Can Secure Tenure Help Reduce Deforestation?

Lessons Learnt from Sumberjaya Watershed, Lampung, Indonesia

Andree Ekadinata, Sonya Dewi, Danan Prasetyo Hadi, Dudy Kurnia Nugroho
Spatial Analysis Unit - World Agroforestry Centre South East Asia

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Summary:

While land is a crucial asset for most people in rural, hilly area of Sumberjaya, Lampung province, securing land tenure has been a long battle. Long after their establishment in the early 1970s, Forestry Department announced that 30% of the watershed area classified as *protected area in 1990 (Verbist and Pasya, 2004)*. Farmers were demanded to stay away from their managed gardens. Both the process of policy making and the implications of the policy ignited conflict between the farmers and the government, which culminated by the government's action of farmer eviction from their land in 1991, 1995, and 1996 (Kusworo, 2000). Negotiation support system which is based on social forestry concept was later introduced in the area in 1998, following the starting point of devolution process; a period many called as 'reformation' in Indonesia. The system offers more tenure security in the form of rights to manage land inside protected area by the means of preserving remaining forest (stop further deforestation) and planting new tree ('reforestation'). This concept, generally known as HKm, was instantly accepted by farmers and implemented in 1998. Four years after the HKm enactment, 3 farmer groups, consist of total 292 households, obtained their 5 years HKm permit. Later on in 2006, 16 farmers groups also obtained their permit. Now, 8 years after the enactment of HKm, it is timely to ask whether securer tenure provided by social forestry concept really meets its conservation objectives: to reduce deforestation and to increase tree cover in Sumberjaya watershed.

We identify 8 major tenure systems in Sumberjaya. Those systems can be classified into three levels. The first level is tenure systems based on forest status map issued by Department of Forestry in 1990. It classifies Sumberjaya watershed into *national park*, *private land* and *protected area*. The second level is tenure systems under protected area. Using participatory-based maps areas were stratified into *HKm area with granted permit, HKm area which are under on-going process of permit application and non-HKm area.* The third tenure level further classifies the second level of tenure systems to differentiate area based on historical event of eviction (eviction and non eviction).

We use satellite imageries to classify forest and agroforest at several time steps and calculate the areas of forest and agroforest in all tenure systems, i.e., national park, private land, and protected area including HKm area. Forest cover map was produced from eight different image snapshots, with the earliest were of 1973 and the most recent ones were taken in 2005. We calculate deforestation rate between a pair of consecutive post-classified images and compared the results across different tenure systems in Sumberjaya.

Our results showed that farmer do commit to HKm conditions: under HKm, the areas of forest loss decreases and agroforest area increases. Deforestation is not completely vanished, but our analysis showed that deforestation rate has reached the lowest level ever since 1973. Within HKm area, deforestation rate remains high in the area where farmer is still in the waiting period to get their Hkm permit. This should put some emphasize to the government to rapidly process the Hkm permit. In addition to *in situ* impact of HKm on reducing deforestation, HKm could also effectively function as a buffer zone to reduce deforestation in the surrounding protected area. Forested area of Bukit Rigis, which is a protected as *'blok perlindungan'*, unmanaged area in the central part of the watershed, is surrounded by land managed under Hkm. This forested areas indeed experiences the lowest deforestation rate compared to any other tenure systems in Sumberjaya. The finding of this study supports the hypothesis that increasing land tenure security can help to reduce deforestation and increase tree cover, and therefore promoting conservation in Sumberjaya area.

1. Introduction to Sumberjaya and Its Land Tenure Conflict

Sumberjaya watershed is located in the northern part of Lampung Province. It has experienced a range of land tenure conflicts over the past three decades. One-third of the watershed area is classified as *protected area* by Forestry Department under Forest Zone Map, which was officially issued in 1990. Protected area is formally defined as forested area allocated to support ecological function of the landscape, which in the case of Sumberjaya, watershed function. However, in reality, most of this area is no longer forested. In Sumberjaya case only 35% of protected area was forested in 1990. The rest of the area was mostly planted with coffee and rice by farmers years before it was designated as protected areas. Forestry Department reinforced the regulation of management of protected area and pushed away farmers from their managed garden. The series of conflicts between the farmers and the government culminated in an event of farmer eviction in 1995.

In 1998, when political reformation was started in Indonesia, Department of Forestry began to re–analyze their policy in almost every aspect. This includes policies that have caused conflict in many areas in Indonesia. In Sumberjaya, social forestry scheme generally known as Hkm (*hutan kemasyarakatan)* was introduced as negotiation support system to settle conflict. The concept is simple: it gives initially 5 years permission to an organized-group of farmers to manage part of the protected area with possibility to be extended to 25 years under two conditions: they will protect the remaining forest in the area and they will plant trees in their garden. Therefore up to a certain level, within Hkm scheme, farmers have some sense of tenure security over their land. Farmers accept this with great enthusiasm. *Hkm* groups were rapidly formed in many areas inside protected land. In 2002, 3 farmer groups obtained their Hkm permission. These are the first HKm groups in Indonesia that obtained HKm permits through participatory process (Verbist and Pasya, 2004). Planting new tree in the garden has been an old concept that implemented by people of Sumberjaya since 1980 (Verbist et. al., 2005). However, maintaining the remaining forest cover is more challenging. Some monitoring is needed to be able to get some reality check of whether by providing farmers with land security, Hkm scheme can help to conserve forest and tree, and therefore watershed protection, in Sumberjaya.

Through this study, we try to address the above question by analyzing the changes in forest area and tree cover inside Hkm area and compared it across other tenurial systems in Sumberjaya. We used remote sensing techniques and spatial analysis approach in the analysis.

2. Description of Sumberjaya

Administratively, Sumberjaya watershed is part of West Lampung District, Lampung Province. The location is about 4 hours driving from Bandar Lampung, the capital of Lampung Province. The size of the watershed is 45000 ha, which include hilly area with elevation around 700-1700 masl. More than 80000 people live in the area. They spread

into 28 villages, located close to the main road and other location in the watershed. Almost half of the population is transmigrates from Java, only less than 20% is indigenous people, the Semendo. Sumberjaya soil is fairly fertile, dominated by Inceptisol, Andisol and Ultisol. Agriculture is the main sector where most of Sumberjaya people where involved in. Farmers plant coffee, paddy field, and horticulture. Verbist et.al, 2005 mentioned that 65% of Sumberjaya is coffee garden. South-west part of the watershed belongs to Bukit Barisan Selatan National Park, the second largest national park in Sumatra. Figure 2.1 showed the location of Sumberjaya watershed.

