIC	SC	Q(K)
Prespecified Models				
ARMA(1,1) with a constant term	0.8758	15.872	16.017	7.4
ARMA(1,2) with a constant term	0.8695	15.982	16.175	7.6
Alternative Models				
ARMA(2,1) with a constant term	0.8694	16.062	16.256	12
ARMA(2,2) with a constant term	0.8697	16.006	16.248	6.9
ARMA(1,1) without a constant term	0.8794	15.789	15.886	7.5
ARMA(1,2) without a constant term	-5.1719	18.814	18.960	55.5 a)
ARMA(2,1) without a constant term	0.8732	15.912	16.057	13.4
ARMA(2,2) without a constant term	0.8662	16.033	16.227	16.1 b)

Notes:
R^2 = adjusted R-square
AIC = Akaike Information Criterion
SC = Schwarz Criterion
Q(K) = Box-Pierce-Ljung Portmanteau test of residual
Autocrrelation with a degree of freedom of K-p-q
where K=12 and 24
a) significant at alpha = 0.001
b) significant at alpha = 0.05

The pre-specified models, i.e. the ARMA (1,1) and ARMA (1,2) models with a constant term, perform well in term of $\overline{R}^2$, AIC, SC, an Q(K=12,24) (Table 2). The ARMA (1,1) model however appears to be slightly superior than the ARMA (1,2) in term of the

[16] Note that Q(K) follows the X^2 distribution.

indicators examined. Alternative models with or without a constant term are also tested in order to see how the pre-specified models fare compare to other models (Table 2). The ARMA (1,1) model without a constant term appears to perform *slightly* better than pre-specified models in term of the indicators used. But the model produces a non-stationary process, which means that the mean, the variance and the covariance of the residuals (e_t) change over time. This non-stationarity is indicated by the sum of the estimators for the AR regression coefficient, which exceeds unity. We have made an attempt to obtain stationarity by applying the differencing technique and running an ARIMA model on the difference data. The result are however very poor (See Tables 3 and 4 of appendix). Consequently, the no-constant ARMA (1,1) model is not selected.

Table 3. ARMA (1,1) Result for the *arko* Variables

		Autocorrelation of Residuals			
Parameters	**Estimates**	**Lags**	**Value**	**Lags**	**Value**
AR(1)	0.9567	1	-0.18	13	-0.20
	(24.790)	2	0.02	14	8.00
MA(1)	-0.978	3	0.23	15	0.11
	(-4.696)	4	0.10	16	0.20
Constant	1445.7	5	-0.07	17	0.06
	(1.070)	6	0.02	18	0.01
R^2	0.8758	7	-0.16	19	0.05
		8	0.01	20	0.09
		9	-0.12	21	-0.11
		10	-0.21	22	0.06
		11	0.03	23	0.05
		12	-0.09	24	-0.02

Notes:
a) Figures in bracket are t-statistics
b) R^2 = adjusted R-square

The other alternative models perform worse than the pre-specified models in term of the indicators used. Two of them are non-stationary, that is the ARMA (2,1) model with a constant term and the ARMA (1,2) model without a constant term even produce non-invertible processes, resulting in a negative $\overline{R}^2$ and a Q(12,24) significantly greater than zero. Thus, these models are not selected.

The preferred model is the ARMA (1,1) with a constant term. Table 3 present ARMA (1,1) result for the *arko* variable. Both the AR(1) and MA(1) parameters are shown to be statistically significant at α = 0.005, while the constant is at α = 0.1. Form these result we can deduce that the realization of *arko* in period *t* depends on the values of *arko* in period *t* – 1 and the MA(1) form of the error terms. Furthermore, it can be inferred from the $\overline{R}^2$ value of 0.8758 that over 87 percent of the dynamics of *arko* between 1969 and 1994 can in theory be explained by the ARMA(1,1) model. In the next section, it will be analysed whether the dynamic of *arko* is also influence by the other variables, especially by the dynamic of the international cinnamon market.

Autocorrelation-Distributed Lags (ADL) Models

The general form of an ADL model is

$$y_t = x'_t \beta + e_t \quad (3)$$

Where

$$e_t = \rho_1 e_{t-1} + ... + \rho_p e_{t-p} + v_t \quad (4)$$

For models with an AR(p) error term[17] , and

$$e_t = v_t + \theta_1 e_{t-1} + ... + \theta_q e_{t-q} \quad (5)$$

for models with an MA(*q*) error term. As usual, x'_t is a (1 x *K*) vector containing the *t*-th observation on *K* explanatory variables, which in this case include lagged variables. β is a (*K* x 1) vector of regression coefficient, while v_t is another error term with a zero mean and constant variance, and is assumed to be uncorrelated over time.

The coefficient $\rho_1, \ldots, _p$ are estimated by the Cochrane–Orcutt iterative procedure. The software used, i.e. Shazam, produces both maximum likelihood and least squares estimators of ρ. For the coefficient $\theta_1, \ldots, _q$ the least squares procedure is applied.

[17] Note that in this case it is the error term ….. that follows an AR(*p*) process, not the dependent variable.

