

ANALYSIS OF MANAGEMENT OF CORRIDOR BETWEEN GUNUNG HALIMUN NATIONAL PARK AND GUNUNG SALAK PROTECTION FOREST AREA BASED LOCAL COMMUNITY CONDITION

Wawan Gunawan¹⁾, Lilik Budi Prasetyo²⁾, Rinekso Soekmadi³⁾

1. Primate Research & Development Institute, Ministry of Forestry
2. Departement of Forest Resource Conservation, Faculty of Forestry Bogor Agricultural Institute (IPB)
3. Departement of Forest Resource Conservation, Faculty of Forestry Bogor Agricultural Institute (IPB)

Abstract

The corridor of Gunung Halimun National Park – Gunung Salak Protection Forest that functioned as animal movement corridor, animal habitat, and animal feeding ground, has suffered from pressure by people that use natural resources in the area. The general objective of the research is to analysis corridor management activity based local community condition. To achieve the objective several special objectives are needed (1) to study local community condition, including household characteristics, local community perception about corridor existence, natural resources utilization in the corridor, and natural resources preservation in the corridor, (2) to study stakeholder's role related to corridor existence, (3) to analyze recent corridor management activity. Research is conducted through interview by using questionnaire, field observation, and literature study. The results show that Purwabakti and Cipeuteuy villagers generally tend to use natural resources of the corridor from medium to high intensity. Their perception of corridor conservation is medium unfortunately, the natural resources conservation activities are very rare implemented. Stakeholders, who have interest in the existence of corridor, play a role in preserving the corridor. However, the corridor area have not been managed specially as a corridor. Coordination among stakeholders to manage corridor are very weak, since most of activities are conducted individually (separately), wich depend on their interest. Because of importance the corridor function, the corridor area need to be preserved and managed as the corridor. The corridor management activity can do in the corridor area and out/around the corridor area.

Key words : corridor, Gunung Halimun, national park, Gunung Salak, protection forest

INTRODUCTION

Forest is a an ecosystem unit which can be considered as a land area of land resources domination by trees within their environmental allience, the components of which area inseparable (Act of Republic of Indonesia No. 41 of 1999, Article 1: Verse (2)). The utility of a forests had aalready long been felt by surrounding society in supporting their daily lives, either directly or indirectly. This is apparently true for societies living in Purwabakti Village (in the region of GunungSalak), Pamijahan Subdistric, Bogor Distric and in Cipeuteuy Village (in the region of Gunung Halimun), Kabandungan Subdistric, Sukabumi Distric (collectively refered to as communities of Purwabakti-Cipeuteuy Forest).

Viewed from landscape ecology, Purwabakti – Cipeuteuy forest has its own uniqueness, due to the fact that this forest connect two forest regions of quite high biological diversity,i.e, Gunung Halimun National Park (GHNP) and Gunung Salak Protection Forest (GSPF), therefore, Purwabakti – Cipeuteuy forest functions as a corridor between both region (refered to as GHNP – GSPF). In ecological perspektif of Bennet (1999), a corridor is a linier vegetational strip, which can be a continous, or near continous track between two habitats.

The corridor of GHNP – GSPF that functioned as animal movement corridor, an habitat of wild animals, and feeding ground for wild animals, but its condition is now increasingly in danger. Based on a study (Cahyadi, 2003) it is estimated that the corridor has a length of 4.64 Km and an average width of 0.7 Km. This quite narrow corridor is presently suffering from a deleterious pressure due to activities of natural resources utilization by the local society. Considering its importance as a connecting corridor between two area with high biological diversity, a management analysis of the corridor based on local community condition is considered highly important for protecting the corridor, the existence of which is increasingly threatened.

The general objective of the research is to analyze corridor management activities based on located between GHNP and GSPF area based on local community condition. To achieve the objective several special objectives are needed : (1) to study local community condition, including household characteristics, local community perception about corridor existence, natural resources utilization in the corridor, and natural resources preservation in the corridor; (2) to study stakeholder's roles related to corridor existence; (3) to analyze recent corridor management activity.