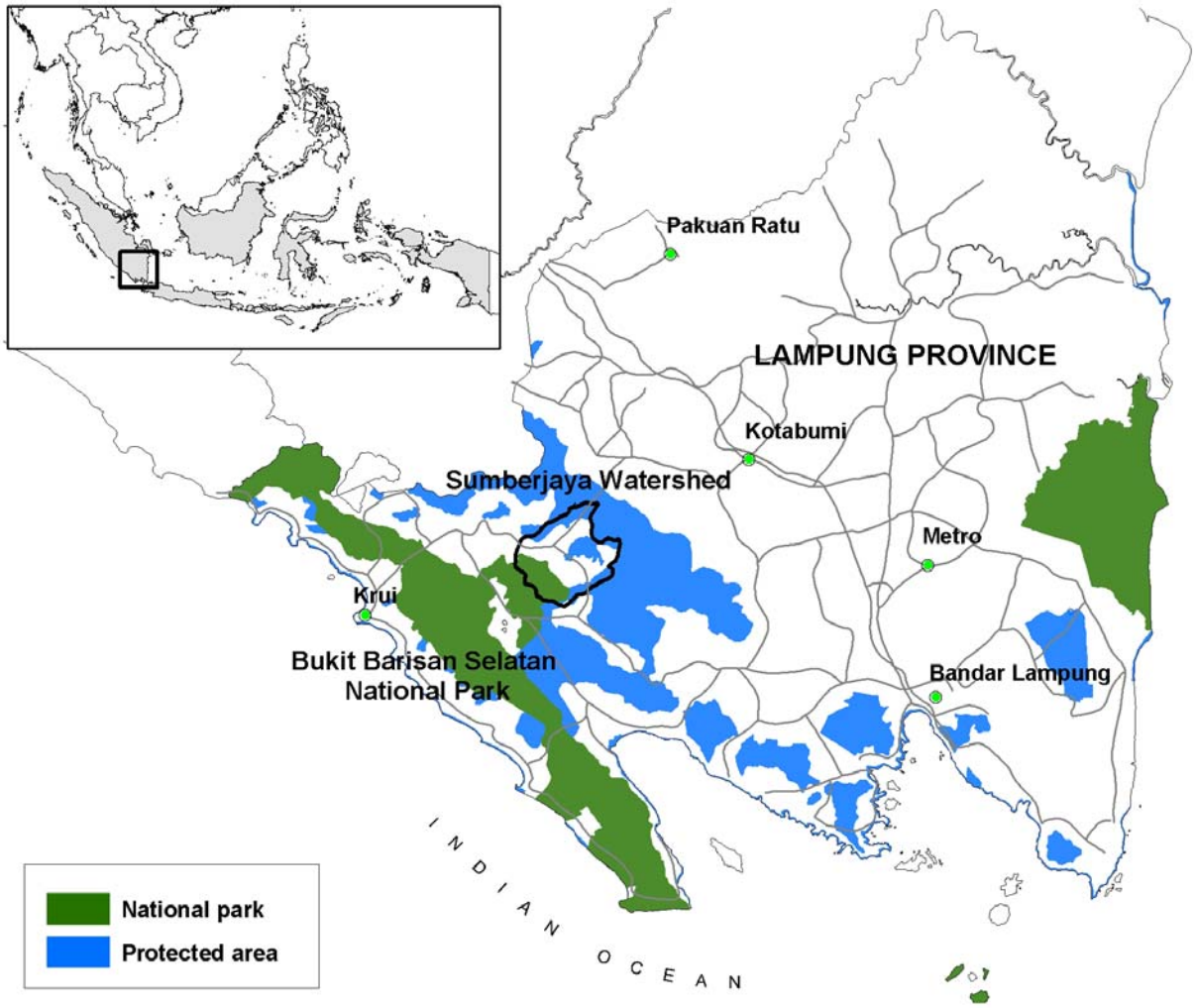


Figure 2.1. Location of Sumberjaya watershed in Lampung Province, with Kerinci Seblat National Park at south-west part

3. How Do We Approach The Problem?

The main outputs required for us to be able to answer the question on whether Hkm is good enough to reduce deforestation are the amount of forested area for each types of tenure system and the rate of deforestation at each system. In order to do that we need stratification map of tenure system and time-series land cover map showing mainly forest and tree-based system. The stratums on tenure boundaries map will serve as a basic unit of analyses. Therefore it should be detailed enough to include the following:

- **Forestry-Land Status**. It can be national park, protected area, or private land.
- **Social Forestry Status**. If the land is classified into protected area than the next step is to see its reception to social forestry program. It can be Hkm area with granted permit, HKm area which are under on-going process of permit application and non-HKm area.

3.1 Materials

The study needs two main sources of data. The first dataset is required to develop stratification of land tenure. The second set of materials is needed to produce time series of forest cover maps. The materials used for land tenure stratification are: several thematic maps (table 3.1.) that was collected from different source, participatory map and some additional ground information that was collected by ICRAF team.

Table 3.1. Materials for Land Tenure Stratification

No	Theme	Resolution/scale	Date	Material/Source
1	Watershed boundary	1:25000	2004	Aerial photo; digital elevation model
2	National park boundary	1 : 25000	2005	World Conservation Society, 2005
3	Protected forest boundary	1 : 25000	1994	Dinas Kehutanan Kabupaten Lampung Barat
4	Farmer group boundary	1 : 25000	2005	Participatory mapping conducted Farmers and Forestry Department, West Lampung

Forest cover maps were produced from time series of satellite images taken in 1973-2005 taken from 3 types of sensor and resolution (table 3.2). For analysis purpose, images were resampled to 30m resolution. Images were registered to Universal Transverse Mercator (UTM) coordinate system, zone 48-southern hemisphere, datum WGS 1984. Absolute radiometric calibration (Chavez, 1996) was conducted to reduce distortion in imageries digital values due to differences in atmospheric condition during image acquisition.

Table 3.2 Satellite images for forest cover mapping

No	Satellite	Sensor	Acquisition Time	Original Resolution
1	Landsat	ETM	2-Mar-05	30m
2	Landsat	ETM	20-Oct-02	30m
3	Landsat	ETM	6-Jan-99	30m
4	SPOT	XS-2	5-May-00	20m
5	SPOT	XS-2	26-Sep-97	20m
6	Landsat	MSS	3-May-89	79m
7	Landsat	MSS	22-Jun-78	79m
8	Landsat	MSS	12-Jun-73	79m

3.2 Methods

3.2.1 Land Tenure Stratification

We aim to produce a tenure stratification map that appropriately capture the heterogeneity of land tenure security. We focused the stratification of land tenure on the area where social forestry scheme (HKm) is conducted. Based on Ministry of Forestry decree no 31/Kpts-II/2001, HKm (*hutan kemasyarakan*) is defined as a community based forest management located inside state forest-land. In the case of Sumberjaya, state forest-land can only have two meanings: *national park* or *protected area*, and HKm can only be located within protected area and not within national park area. HKm area is further classified into areas belong to farmers who have received formal HKm permits from the local government and those who apply for HKm permit but have not been granted yet. The historical event of eviction in the 1992-1995 was also documented and mapped for further exploration.

Considering the facts above, we identify 8 major tenure systems in Sumberjaya, based on three hierarchical levels (see Figure 3.1). The first level is tenure systems based on forest status map issued by Department of Forestry in 1990. It classifies Sumberjaya watershed into *national park, private land* and *protected area*. The second level is tenure systems inside protected area. Using participatory-based maps the areas are stratified into *HKm area with obtained permit, HKm area with in-process permit and non-HKm area*. The third tenure level further classifies the second level of tenure systems to differentiate area based on historical event of eviction (eviction and non eviction).

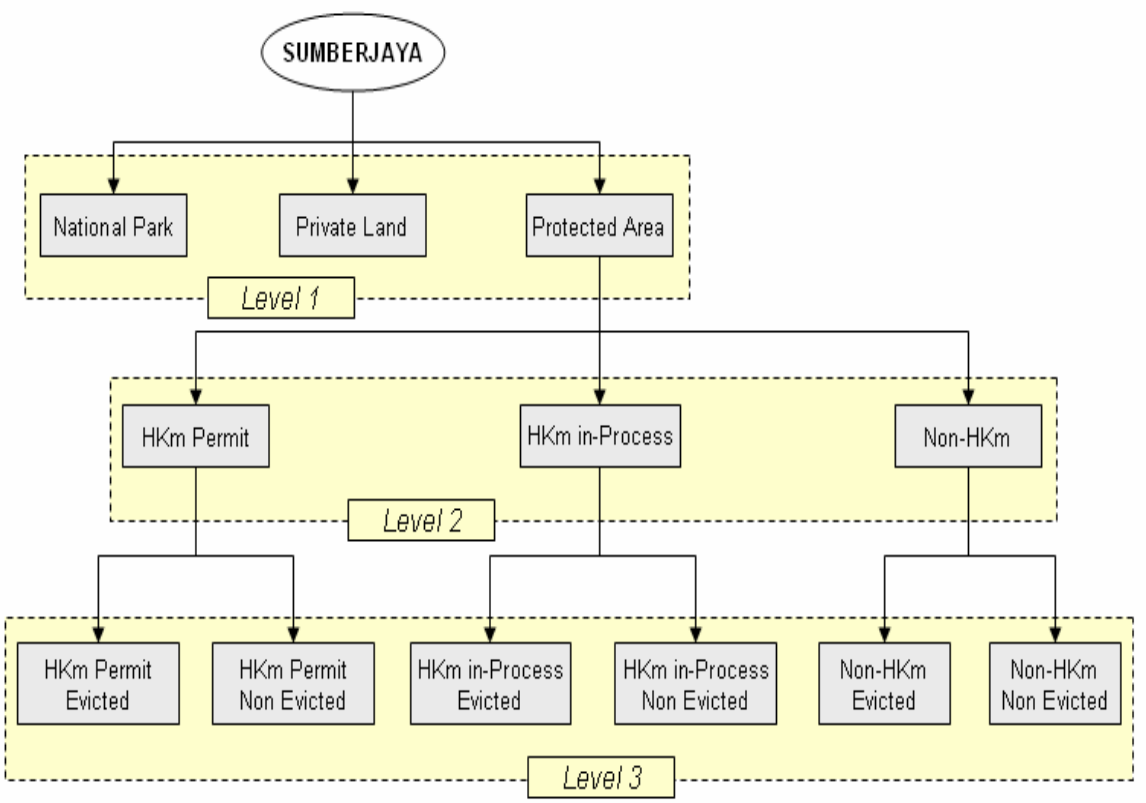


Figure 3.1. Stratification of land tenure

3.2.2 Forest Cover Mapping

Object-based image classification approach was used to produce forest cover maps of study area. The motivation of using this approach is the fact that the expected result of many image analysis tasks is the extraction of real world objects, proper in shape and proper in classification. This expectation mostly cannot be fulfilled by common, pixel-based approaches (Definiens, 2001). However, the degree of suitability of techniques to use ranges from one application to another. In forest-agroforest landscape mosaics, especially in the humid tropics, where vegetation is usually dense, heterogeneous and multi-strata, the level of difficulties in classifying images with high accuracy are very high.

Object based approach is basically a method of digital image classification based-on creation of spectrally homogenous cluster of pixels that represent real objects on the earth surface. The cluster of pixel is called *image segments*, which contained not only spectral information from the satellite image but also spatially related information such as area, perimeter, neighborhood relationship, etc. In contrast to traditional image processing methods, the basic processing units of object oriented image classification are image objects or segments, and not single pixels.