To find the "true" lag length for the explanatory variables, the author optimize values of the model selection indicator used earlier in ARIMA analysis. In this case, the rule is to choose a lag length that maximizes $\overline{R}^2$ and/or minimizes the AIC and SC. Due to the limited sample size, however, the author also takes into account how much the degree if freedom is reduced by seemingly "superior" lag length in this selection process.

One problem in estimating lagged regression coefficient is that there may be a severe multicollinearity between the columns of the X matrix that represent the same lagged variable. This problem can result in the estimated coefficients having a very large standard error, leading to imprecise least square estimators for the coefficients. To reduce such a problem, the author also performs regressions using the Almon lags and sees if the parameters estimated differ significantly from those estimated without polynomial (Almon) lags.

All explanatory variables specified in equation (1) were initially included in the analysis. Following the ARIMA results discussed earlier, an i = 1 for the *arki* variable is assumed. Thus the AR(1) property of *arko* is retained. For the *fobj* variable, the author examines models with j = 0, … , 4 denoted as *fobj* (0.j). Models with a higher value of j, especially *fobj* (0.3) and *fobj* (0.4), are included mainly for comparison purpose. These models might outfit those with a lower value of j, but their low degree of freedom does not seem to justify their selection. For j = 4, for example, the degree of freedom would be reduced to $T – K – L$ = 10, where T = sample size, K = number of regressors (including constant term) and L = lag length. Nonetheless, the author still takes info account the results of these models when making inference from the analysis.

Given the ARIMA result, it is expected that the error term will follow an MA(1) or MA(2) process. The selection of ARMA (1,1) process for the *arko* (1969-1994) variable should not hinder the use of MA(2) here. This is because the sample is different. Furthermore, the ARMA (1,2) model of *arko* (1969-1994) is only slightly inferior to the ARMA (1,1) one.

The author also examines models with either AR(1) or uncorrelated error terms. The latter is estimated by the usual ordinary least square (OLS) method. Almon Lags of 1 to 4 are used, depending on the lag length of the *fobj* variable.

To see if there is a possible multicollinerity between the explanatory variables, individual correlations between the variables are computed. Of concern is the high correlation between *popn* and *fobj*, which is shown to be 0.651. this value is greater than the correlation between *arko* and *popn* (=0.471), and between *arko* and *fobj* (=0.420). A high correlation value of 0.562 between *popn* and *arki* is also found. Because *popn* appears to be highly correlated with the other explanatory variables, while on the other hand this analysis aims to investigate the link between *arko* and *fobj*, then it is *popn*, not *fobj*, that will be dropped if signs of severe multicollinearity are detected.

Results of the selection of the "true" time lags are presented in Table 5 and 6 of Appendix A. The tables show that the distributed lag models estimated by the OLS method is inferior to ADL models with AR(1) and MA(*q*=1,2) error terms. This means, the data do have autocorrelated error terms. In the of $\overline{R}^2$, the moving average error models appear to be superior than their autoregressive counterparts. Use of the Almon lags do increase the explanatory power of models with AR(1) or uncorrelated error terms, but still, the moving-average error models produce a better result. As an example, the author present in Table 5 of Appendix A results for *fobj* (0.4) with an Almon lags of 1 to 3for the AR(1) or uncorrelated error models.

Table 6 of Appendix present some performance indicators for the MA(*q*) models, including the asymptotic estimates of θ_q and their asymptotic t-ratio. For all models analysed, use of the Almon lags is shown to produce the same results for some of the models as examples.

Models that include *fobj* (0.4), *fobj* (0.1) and *fobj* (0.0) clearly produce better results than do other models. But as discussed before, use of *fobj* (0.4) leads to a very low degree of freedom of 10. Thus, this model is only used for comparison purpose.

The results, however, indicate that multocollinearity does exist. It can be deduced from the fact that all models analysed produce a negative sign for *popn*. More importantly, in many cases, e.g. in models with AR(1) error term, this negative coefficient appears to be significant at $\alpha = 0.05$. Thus instead of leading to a larger cinnamon planting areas, population growth is shown to lead to a decline in the planting areas. Because this conclusion results from linear dependency of the data, and thus is a biased one, the *popn* variable is dripped from the analysis to eliminate multicollinearity.

Table 4. Adjusted R-square and Estimated MA Coefficient for ADL Models with MA Error Terms [a)]

Alternative Lag Length for the fobj Variable	MA Order	R^2	Theta-1 b)	Theta-2
A. *fobj*	1	0.8259	0.1856	
			(0.7401)	
	2	0.8261	0.1883	-0.0337
			(0.7128)	(-0.1278)
B. *fobj* (0.1)	1	0.7489	0.1511	
			(0.5557)	
	2	0.7491	0.1370	0.0597
			(0.5107)	(0.1957)
C. *fobj* (0.4)	1	0.8337	-0.2568	
			(-0.9724)	
	2	0.8982	-0.1493	-0.8502
			(-0.3199)	(-2.6041)

Notes:
a) The general form of the models is
arko = f (*arki*, *fobj* (0.j), dummy)
where j = the largest time lag
b) Asymtotic estimates of theta. Figures in bracket are asymtotic t-ratio

Result of MA(*q*=1,2) error models without *popn* are presented in Table 4 and 5. As before, models with and without the Almon lags produce the same regression results. Thus, the Almon lag results are not presented in these Tables.