METHODS OF RESEARCH

Time and Location of the Research

Research is conducted in Purwabakti – Cipeuteuy forest, serving as a GHNP - GSPF corridor and in Purwabakti Village, Pamijahan Subdistrict, Bogor District as well as in Cipeuteuy Village, Kabandungan Subdistrict, Sukabumi District, in the Province of West Java, during 8 months (Januari – September 2003). Data were collected in the field during 2 months (Maret – April 2003).

Sampel Units

Sample units in this study were household heads in the two villages. The purposive sampling method was applied for determining sampling locations, and random sampling was applied for taking sample units in each location.

Data Collection and Data Analysis of Local Community Conditions Characteristics of Household

Data collection was conducted through interviewing household heads as respondents, using questionnaires. Parameters to be obtained were: age of respondents, total household members, level of education, chief means of livelihood, income level, duration (time spent) for going into the forest, and acreage (size) of land ownership. Collection data were tabulated and explained descriptively.

Perception of Local Community About the Existence of GHNP – GSPF Corridor

Data were collected through interviewing household heads as respondents, using questionnaires. Parameters to be obtained were : knowledge about forest, corridor, Gunung Halimun National Park, utility of a forest, and forbidden as well as permissible activities in that area. Data were scored and tabulated, and explained descriptively.

Utilization Activities of Natural Resources in GHNP – GSPF Corridor by Local Community

Data were collected through interviewing household heads as respondents by using questionnaires. Parameters to be obtained were : type of natural resource utilized, quantity of natural resource utilized, frequency of resource utilization, type of resource utilization, and location of resource utilization. Data were scored and tabulated, and were explained descriptively.

Spearman correlation test was applied to measure correlation strength between household characteristics and perception level of respondents about the existence of corridor, and utilization of natural resources within the corridor by local communities. Statistical calculations were performed by using SPSS (*Statistical Product and Service Solutions*) Version 10.0.

Efforts for Natural Resource Conservation in the Corridor by Local Community

Data for this purpose were collected through structured interviewing of household heads as respondents. Parameters to be obtained were : type of conservation activities, time of performing the activities, frequency of performing the activities, caretaker/sponsoring agency, and values/cultural customs of natural resource conservation. Data were then tabulated and explained descriptively.

Collection and Analysis of Supporting Data

Roles Played by Interest Groups on the Existence of the Corridor

Data for this purpose were collected through interviewing the *stakeholders* directly, and through literature study for obtaining secondary data. Data were then tabulated and explained descriptively.

Spatial Data

Spatial data were collected through field observation/*ground check*, and through copying the already existing data. Data to be collected were about : location of village to be studied, locality of natural resource utilization within the corridor by local community, digital map of the corridor, map of mandate resort of the Institute of Gunung Halimun National Park and Perum Perhutani Unit III West Java (KPH Bogor and KPH Sukabumi), map of slopes, map of rainfalls and map of soils in the corridor area.

Spatial data of observed objects were in terms of geographical coordinates, and were transferred to the computer for mapping of their localities in the corridor map. The various maps thus obtained were then overlaid for determining landuse pattern and land ownerships within the corridor. Besides, to analyze the function of corridor as protection forest area, scoring and overlaying were performed into the slope map, soil map, and rainfall map, in accordance with criteria of forest area function, by using data scored based on Agricultural Ministerial Decree (SK Mentan) No. 837/Kpts/Um/11/1980 (Departemen Pertanian, 1980). Analysis of spatial data was performed by using software Arc/Info 3.5.1 and ArcView GIS 3.2.

RESULTS AND DISCUSSION

Condition of local Communities the GHNP – GSPF Corridor

Characteristics of Local Households in the Corridor

Table 1 shows the characteristics of households in Purwabakti and Cipeuteuy Village, expressed by randomly selected respondents (household heads).