There are two major advantages of using object based approach, firstly is in its ability to automatically extract the desired objects of interest in an image right from the beginning

of classification process, and secondly is in the chance of combining both spatial and spectral parameters in identifying one particular landcover class. These approach suit very well to address the complexity of image classification for forest-agroforest mosaics of tropical humid tropics for the following reasons:

- image objects produced by object based approach capture spectral variations inside a patch of agroforest. Due to its complex vegetation structure, the main issue in agroforest identification from satellite images is in recognizing the levels of variations within a group of pixels. Pixel-by-pixel classification cannot pick up well these variations;
- it allows users to include process-based knowledge of land use/cover changes by taking into account spatial determinants and field knowledge in the classification process; e.g., location of settlement, possible neighborhood type of landcover, etc.

Three landcover classes identified are: *forest, agroforest,* and *others*. *Forest* refers to an area characterized by more or less dense and extensive natural tree which may be exploited (partly/selectively logged), *agroforest* refers to coffee agroforest which is coffee-based cultivation with shaded-tree, while *other* refers to any type of landcover beside forest and agroforest. This is mostly paddy field, settlement, and grass.

3.2.3 Calculation of Deforestation and Annual Deforestation Rate

In this study, we define deforestation as any events where forested area is converted into non forest area between two time steps. Non forest area includes coffee plantation, paddy field, settlement, and others and time steps refer to the time series of forest cover maps. In order to analyze deforestation, we calculated the following parameters:

- *Total forest cover* (ha); total forested area in one point of time inside particular tenurial stratum
- *Deforestation area* (ha); total conversion of forested area to no forest between two time steps
- *Proportion of Forest* (%); forest area in one particular tenurial stratum over total forested area in Sumberjaya watershed, interpreted as forest contribution of a tenurial stratum to total forest in the watershed
- *Annual deforestation area* (ha/year); the average *deforestation are*a over the period of two time steps
- *Annual deforestation rate* (%/year); deforestation rate is forest loss during two time steps divided by forest area in the first time steps multiplied by 100; annual deforestation rate is the average of deforestation rate over the period of two time steps taking into account discounting factors between two time steps.

  $f_n = f_1(1-r)^{n-1}$ where f = total forest cover; r= deforestation rate and n= time periods between time steps. Assuming r is consistent :

  $r = 1 - \sqrt[n-1]{f_n / f_1}$

4. Results

4.1 Tenure Strata in Sumberjaya Watershed

In the watershed, three forest zones are identified: protected forest (PA), private land (PL) and national park (NP). Those three classes of forest zones were used as the first layer for stratification. Private land is the largest, covering approximately half of the watershed area, while NP and PA covered 16% and 34% respectively.

The social forestry scheme (Hkm) only takes place in protected area, and therefore further differentiation to eventually come up with strata as the units of analyses was only done in PA zones. The basic idea of Hkm programs in Sumberjaya is farmer were asked to protect remaining forest and if possible plant new tree and as a reward farmer were provided with increased tenure security and a rights to use and manage land inside protected area. More than half the protected area is currently managed by farmers under HKm program (see figure 4.1). Even though some of them have not obtained their permit yet, the farmer organization is already well established. Therefore we refer to this as Hkm area. Approximately 16% (2047 ha) of protected forest land are cultivated by farmers that decide not to participate in Hkm programs, this area is refers as 'No HKm' area.

Inside Hkm areas, further stratification can be made based on their permit status or based on eviction in the past. It can be classified into Hkm with permit already obtained (Hkm-obtained) or Hkm with permit in progress (Hkm in progress). HKm-obtained, covers 28% (3444 ha) of protected area while Hkm in progress covers 56% (6984 ha).

Protected area can also be further differentiate into HKm-obtained permit with eviction in the past, HKm-obtained with no eviction in the past, HKm in progress with eviction, HKm in progress with no eviction, No Hkm with eviction and No HKm with no eviction.is, which cover area of 24% (2978 ha), 4% (465 ha), 35% (4365 ha), 21% (2619 ha), 7% (888 ha) and 9% (1159 ha), respectively.

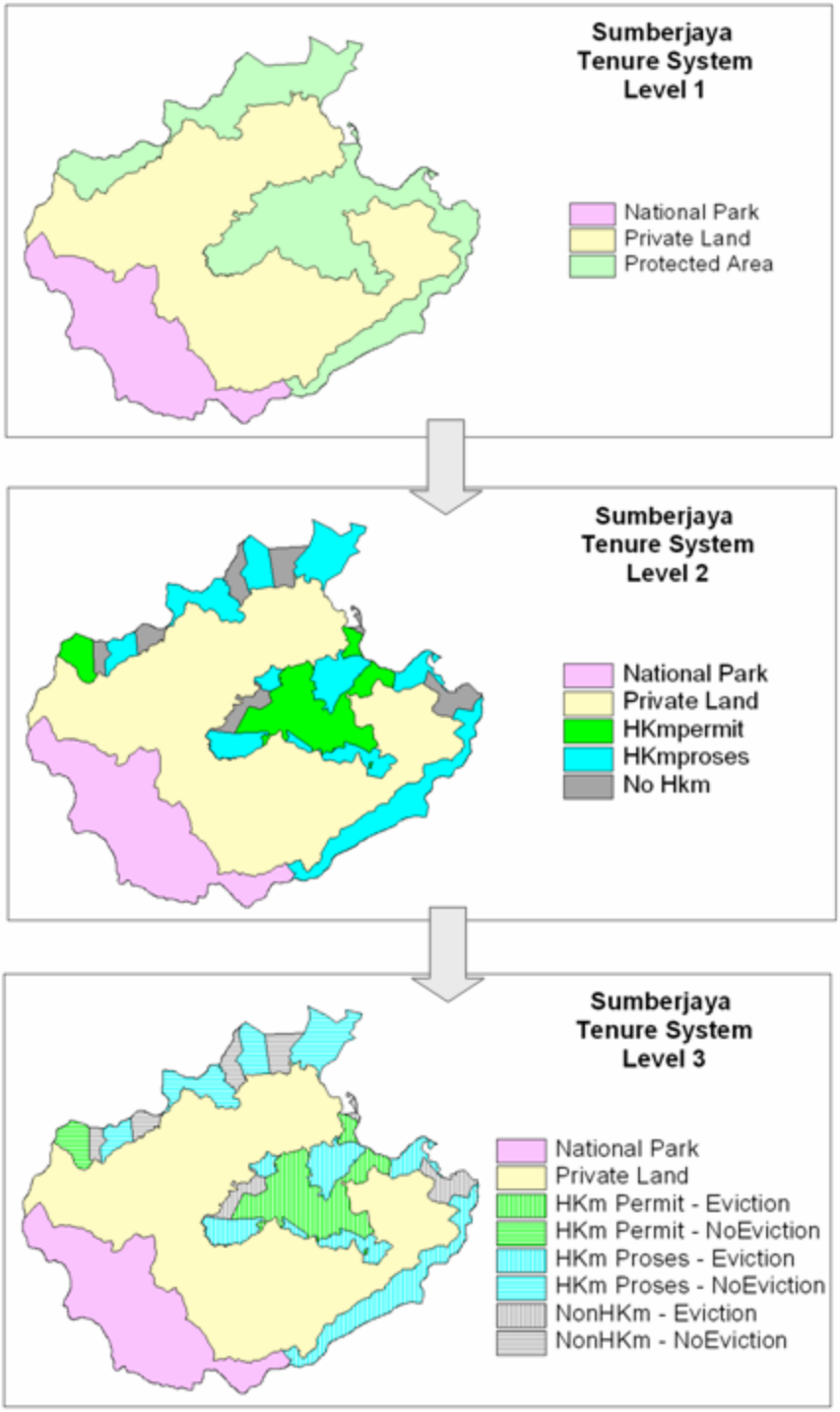
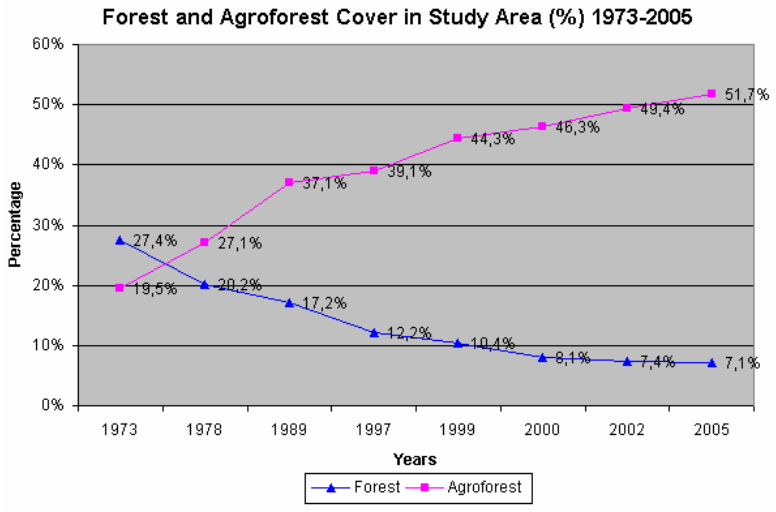


Figure 4.1. Land tenure stratification in Sumberjaya watershed

4.2 Forests and agroforest cover changes in Sumberjaya (1973-2005)

Time series land cover maps showed that forest cover consistently declines over the period of 1973-2005, with varying rates (Figure 4.2 a). Forested area initially covered 27.4% of the total watershed area in the beginning of study period and reduced to 7.1% in 2005. On the other hand, the opposite pattern is evident for coffee agroforest cover, which shows steady increases over the study period. Presently coffee agroforest is the most dominant landcover type in the area. Initially covered less than 20% of the watershed, it rapidly increases into remarkably 51.7% (22.000 ha) of Sumberjaya watershed. Figure 4.2b showed that deforestation is remarkably high in the entire watershed. However, the annual deforestation rate fluctuates over period of study. The deforestation peak was in 1999-2000 where 22.3% forest was gone within 1 year. The second highest deforestation rate occurred in the watershed happened back in 1973-1978. In between these two peaks, the deforestation rates are relatively low and quite stable in magnitude.