Models with *fobj* (0.4) appear to produce a high $\overline{R}^2$, with the MA(2) model performs better than the MA(1). But as Table 5 shows the regression coefficient for *fobj* with a time lag of 1,2 and 3 are not significant at α = 0.05. the degree of freedom is only 11. Thus, while the results indicate a possible time lag of 4, the models are not used here.

We can conclude from Tables 4 and 5 that the models employing no time lag for *fobj* is the preferred ones. They give higher $\overline{R}^2$ than do models with *fob*j. The regression coefficients for *arki* are show to be significant at α = 0.005, thus confirming the AR(1) property of *arko* as indicated by the ARIMA results. The variable *fobj* also has significant regression coefficients (that is, at α = 0.025), which means that the size of cinnamon areas in year *t* is influence by export (fob) price at the same year. Also interesting is the finding that the dummy variable (*dumy*) appears to be a non-significant regressor of *arko*. This means, cinnamon planting areas continue to expand despite the implementation of KSNP Programs.

Table 5. Estimated Regression Coefficient for ADL Models with MA Error Terms

Alternative Lag Length for the fobj Variable	MA Order	Explanatory Variables: *arki*	*fobj*	*fobj (1)*	*fobj (2)*	*fobj (3)*	*fobj (4)*	*dumy*	Constant Term
A. *fobj*	1	0.7378	3.1842					-1888.1	8021.6
		(7.7650)a	(2.3414)b					(1.3237)	(2.1024)b
	2	0.7367	3.1267					-1874.6	8124.5
		(7.3136)a	(2.2299)b					(-1.3082)	(2.0747)
B. *fobj* (0.1)	1	0.7496	3.2640	-0.0810				-1896.9	7550.4
		(5.7360)a	(2.0900)c	(-0.0532)				(1.2388)	(1.5327)
	2	0.7508	3.4666	-0.3272				-1856	7542.9
		(5.5785)a	(2.0053)c	(-0.1892)				(-1.1879)	(1.4952)
C. *fobj* (0.4)	1	0.6560	1.5136	0.7791	0.3847	0.345	2.3269	-2400.9	8907.9
		(2.2595)b	(1.3877)	(0.6759)	(0.3162)	(0.2833)	(2.1164)c	(-1.3122)	(0.8677)
	2	0.5580	0.6485	2.1626	0.3491	0.8123	2.3145	-3275.6	12174.0
		(2.7932)b	(0.4589)	(2.5884)b	(0.3900)	(0.7696)	(2.5547)b	(-2.0597)c	(1.6853)

Notes:
a) Significant at alpha = 0.005
b) Significant at alpha = 0.025
c) Significant at alpha = 0.05

Finally it is noticed that both MA(1) an d MA(2) error models yield similar results in term of $\overline{R}^2$ and the significance of the regressors. These result give a mild dilemma in choosing between MA(1) an d MA(2). Because the main goal here is to see if there is a link between *fobj* and *arko*, not to obtain robust regression estimators for forecasting purpose. We should not be deeply concerned by this dilemma. Note however that the ARMA (1,1) result of the ARIMA analysis has no technical consequence for the current analysis.

Discussion

A number of inference can be made from these economics results. Firstly, the dynamics of international cinnamon market as represented by export price does influence the size of cinnamon planting areas in Kerinci. Our ADL models suggest that the size of planting areas in a given year is affected by realization of export price in the same year. At a glance this result may seem to imply no time lags between export price and cinnamon areas. But the author is not prepared to draw such a bold conclusion due to the good performance of models with a time lag of 4 years.

If the relationship between export price and the size of cinnamon areas does take a "no time lag" form, one possible explanation is that establishment of new cinnamon farming is influence by current cinnamon income. A higher export price would mean a higher cinnamon income[18], which thus gives farmers greater financial capacities to meet the costs of establishing a new cinnamon farming.

One problem with this "no time lag" argument is that it assumes a relatively short time lag between forest clearing and establishment of cinnamon farming[19]. However, this time lag can sometime take a year, depending on rainfall intensity and *anak ladang* availability.

This no time lag argument also assumes a smooth and speedy data collection process. If a farmer establish cinnamon farming in year *t,* for example, then his or her head of village is assumed to record it officially in the same year. So do official of the district office for tree crops. Thus, the time lag between an actual establishment of cinnamon farming and its official recording at the district level has been assumed to take less than a year. Which such an assumption is reasonable, in practice data collection does not always work smoothly and speedily. Moreover, village officials may possibly wait until the cinnamon reaches an age of 1 or 2 years before recording farm officially.