A



B

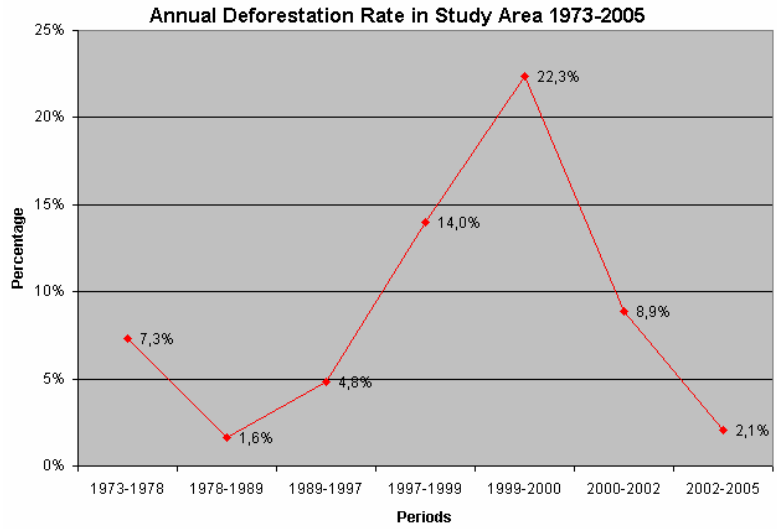


Figure 4.2. Forest cover in Sumberjaya watershed (A) and annual deforestation rate in 1973-2005 (B)

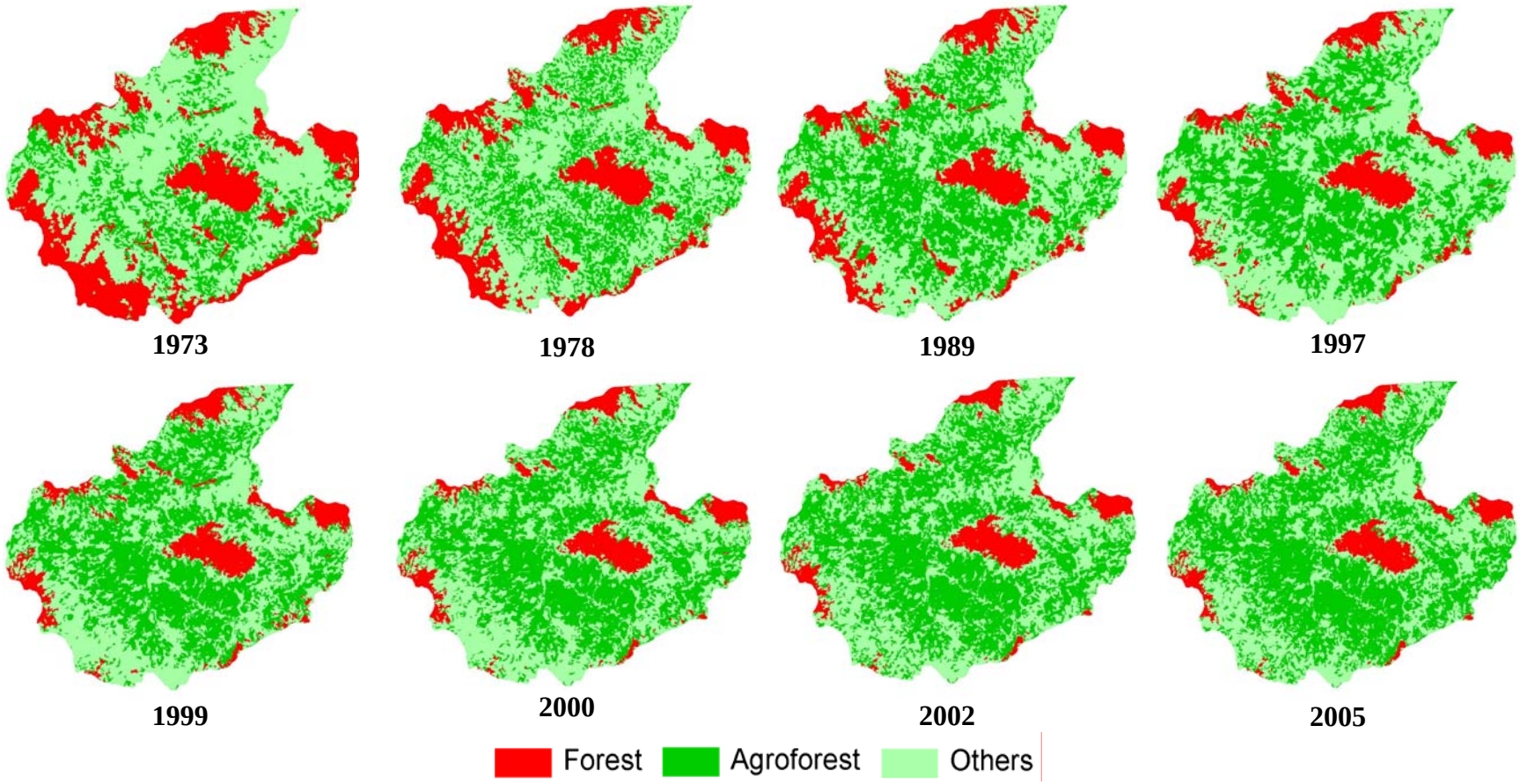


Figure 4.3 Forest cover maps of Sumberjaya 1973-2005

4.3 Deforestation within National Park, Protected Area, and Private Land

Our analysis in the first stratification level (see Figure 3.1.) showed that, today in Sumberjaya, *protected area* (PA) contributes 76% of the total forest in the study area, while PA itself only covers one-third of total study area. Historically PA has shared the largest coverage of forested land since 1973, and it grows ever since as 'supplier of forest' since forested area in other class was declined (figure 4.4). Take private land (PL) for example, which in 1973 had 8% of its area covered by forest, but in 2005 forest cover is reduced to less than 1% (Figure 4.5). The forest loss in percentage is even more drastic in *national park (NP).* While law enforcement should be stricter in NP compared to other areas, its contribution to total forest cover rapidly declines to a half in the period of thirty years. While there is a huge gap between the 'expected' and actual deforestation rate in both area assigned as NP and PA, NP shows a much larger gap. Unless there is a revolutionary change in the law reinforcement, the relative trend will be more or less stable in the future. The implication is that relying more in NP does not really help to reduce deforestation without some boost of effort for law reinforcement and that mechanism that slowing down deforestation in the protected area should be encouraged.

Agroforest in this level, share a different story. Even though forest is really minute in PL, more than a half of agroforest in the watershed is actually located in this area. National park and private land shares 15 and 20% respectively.