For these practical reasons, a time lag of 4 years appears to be equally possible. Unfortunately, this speculation is not supported by a hard evidence. And thus should remain as a speculation. Nonetheless, it can be confidently concluded that export price does influence the size of cinnamon planting areas, even though the exact shape of the relationship is still open for further deliberation.

Secondly there appears to be strong internal forces that govern the stochastic process of cinnamon planting areas. This result can be deduced from the high $\overline{R}^2$ value of over

[18] It is assumed here that farm gate prices are good reflections of export prices.
[19] This time lag is referred to as the drying period in this thesis.

87 percent for our ARMA (1,1) model as compare to the value of less than 83 percent for the ADL models. The high significant of *arki* in the ADL models gives further support for this conclusion[20].

This result has a very important implication. This is, while export price does affect cinnamon planting areas, there are strong internal factors that also influence the size of the areas. These factors may include variables such as population growth (as indicated by its high correlation with *arki* and social values land ownership and social status

Thirdly, despite the establishment of KSNP in 1982 which has then followed by the subsequent conservation program, the size of cinnamon areas in Kerinci continues to expand. As cinnamon expansion usually result in greater deforestation, this implies that KSNP programs have been somehow ineffective in halting deforestation trend in Kerinci. The boundary problem discussed earlier is one possible explanation for this ineffectiveness. Nonetheless, other forms of government failure may also play a role here. This issue will be discussed further in the following section.

CONSERVATION MANAGEMENT AND GOVERNMENT FAILURE

So far we have discussed the difficulties facing the government in establishing a definite KSNP boundary. For many years since 1982, this problem does not seem to be resolved properly. As a consequence, it has caused frictions between government officials and farmers, and to some degree between officials of the government agencies involved in KSNP management. The problem is however not the only form of government failure identified during the field-work. There are a number of problems such as overlapped spatial planning, ineffective detection policies and poorly targeted projects which also hinder KSNP's conservation programs. The focus of this section is to analyse such forms of government failure and alternative ways to remedy them.

[20] One may be tempted to compare the relative influence of export price and the stochastic process of *arko*. But given our small sample size, the author opts not to do so.

Overlapping Spatial Planning

A closer look at the boundary problem discussed earlier reveals a fact that the problem is only a symptom rooted in more serious causes. These causes are unsatisfactory spatial planning, poor inter-ministerial coordination, lack of competence on behalf of the official involved in planning and policy making, and corruption. To elaborate this point, Table 6 about overlapping land uses *inside* KSNP area is presented.

Table 6. Non-conservation Land Uses Inside The KSNP Area (1994)

Land Uses	Area (Hectares)	% a)
1. Smallholder farming	49,744	3.20
2. Forest concessionaires	222,500	14.30
3. Industrial forest plantation	30,540	2.00
4. Tree-crop estates	12,200	0.80
5. Mining	2,200	0.10
Total	317,184	20.40
Total KSNP Area	1,556,467	100.00

Source: Derived from WWF (1994)

Notes: a) Non-conservation land uses as a proportion to total KSNP area according to the 1993 Boundary Agreement (TBK)

The table clearly shows that over one-fifth of KSNP area of 1,556,467 hectares[21] are being used for non-conservation activities. Putting smallholder farming aside it can seen from the table that various government ministries have to the past given non-conservation land use approvals for over 17 percent of KSNP area. Over 250 thousand hectares were in fact allocated for forest concessionaires and industrial forest plantations (IFP). Because KSNP authority is a Ministry of Forestry's subordinate, while on the other hand it is the same ministry that has the power to issue forest concessions and IFP approvals, this fact suggests a lack of coordination among various divisions within the ministry. A similar lack of coordination also occurs between officials of the Minister of Forestry, Agriculture (especially the Director General of Tree Crops)[22] and Mining, resulting in overlapping land uses between tree crop estates, mining and national park.

[21] Based on the 1993 boundary agreement

[22] The current Habibie government has transferred the Dir.Gen of tree crops from the Ministry of Agriculture to the Ministry of Forestry.

Lack of coordination is however not the only cause of the problem. During the fieldwork the author found that most government agencies involved in KSNP management implement a very out-of-date Geographical Information System (GIS). As a result, many of the officials involved were unable to locate the exact boundary of KSNP at a given area, even though the boundary is supposed to have been clearly established via the so-called Boundary Agreement. With such limited geographical information, it is not surprising to find KSNP spatial planning was somehow unsatisfactory.

This situation is in stark contrast with the wealth of geographical and other information available at WWF office in Jakarta and Sungai Penuh. These office gather not only geographical information from satellite photos, but also regularly send small research teams to villages at the forest frontier. The research aims to produce a complete village profile, including baseline data on up-to-date forest boundaries, topography, biodiversity, demography, and specific social economic profiles. Equipped with such information, staff at the WWF seem to be more competent in preparing spatial planning and formulating local development and conservation policies.

Corruption is another serious problem. In Indonesia government licenses and approvals have long been used by senior military and/or government official as source of illegal commissions. Notwithstanding lack of hard evidence available to the author, given the corruption culture in Indonesia it can be assumed that the above overlapping is unlikely to be free from corrupt dealings between senior military/government official and large companies.

With all these impediment, the boundary problem should come as no surprise. Officially it is claimed that as of 1994, 60 percent of KSNP's boundaries have been clearly defined. But given the above deficiencies on behalf of the government agencies involved in KSNP management, one may be forgiven for being skeptical about such an official figure.

Even the boundaries have been truly established, policing the is an other hurdle. As will be discussed next, lack of staff and equipment facing KSNP authority precludes implementation of effective policing.

The Cat-and-Mouse Game

When the Kerinci-Seblat forest were declared as a national park, a game of conflicting interests between farmers and external agencies began. On the one hand, farmers are include by their land demand and the high financial returns of deforestation to continue clearing forest. On the other hands, the interest of the government, the World Bank and other external agencies lies in the conservation of the forests.

Using the result of Walker and Smith (1993) as a guide, it can be deduced that compliance to the national park riles depends *inter alia* on detection probability. If detection probabilities fall below a given threshold that ensures compliance, it is economically rational for farmers to choose non-compliance, that is, to clear a forest. In the extreme case of zero detection probability, for example, forest encroachment would continue unhindered. On the other extreme (that is, at a detection probability of one), no encroachment would occur provided that the detection process is followed by the effective prosecution with severe penalties for non-compliance. In between these extremes, non zero detection probabilities could lead to a decline of land supply, resulting in long-run marginalization of land ownership and/or exodus to the non-agricultural sectors.

In practice is difficult to determine the value of detection probability. However, one can have an arbitrary guess on its range by comparing the number of staff and equipment available to the detecting agency to the size of the areas to be supervised. The larger is the size of the areas to be supervised by a unit of staff or equipment, the lower the detection probability would likely be. Note here that for an effective detection process, the number of filed and equipment is more important than that of administrative staff and off-field equipment. In addition to this approach, understanding potential external threats to the supervised areas is also a useful tool in “guessing” the value of the detection probability.

Table 7 present data on the number of staff and equipment available to the KSNP authority. The average size of the areas to be supervised by a unit of staff or equipment is also computed. Because all conversation programs in KSNP are directed from Kerinci, the distribution of these staff and equipment between Kerinci are analysed.

Table 7. Personnel and equipment Available to The KSNP Authority and Their Ratio to Total Area to be Served (1994)

Personnel and Equipment		Number of Personnel and Equipment			Area Covered per unit personnel or equipment a)		
		Kerinci	Outside Kerinci	Total KSNP	Kerinci	Outside Kerinci	Total KSNP
1. Personnel							
Administrative staff		24	25	49	8,464	53,959	31,765
Field Staff		14	32	46	14,821	42,155	33,836
Total Staff		38	57	95	5,461	23,666	16,384
2. Forest Guard Posts		12	21	33	17,292	64,237	47,166
3. Vehicles							
Motorcycles		4	4	8	51,875	337,242	194,558
Four-Wheel Drives		2	0	2	103,750	NA	778,234
4. Radio Communication							
Base Station		1	1	2	207,500	1,348,967	778,234
HF Transceivers		1	4	5	207,500	337,242	311,293
VHF Transceivers		6	10	13	34,583	134,897	97,279
5. KSNP Area (Hectares) a)							
Kerinci	207,500						
Outside Kerinci	1,348,967						
Total KSNP	1,556,467						

Source : Derived from WWF (1994)
Notes : a) According to the 1993 Boundary Agreement (TBK)

Several pictures emerge from the table. Firstly, there is a significant disparity between the number of administrative and filed in Kerinci. One may reasonably expect Kerinci to have a relatively large administrative staff because the district is the “capital” of KSNP. But to have the number of these staff almost double that of field staff is very poor staffing policy. It can be seen from the table that while the area to staff ratio for administrative staff is 8,646 hectares per individual staff, the figure for field staff is almost 15,000 hectares. As not every individual filed staff officer is equipped with a motorcycle, to expect these staff to supervise an area of 15,000 hectares is almost inconceivable. In brief. It can be concluded that Kerinci needs more filed staff and less administrative ones.

Secondly, this problem of understaffing in term of the number of field staff is made worse by the fact that the field staff are seriously under-equipped. For a detection process to be effective, field staff need to be well equipped with transportation and communication means. The table shows that not all filed staff have access to motorcycles and ratio transceivers.

Table 8. Number of additional Staff and Equipment Needed Outside Kerinci to Meet Kerinci's Level of Area Coverage (1994)

Personnel and Equipment	Number of Personnel and Equipment		
	Available	**Total Needed a)**	**Additional Needed**
1. Personnel			
Administrative staff	25	156	131
Field Staff	32	91	59
Total Staff	57	247	190
2. Forest Guard Posts	21	78	57
3. Vehicles			
Motorcycles	4	26	22
Four-Wheel Drives	0	13	13
4. Radio Communication			
Base Station	1	7	6
HF Transceivers	4	7	3
VHF Transceivers	10	39	29
5. KSNP Area Outside Kerinci (Hectares) b)		1,348,967	