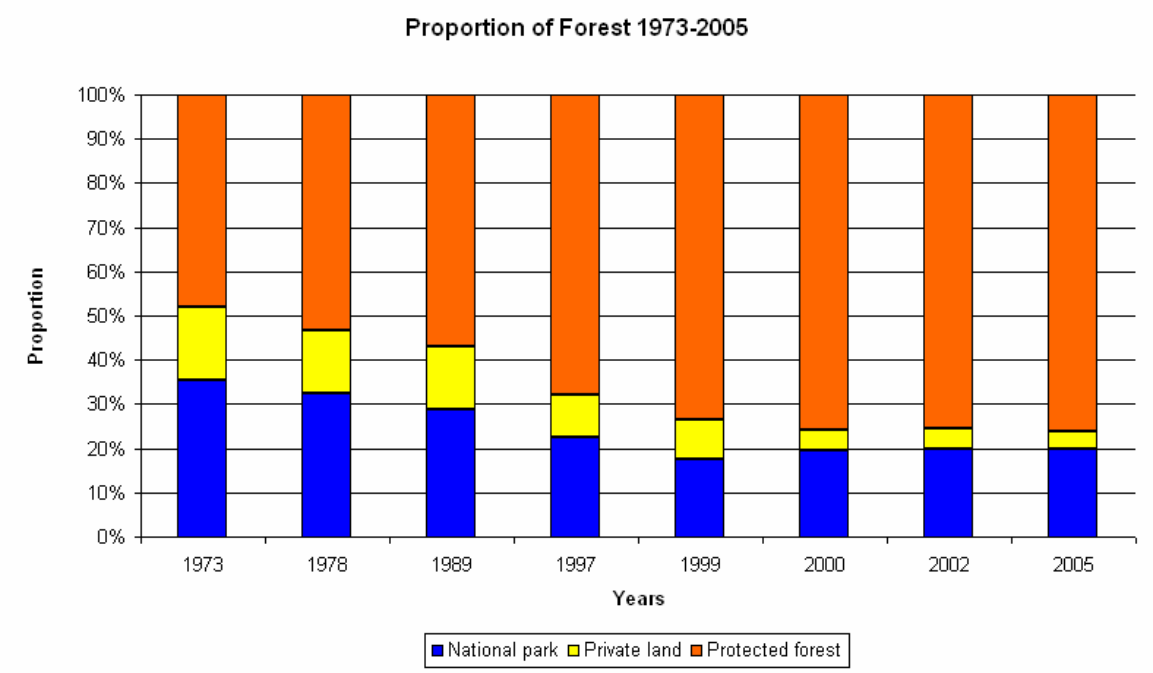


Figure 4.4 National Park, Private Land and Protected area's contributions to total forest in Sumberjaya watershed

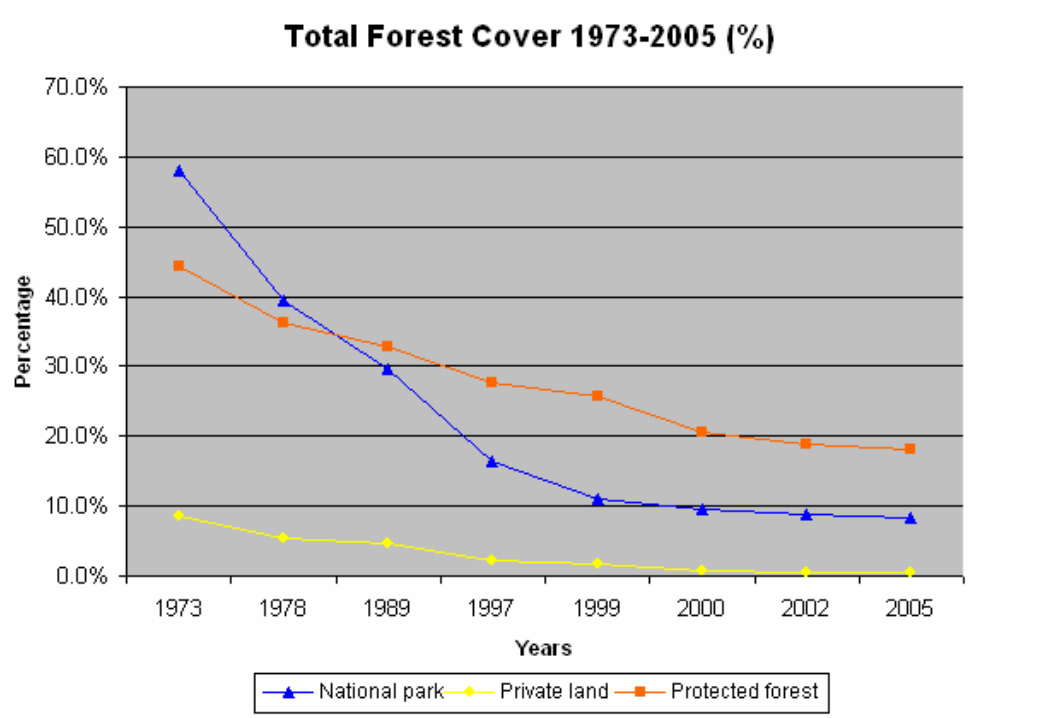


Figure 4.5. Percentage of forest cover on Sumberjaya watershed 1973-2005

The average rate of forest loss over the whole study period is highest in PL (13.7%/years) and lowest in PA (5.1%/years). The annual deforestation (ha) is consistent during early study period. It is initially high in 1970's then slowing down and reaching a peak during 1997-2000 period, especially in PA (Figure 4.6). As for the annual deforestation rate, which is basically a relative comparison of forest loss to initial forested area in each time step, the pattern is different. Since forest cover was high in the beginning of study period especially in PL, early deforestation rate is low. Later, when forest cover is low, PL shows much higher rate than the others during 1999-2000 (Fig 4.6).

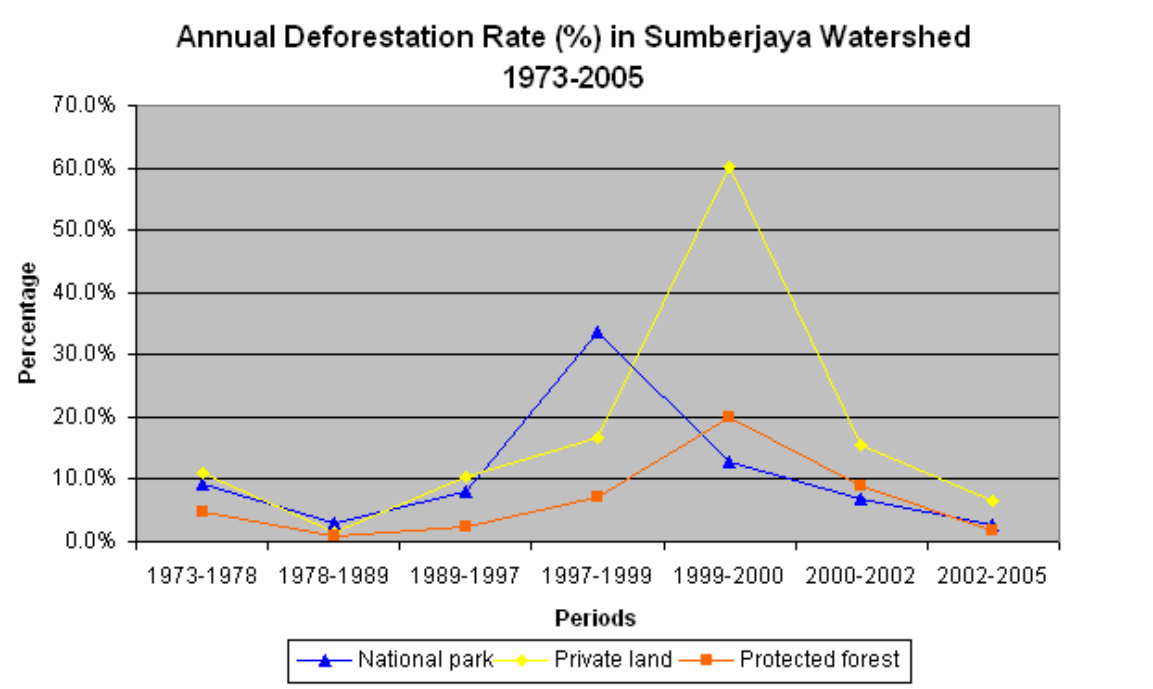


Figure 4.6. Annual deforestation rate in Sumberjaya watershed 1973-2005

4.4 Deforestation in Protected Area of Sumberjaya Watershed

PA is where social forestry program conducted. Within PA, 84% of area is cultivated land over which farmers have submitted application for or already obtained permit of HKm (HKm area); 16% of the area is managed by individual farmers who don't belong to any farmer groups and therefore have not applied for any HKm permit (no-HKm area).

Forest cover is relatively stable in Hkm area with permit already obtained, as showed in figure 4.7. Over the past 17 years since 1989, HKm obtained permit area has the largest forest cover, even compared to national park. Area under No-Hkm is of the second highest in term of forest cover. In protected area, HKm in-process area has the lowest forest cover. There are almost no differences in the trend of forest cover inside Hkm-area after social forestry concept was introduced in 1998. The trend is still declining.