Source: Derived from WWF (1994)
Notes: a) Computed from the ratio between total KSNP area outside Kerinci and the size of area covered by per unit staff or equipment in Kerinci (Seee Table 3.7)
b) According to the 1993 Boundary Agreement (TBK)

Thirdly, as discussed earlier KSNP official have failed to immediately detect and prevent removals of boundary markets. This failure clearly indicates that the area to staff and area to equipment ratios in Kerinci are too high. Nonetheless, we have no scientific basis to suggest an optimal level for these ratio. As a simple guide, however, it suffices to suggest that these ratios need to be reduced to a level such that any boundary violation can be detected within an arbitrarily set short period, say, within less than a month

Fourthly, the problem of understaffing and under-equipment in KSNP's office outside Kerinci is even worse than that in Kerinci. Field staff in these office have to supervise an area which is three times larger than the size of area under the responsibility of their Kerinci's counterparts. The area to motorcycles ratio in these offices is six times worse than that in Kerinci. The ratios for forest guard posts and radio communications are not encouraging either. Thus, a large number of additional staff and equipment are needed outside Kerinci to meet the Kerinci's standard (Table 8). Given the fact that with a relatively larger staff and more equipment KSNP's Kerinci offices are still unable to deal with forest intrusion, one can easily imagine how much bleaker is the picture in areas outside Kerinci.

From these data it can then be inferred that detection probability in Kerinci seems to be very low, and is even lower in areas outside Kerinci. Consequently, there exist a relatively good chance for farmers of not being detected if they clear remote forests. Our observation shows that whenever farmers believe such in the case, they adopt the game of "cat-and-mouse" by clearing areas deep inside the forest, but leaving areas next to the official boundary untouched. From the outside the forest appear to remain pristine, but deep inside, new farming areas are being established.

In adopting this game, farmers normally minimize their financial risks by relying more on short-term food crops rather than on perennial crops such as cinnamon. They also tend to become more "nomadic" in order to minimize the risk of being detected. Thus, this game could in the future lead to a more worrying problem of shifting cultivation with short fallow periods, particularly in remote forests.

Table 9. Non-conservation Land Uses in Areas Adjacent to The KSNP Area (1994)

Land Uses	**Area (Hectares)**	**% a)**
1. Transmigration settlements	58,404	3.80
2. Forest concessionaires	689,641	44.30
3. Industrial forest plantation	27,800	1.80
4. Tree-crop estates	197,130	12.70
5. Mining	118,773	7.60
Total	1,091,748	70.10
Total KSNP Area	1,556,467	100.00

Source: Derived from WWF (1994)
Notes: a) Non-concervation land uses as a ratio to total KSNP area according to the 1993 Boundary Agreement (TBK)

The problem unfortunately does not end here. As a result of poor spatial planning, KSNP is closely surrounded by non-conservation land uses. These include transmigration settlement, forest concessions, industrial forest plantation, tree crop estates and mining (Table 9). This means, in addition to the "cat-and-mouse" game practiced by local farmers, additional threats to the KSNP may come from economic agents might adopt a similar cat-and-mouse game, if it is profitable for theme to do so.

The Beneficiaries of Conservation

In brief, it can be said that the benefits of KSNP flow mostly to individuals not directly involved in forest clearing and/or whose livelihood is not dependent on lands cleared from a forest. For example, while KSNP creates employment and economic opportunities in the eco-tourism sector, virtually none of the benefits generated flow to farmers at the forest frontier. In the words of a farmer leader, “we sacrifice our life for the benefits of outsiders”. This controversy suggests that the issue of economic distribution needs to be addressed properly if a conservation program is to be successful.

One alternative way to remedy this distributional problem is to design conservation programs that directly benefits farmers living at the forest frontier. These farmers are the main threats to the existence of KSNP’s forest, yet most of the conservation programs undertaken, including the World Bank’s large scale BICD project, fail to include them as the targeted beneficiaries. Agricultural development in Kerinci, for example, does not deal directly with these farmers. Instead, it deals with farmers whose livelihood does not depend on forest clearing anymore. With such a poor targeting, the view that forest conservation only benefits outsiders should come as no surprise.

Deforestation and Road Development

It is often argued that road development could lead to deforestation. The author’s review of Kerinci ‘s history, however, indicates that road development can in fact provided “official legalization” of previous deforestation. In brief, it can be explained as follows. At earlier states of a deforestation round, farmer establish clusters of temporary residence in the deforested land, with limited road link. Later, other villagers begin to establish rural businesses such as traditional eating places and small shop. After about a decade, these clusters have grown into a small village with more established, albeit traditional, road links. Under this process, in a period of two decades a village can “give birth” to 5 to 10 new villages. Some of the new villages will than become commercial centers, “forcing” the government to establish modern road links to these villages.

A clear example of this process is the history of the village of Selampaung, which has been discussed before. In this village, road development has opened motorcycle access to a large number of *ladangs* at the forest frontier, reducing traveling time to between 15 minutes and an hour. This is in contrast with most other forest-frontier *ladangs*, which are not accessible by motor vehicle, especially in rainy season. In fact many of these *ladangs* can only be reached by walking for about 1 to 4 hours from the nearest village.