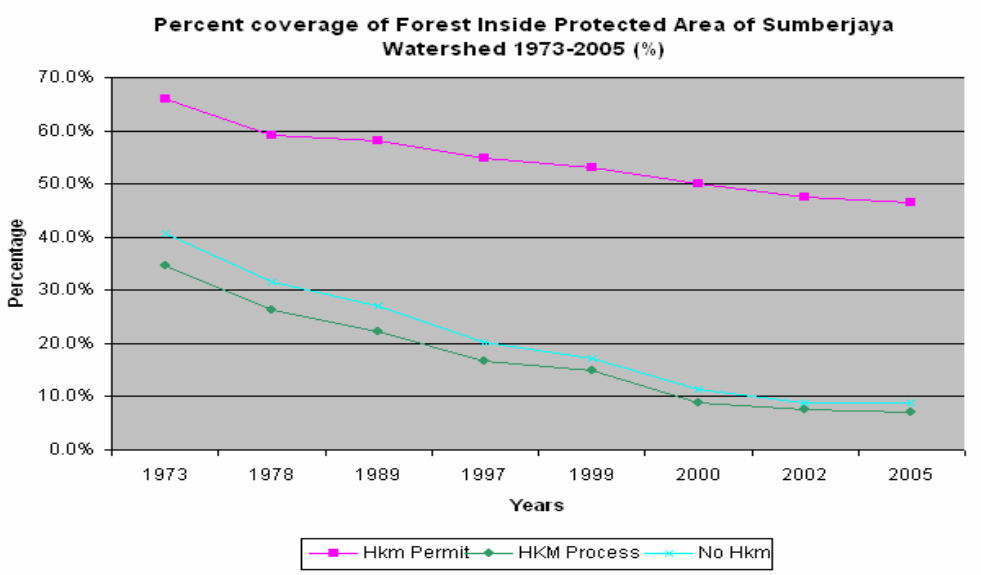


Figure 4.7 Total forest cover in Hkm obtained permit, HKm in-process and no-Hkm area

HKm obtained permit area shows an interesting trend of forest cover, where it convincingly preserved almost all of its remaining forest since 1973. It also grows in contribution to total forest areas in the watershed from 20% in 1973 to 54% in 2005 (figure 4.8), while HKM in-process and non-HKM have been quite stable in terms of their contribution to total forest areas (between 21% to 16% and 7% to 6% respectively).

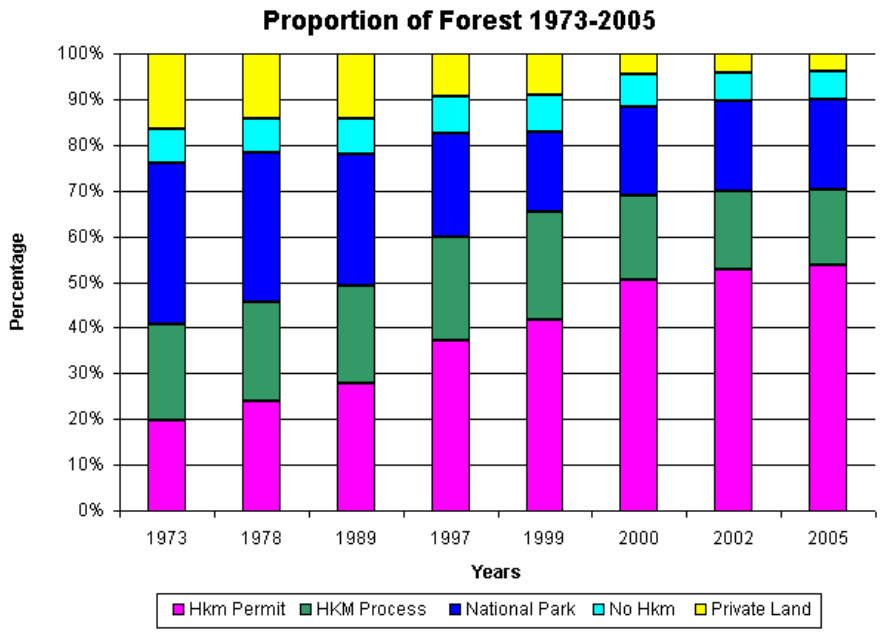
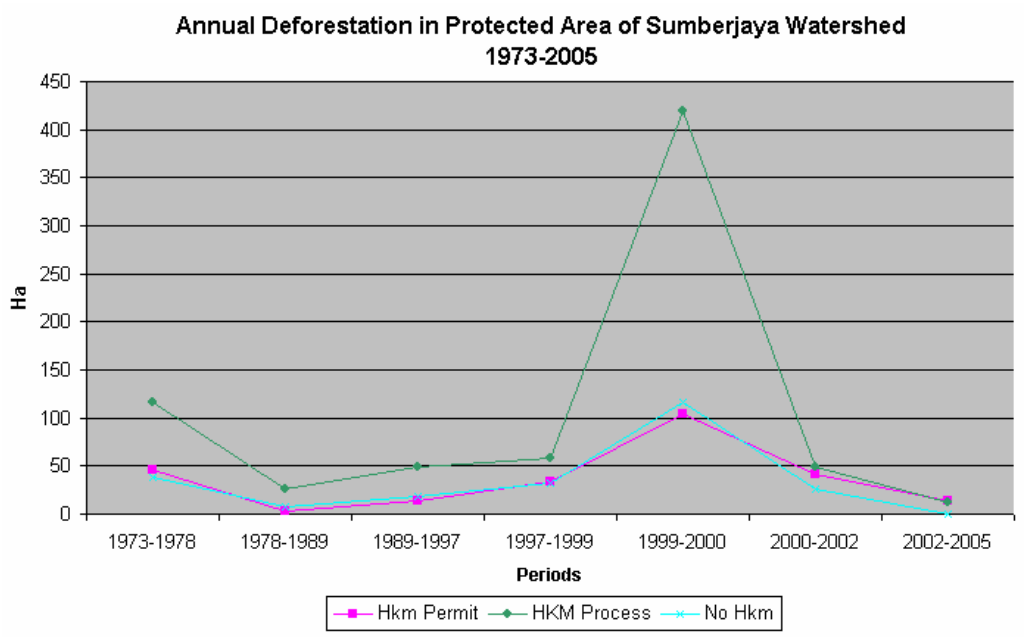


Figure 4.8. Contribution of forest to total forest in Sumberjaya watershed 1973-2005

The analysis of deforestation showed that HKm obtained permit areas consistently are lowest in terms of forest loss (ha) during the study period and it is surprisingly highest under Hkm in-process area for the entire study periods (Figure 4.9). Even after 1998 where Hkm was introduced. Comparison between deforestation rate in national park and

that of private land showed that since 1997 annual deforestation (ha) under Hkm in-process is the highest compared to other tenure systems including private land.



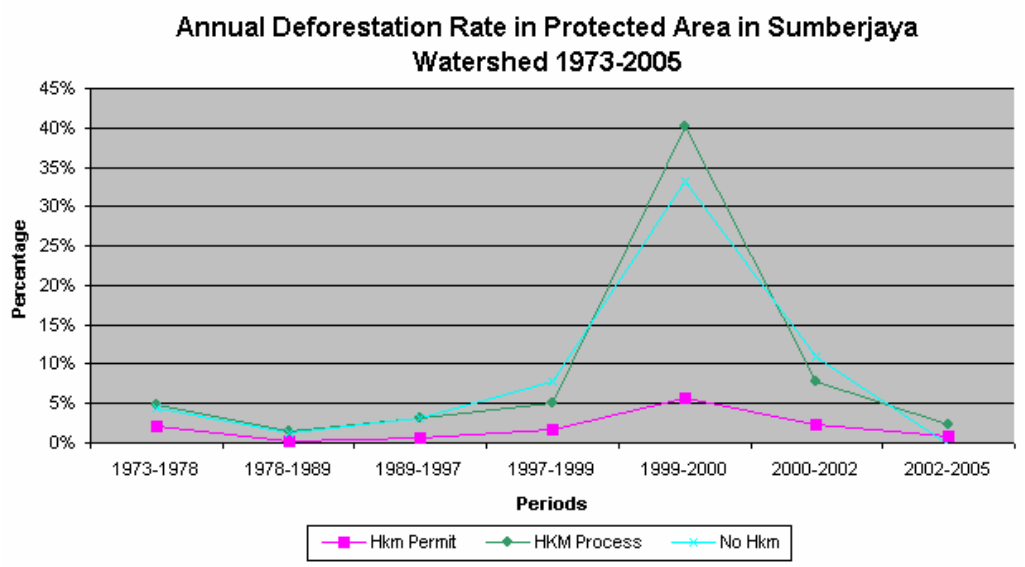


Figure 4.9 Annual deforestation rate of Hkm-obtained permit, HKm in-process and No-Hkm in Sumberjaya watershed 1973-2005

As explained before, within PA, 84% of area is classified as HKm area. 28% of PA is now managed under formal Hkm permit (Hkm-obtained); 56% is in process of getting Hkm permit (Hkm-in-process) and 16% was not asked for an Hkm permit (no-Hkm). In connection to historical event, 66% of the currently managed land belongs to farmers that had been evicted in the past and the rest of it is the areas where farmers had never been evicted.

Forest cover is relatively stable in Hkm-obtained with eviction in the past, as showed in figure 4.10. The figure shows that HKm-obtained areas, including HKm-obtained with eviction and HKm-obtained with no eviction consistently are largest in terms of percent coverage of forest (%) during the study period. From the analysis also shown that percentage of forest cover in areas which eviction event occurred has larger forest cover compare to that of areas no eviction event occurred. HKm-obtained with eviction it area shows an interesting trend of forest cover, where it convincingly preserved almost all of its remaining forest since 1973. It also grows in contribution to total forest areas in the watershed from 17% in 1973 to 52% in 2005 (figure 4.11).

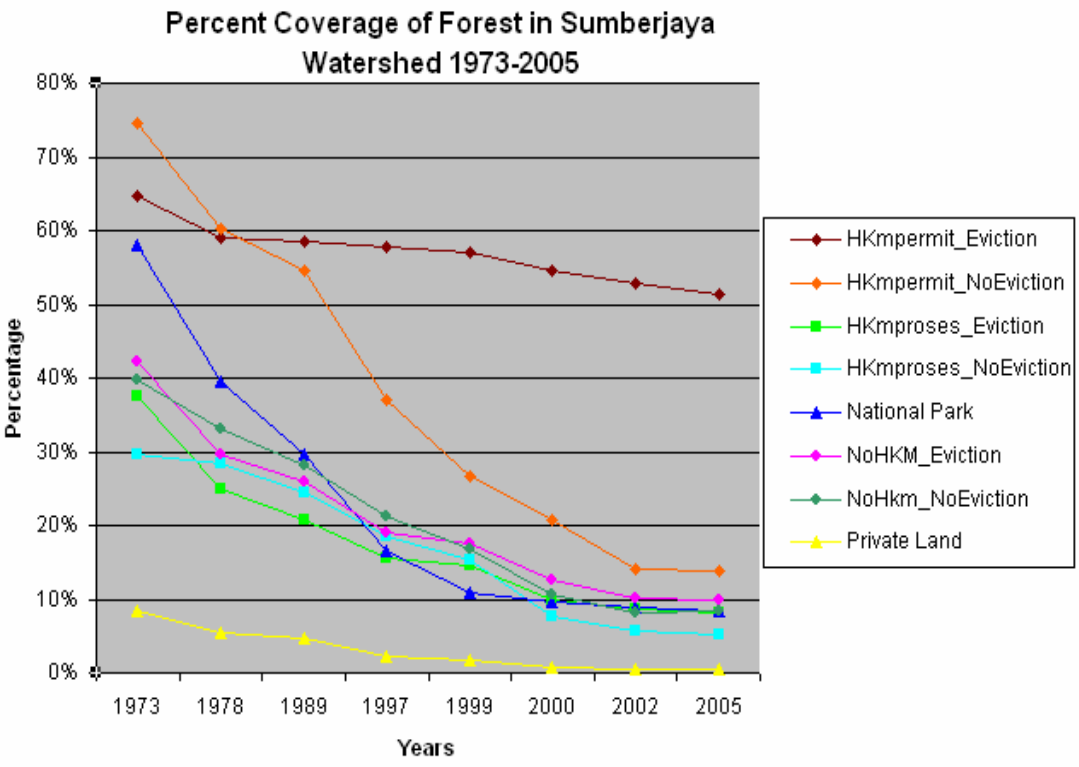


Figure 4.10 Percentage of forest cover for all strata in study area

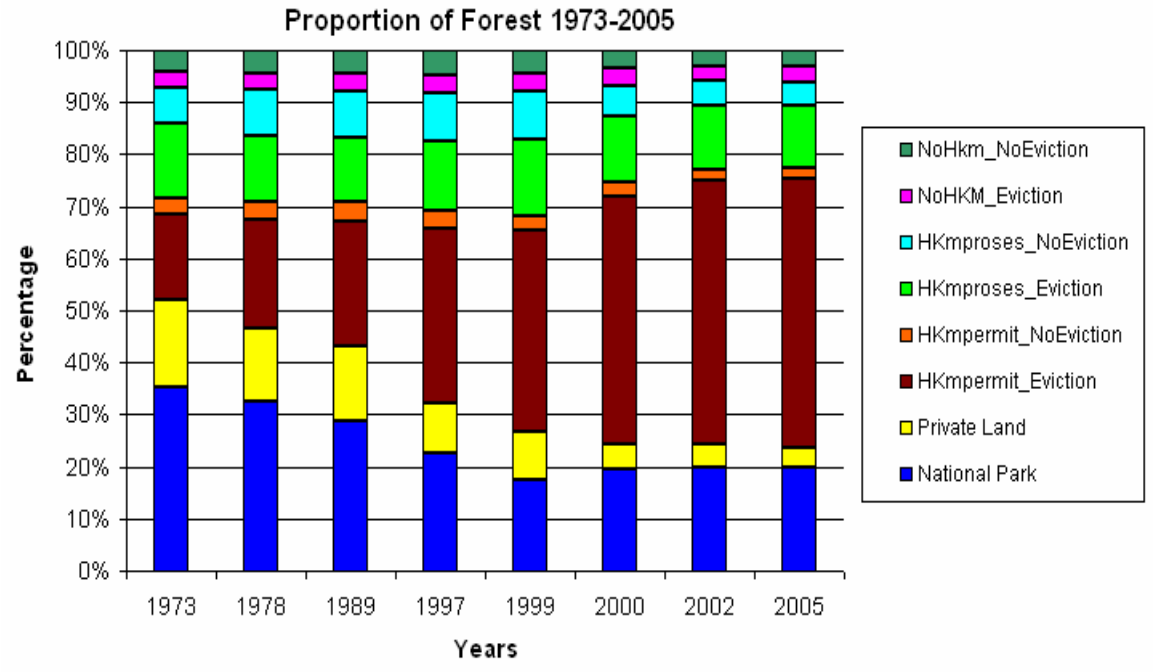


Figure 4.11. Percentage of forest cover in Hkm stratum inside protected area

In the case of evictions area, the relevant question is whether eviction helped to reduce deforestation in the area. Figure 4.12 shows that deforestation rate in area where eviction occurred in the past has lower in terms of deforestation compare to that of in area where eviction event has not occurred in the past.

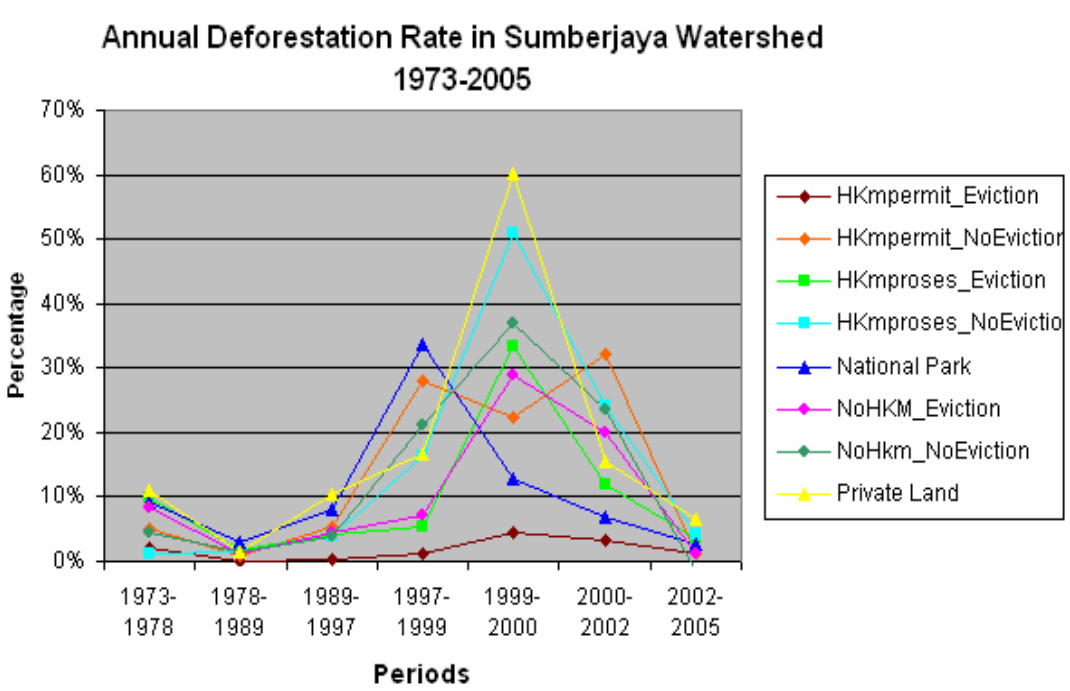


Figure 4.12. Percentage of forest cover in Hkm stratum inside protected area

5. Discussion

Forest cover consistently declines in Sumberjaya watershed over the period of 1978-2005, with the peak of deforestation rate reached in 1999-2000 when 22.3% forest is lost in one year. The period of 1998/1999 witnessed the era of major political change in Indonesia at every level from local to national. Many called this stage as 'reformation period'. It is actually a time where devolution process started to take place and law enforcement was almost non-existent. The impact, especially in forestry, was obvious. Uncontrollable logging happened in almost every forested area of Indonesia, including Sumberjaya. At that time, many farmers who were evicted in 1992/1996 returned and took back their land. In addition, they opened new agricultural land and started to plant coffee as they did many years before. This was the proximate cause of extremely high annual deforestation rate in 1999.