Consequently, road development can be seen as a double edged sword as far as forest conservation is concerned. On the one hand, it could lead to an improved detection process because forest guards have a better access to reach forest frontiers. On the other hands, it sends wrong signals to farmers that deforestation is acceptable because it helps the government's road development programs. More importantly, it also improves farmers' access to reach forest frontiers, which could lead to another rounds of deforestation.

CONCLUSION

This paper describes some result of the study. Using a simple time-series analysis, it is shown that the dynamic of international cinnamon market, as represented by export price, does influence the size of cinnamon planting areas in the district studied. Nonetheless, the exact shape of this relationship is still open for further deliberation. The good performance of the ARMA (1,1) model indicates that there exist strong internal forces that govern the stochastic process of cinnamon planting areas.

The results also indicate that the national programs implemented since 1982 have been somehow ineffective in halting deforestation in the district studied. This problem is caused by government failure such as, firstly, over-lapping spatial planning resulting from poor inter-ministerial coordination, lack of competence and corruption; secondly, ineffective detection procedures do to the problems of poor staffing policy and inadequate staff and equipment; and finally, failure to ensure that the benefits of forest conservation go mostly to individuals directly involved in forest clearing and/or whose livelihood is dependent on land cleared from a forest.

This paper also discussed the case where road development provides "official legalization" for previous forest clearing.

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APPENDIX

Table 1. Cinnamon Planting Areas and Annual Production in Kerinci and Indonesia (1967 - 1994)

Year	Planting Areas (Hectares)		Kerinci's Share (%)	Production's Share		Kerinci's Share (%)
	Kerinci	Indonesia		Kerinci	Indonesia	
1967	5,977	14,637	40.8	5,000	8,265	60.5
1968	7,677	25,382	30.2	2,500	5,456	45.8
1969	17,862	20,019	89.2	2,125	8,425	25.2
1970	23,794	30,960	76.9	328	5,997	54.8
1971	28,068	36,087	77.8	3,300	5,727	57.6
1972	27,628	40,999	67.4	3,500	6,154	56.9
1973	34,900	50,926	68.5	3,900	7,308	53.4
1974	42,500	59,207	71.8	3,950	7,188	55.0
1975	42,500	64,866	65.5	4,000	6,457	61.9
1976	42,500	67,569	62.9	4,000	5,881	68.0
1977	42,500	71,708	59.3	4,000	7,177	55.7
1978	42,000	72,572	57.9	4,200	12,856	32.7
1979	41,450	71,638	57.9	6,200	10,617	58.4
1980	39,866	72,728	54.8	4,500	11,395	39.5
1981	39,135	70,572	55.5	4,165	13,627	30.6
1982	38,987	71,156	54.8	3,904	12,997	30.0
1983	36,728	74,344	49.4	4,723	17,041	27.7
1984	36,673	74,567	49.2	5,116	21,393	23.9
1985	36,766	73,668	49.9	5,737	21,745	26.4
1986	36,506	71,466	51.1	6,025	20,963	28.7
1987	36,815	75,691	48.6	6,778	27,033	25.1
1988	41,574	74,912	55.5	13,012	25,389	51.3
1989	42,625	77,231	55.2	13,012	24,305	53.5
1990	43,039	78,712	54.7	13,779	26,507	52.0
1991	43,518	78,712	55.3	13,779	27,049	51.0
1992	45,106	82,665	54.6	13,769	29,364	46.9
1993	48,652	90,914	53.5	15,576	32,365	48.1
1994	49,802	93,139	53.5	15,792	33,465	47.2
Average*)			56.8			42.9

Source : a) The Tree Crop Statistics (various edition), Directorate General of Tree Crops, Indonesia.
b) The District of Kerinci's Office for Tree Crops

Note: *) Weighted average of Kerinci's share to national planting areas and production.

Table 2. Data Set for The Time Series Analysis

Year	*arko* (hectares)	*popn*	*fobj* US$/ton	*dumy*
1971	28,068	187,074	931.48	0
1972	27,628	191,621	603.41	0
1973	34,900	191,599	887.62	0
1974	42,500	204,622	1,738.09	0
1975	42,500	211,862	901.03	0
1976	42,500	219,643	781.88	0
1977	42,500	224,686	848.42	0
1978	42,000	230,894	660.18	0
1979	41,450	235,879	715.70	0
1980	39,866	240,917	1,097.03	0
1981	39,135	250,244	1,063.18	0
1982	38,987	258,633	1,150.76	0
1983	36,728	266,033	1,142.27	1
1984	36,673	272,060	1,163.38	1
1985	36,766	278,839	1,078.14	1
1986	36,506	275,591	1,319.78	1
1987	36,815	274,534	1,895.16	1
1988	41,574	280,999	1,897.26	1
1989	42,625	283,922	2,671.93	1
1990	43,039	280,017	1,895.50	1
1991	43,518	283,295	1,699.92	1
1992	45,106	280,793	1,579.81	1
1993	48,652	283,495	1,760.48	1