Among private lands, protected areas and national park, nowadays protected areas contribute most significantly to the watershed region in terms of extents of forest cover (76%), even though its annual deforestation is still considerably high. Suffice to say that at the moment, in terms of conserving remaining forest in the watershed, protected area is the most crucial part where most effort should be put. More interestingly, from livelihoods perspective, protected areas are also an important part since tenurial conflict in Sumberjaya is mostly about farmer land in protected area, and therefore HKm system if established there.

Forest loss inside Hkm-obtained permit as a whole is the lowest compared to other tenure system inside protected land. Our data showed that forest loss in area where farmer has not obtained their Hkm permit is slightly higher than the area where farmer has obtained got theirs. This suggests that government's recognition to these Hkm groups is quite important in preventing further deforestation. Farmers who hold Hkm permits must be accountable in preserving remaining forest, but those who are still applying do not have any responsibility nor incentive to preserve forests. The fact that deforestation rate is declined in Hkm-obtained areas from 6% in 1999 to 1% in 2005 showed that Hkm mechanism is an effective means to reduce deforestation, although up to now it does not stop deforestation completely. Therefore our recommendation to the local governments and Forestry Department are they should consider to facilitate the more speedy process in reviewing the Hkm permit application.

In addition to forest loss, the land cover that replaces the forest is very important from environmental service perspective as well as livelihoods perspective. In Sumberjaya case, since 1973 agroforest has dominated the area that once was forested. The agroforest area continuously expands over the study period, starting from 19.5% in 1973 to 51.7% in 2005. Coffee agroforestry system has been initiated by smallholders without any support from any government programs and has been established during may years. Since establishing agroforest is all about planting tree in coffee garden, this action can be considered as a phase of re-treeing process in the watershed (Verbist et. al., 2005). Economically the establishment has been quite viable. We calculate the annual change in area of agroforest in each time period of satellite image, and plot it against annual

deforestation value, the result showed that the ‘re-treeing process’ is relatively higher than the forest loss (Fig 5.1).

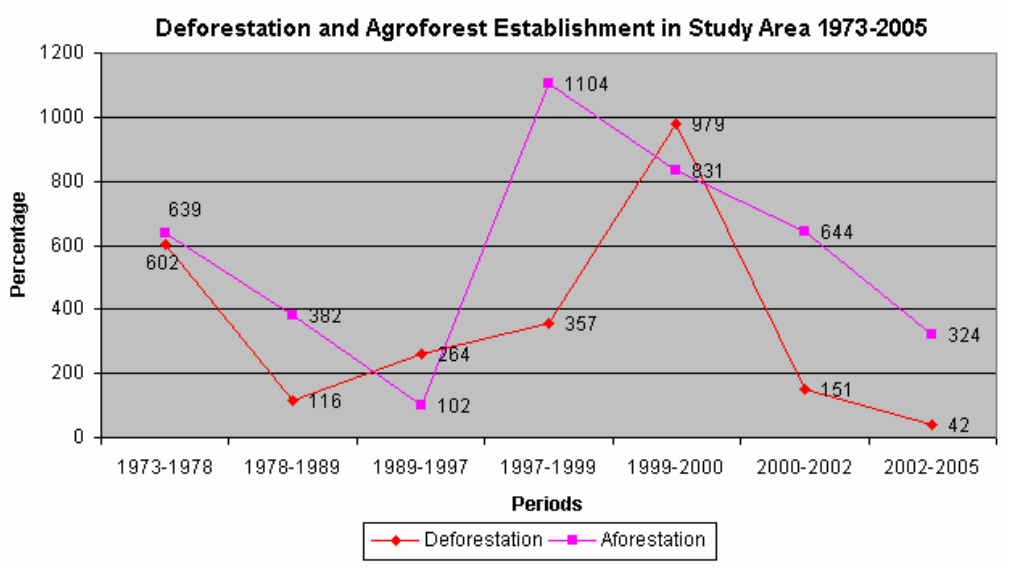


Figure 5.1 Deforestation vs agroforestation ?

The number of tree planted in the landscape inside Hkm area is significantly increased as reflected in the area of agroforest, which shows that farmer groups who hold Hkm permits fulfilled their commitment to plant new trees on their garden. Since 1998, total area of agroforest inside Hkm-obtained area significantly increased from 17% to 21 % in 2005, while in HKm in-process area increased from 41% to 50% in 2005. This might have more connection to secure tenure that brought by Hkm concept. Farmer might think that it is saver now for them to invest in planting tree than 10 years ago when eviction is still haunting.

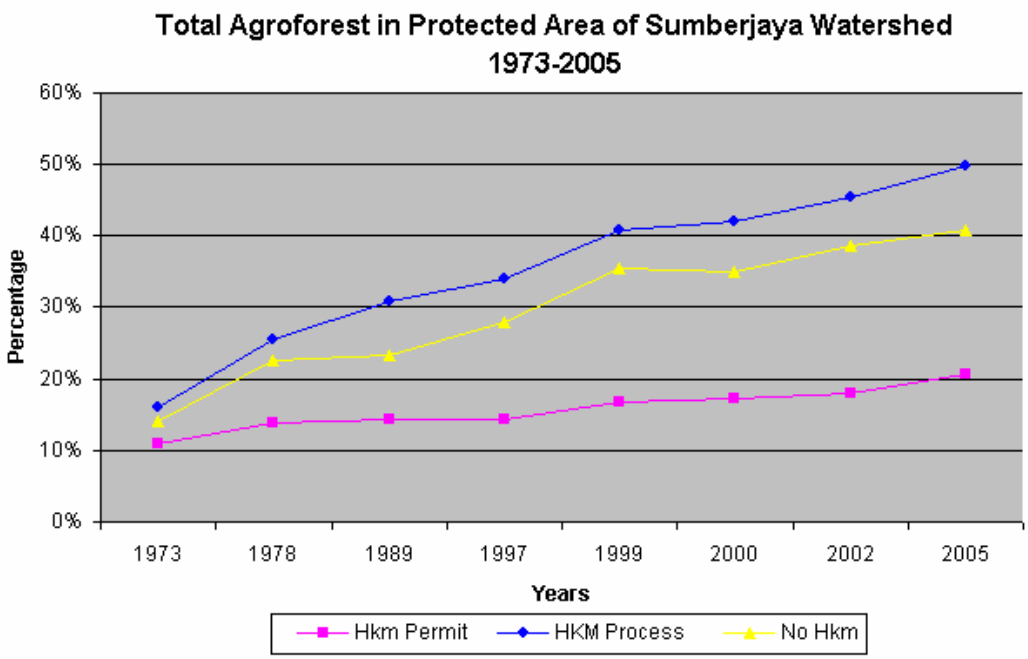


Figure 5.2 Agroforest in Protected Area

6. Conclusion

Secure tenure is crucial for farmers' livelihoods especially in the area of Sumberjaya in which people are dependent on income from coffee since more than thirty years ago. From the government's perspectives these livelihoods needs were conflicting with environmental protection issues and therefore they decided to keep people off from some areas which were accessible previously. Inevitably some conflicts between farmers and governments took place. Magnified by the national political instability during the reformation era, the demand for land, the conflict and the illegal logging have put enormous pressure to forest.

Deforestation rate has been high in most areas in Sumberjaya between 1973 to 2005, and reached its highest peak during the reformation era. The decline in forest cover has been sharpest in National Park, which reduces its role as a significant supplier of forest in Sumberjaya watershed in 1973 into almost a half nowadays. Most of forest loss in national park is due to conversion into non tree-based system with 25% of area deforested between 1973-2005 becomes agroforest nowadays. This implies the significant reduction in environmental services, especially for instance when we take into account the high resemblance of roles of tree based systems and forests in terms of watershed protection (Verbist et al, 2005). Therefore a better law enforcement systems in the National Park area is required.

Protected areas were the areas where the conflict mostly took place and at the same time protected areas is where most forest of Sumberjaya watershed lies (76%). Therefore managing well the protected areas is crucial both from conservation and development

perspectives in Sumberjaya watershed. As a trade-offs solution, social forestry through Hkm program facilitates a new scheme to provide secure tenure for farmers to plant and harvest new trees in the exchange of their contribution to preserving the remaining forest inside protected area.

This study of land cover changes across different tenurial systems shows that farmers who are granted with HKm permits have been accountable to the HKm scheme: inside Hkm, the extent of forest loss decreases and agroforest area increases. Even though deforestation rate does not reach the zero level, the study shows that the present rate of deforestation is the lowest ever since 1973. The deforestation rate remains particularly high in the area where HKm permits have not been granted yet. The processing of HKm permit application should be facilitated more rapidly by the government in order to push farmers to be accountable in managing their land while preserving the remaining forest.

In addition to *in situ* positive impact of HKm on deforestation and agroforestation, the study also reveals the role of HKm as a buffer to the surrounding protected areas. Bukit Rigis areas, which are surrounded by HKm, showed a much lower deforestation rate compared to other protected areas not surrounded by HKm. The farmers confirmed the social buffer indeed prevents people from encroaching to the forest area where HKm groups exist. This shows that some spatial land use planning can in fact help in reducing deforestation.

7. Reference

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