Source : a) The Tree Crop Statistics (various edition), Directorate General of Tree Crops, Indonesia.
b) The District of Kerinci's Office for Tree Crops
c) The District of Kerinci's Office of Statistics

Table 3. Sample Autocorrelations and Partial Correlation For The Differenced arko Variable

k	Autocorrelation	Partial Auto-correlation
1	0.46	0.46
2	0.16	-0.07
3	0.20	0.20
4	0.34	0.23
5	0.22	-0.04
6	-0.19	-0.41
7	-0.19	-0.03

Note: N=25

Table 4. ARMA (1,1) Results for The Differenced arko Variable

		Autocorrelations with residuals			
Parameters	**Estimates**	**Lags**	**Value**	**Lags**	**Value**
AR (1)	0.2595	1	-0.01	13	-0.05
	(0.6187)	2	-0.01	14	-0.14
MA (1)	-0.2608	3	0.05	15	0.01
	(-0.6248)	4	0.23	16	-0.02
Constant	973.54	5	0.26	17	-0.05
	(1.0670)	6	-0.29	18	0.00
R^2	0.1517	7	-0.06	19	-0.01
		8	-0.02	20	0.02
		9	-0.12	21	0.00
		10	-0.14	22	0.00
		11	-0.07	23	0.00
		12	-0.10	24	0.00

Notes:

a) Figures in bracket are t-statistics

b) R^2 = adjusted R-square

Table 5. Performance Indicators for ADL Models with AR (1) and Uncorrelated Error Terms, without or with Almon Lags[a)]

Alternative Lag Length for the *fobj* Variable	R^2	AIC	SC	Rho
Models with AR (1) error term and without Almon Lags				
fobj	0.8423	15,352	15,599	-0.0948
fobj (0.1)	0.7922	15,414	15,712	-0.1431
fobj (0.2)	0.6957	15,353	15,702	-0.0532
fobj (0.3)	0.7304	15,150	15,549	-0.3070
fobj (0.4)	0.8538	14,596	15,044	-0.2658
Models with uncorrelated error term and without Almon Lags				
fobj	0.8360	15,391	15,638	-0.1742
fobj (0.1)	0.7666	15,530	15,828	-0.2425
fobj (0.2)	0.6934	15,361	15,709	-0.1517
fobj (0.3)	0.6764	15,333	15,731	-0.3405
fobj (0.4)	0.8258	14,772	15,219	-0.2740
Selected Result for Models with AR (1) error term and Almon Lags				
fobj (0.1,2)	0.7922	15,414	15,712	-0.1431
fobj (0.4,2)	0.8712	14,441	14,789	-0.2540
fobj (0.4,3)	0.8598	15,545	14,942	0.2622
Selected Result for Models with Uncorrelated Error Term and Almon Lags				
fobj (0.1,2)	0.7666	15,530	15,828	-0.2425
fobj (0.4,2)	0.8530	14,574	14,922	-0.2892
fobj (0.4,3)	0.8408	14,671	15,069	-0.2555

Notes:

a) The general form of the models is

arko = f *(arki, popn, fobj (0.j,k), dumy)*

where j = the largest time lag, and k = Almon Lags

b) Asymptotic estimates of theta. Figures in bracket are asymptotic t-ratio.

Table 6. Adjusted R-square and Estimated MA Coefficient for ADL Models with MA Error Terms, without or with Almon Lags[a)]

Alternative Lag Length for the fobj Variable	MA Order	R^2	Theta-1 b)	Theta-2
A. *fobj*	1	0.9064	-0.9997	
			(3.8011)	
	2	0.8852	-0.4761	-0.5237
			(-1.2320)	(1.5317)
B. *fobj* (0.1)	1	0.8412	-0.9999	
			(2.7195)	
	2	0.8472	-0.5769	-0.4228
			(-1.3673)	(1.1572)
C. *fobj* (0.2)	1	0.7972	-0.9997	
			(-2.5266)	
	2	0.7516	-0.4198	-0.5799
			(-0.7355)	(0.9239)
D. *fobj* (0.3)	1	0.8074	-0.9999	
			(-1.7492)	
	2	0.7667	-0.5885	-0.4114
			(0.9268)	(0.7821)
E. *fobj* (0.4)	1	0.9169	-0.9995	
			(2.3987)	
	2	0.9008	-0.5098	-0.4894
			(-1.3673)	(1.2102)
Selected Result for Models with Almon Lags				
F. *fobj* (0.1,2)	1	0.8412	-0.9999	
			(2.7195)	
	2	0.8472	-0.5769	-0.4228
			(-1.3673)	(-1.1572)
G. *fobj* (0.4,2)	1	0.9169	-0.9995	
			(2.3987)	
H. *fobj* (0.4,3)	1	0.9169	-0.9995	
			(2.3987)	

Notes:

a) The general form of the models is

arko = f (*arki*, *fobj* (0.j), dummy)

where j = the largest time lag

b) Asymtotic estimates of theta. Figures in bracket are asymtotic t-ratio