Tabel 1. Distribution of Respondents According to Variables of Household Characteristics of Communities in Purwabakti and Cipeuteuy Villages

Variables of Household Characteristics	Categories	Village			
		Purwabakti		Cipeuteuy	
		Number	%	Number	%
Distribution of age of active working household heads	25 – 34 years	10	33,3	4	13,3
	35 – 44 years	8	26,7	12	40
	45 – 54 years	6	20	9	30
	> 55 years	6	20	5	16,7

Variables of Household Characteristics	Categories	Village			
		Purwabakti		Cipeuteuy	
		Number	%	Number	%
	Total	30	100	30	100
Number of household members	Small (2 – 4 persons)	8	26,7	15	50
	Medium (5 – 6 persons)	16	53,3	13	43,3
	Large (> 6 persons)	6	20	2	6,7
	Total	30	100	30	100
Formal education Level	Unschooler/dropouts	0	0	17	56,7
	Prim school graduates	21	70	10	33,3
	Sec school graduates	9	30	3	10
	Total	30	100	30	100
Chief means of Livelihood	Plant cultivators	7	23,3	20	66,6
	Government employees/plantation workers	18	60	0	0
	Service providers (transportation, etc)	3	10	5	16,7
	Traders/entrepreneurs	2	6,7	5	16,7
	Total	30	100	30	100
Income level	Low (<Rp 74 000/capita/month)	26	86,7	18	60
	Medium (Rp 74 000 – Rp 148.000/capita/month)	4	13,3	10	33,3
	High (> Rp 148.000/capita/month)	0	0	2	6,7
	Total	30	100	30	100
Duration for going Into the forest	Near (< 30 min)	17	56,7	4	13,3
	Intermediate (30 - 60 min)	12	40	25	83,4
	Far (> 60 min)	1	3,3	1	3,3
	Total	30	100	30	100
Size of land ownership	Small (< 0,25 ha)	25	83,4	10	33,3
	Medium (0,25 ha – 0,5 ha)	4	13,3	10	33,3
	Large (> 0,5 ha)	1	3,3	10	33,3
	Total	30	100	30	100

Distribution of age of working household heads in Purwabakti Village were in the age group of 25 – 34 years. While in Cipeuteuy Village these were in the age of 35 – 44 years, mostly. According to the Central Bureau of Statistics (Badan Pusat Statistik, 2003:12), age groups of 25 ~ 34 years and 35 – 44 years are within the prime age group with age interval of 25 – 54 years. Communities of this prime age are generally possessing the prime ability and condition in performing their work, resulting in good quality products.

Average number of household members in Cipeuteuy Village was smaller than for those in Purwabakti Village, which could be an indicator of success in implementing family planning program (the success of which was apparently higher than that in Purwabakti Village). Levels of formal education in both villages, were quite low, and this was due to the limited education facilities.

Most people of the community in Purwabakti Village were workers/employees of plantation industry, due to the existence of tea plantation managed by PTPN VIII (State owned Plantation Industry). On the other hand, people in Cipeuteuy Village are generally plant cultivators. Per capita income levels of both villages were quite low (< Rp 74.000/ capita/month). According to the standard limit of poverty level established by the Central Bureau of Statistics (BPS, 2000:577) income level of Rp 74.000/capita/month is the limiting poverty line for West Java

Most people of Purwabakti Village were living near the corridor forest (with access time of less than 30 minutes), while people in Cipeuteuy Village were mostly in a moderate distance from the corridor forest (with access time of 30 – 60 minutes). This quite low distance from the corridor forest resulted in a potentially high level of natural resources utilization by the local communities to fulfill their daily needs.

Most people of Purwabakti Village were possessing land of small sizes, while those of Cipeuteuy Village were evenly distributed in the three land size category (small, medium and large). The quite small sizes of land owned by most people in the community resulted in a low level of land products for fulfilling their daily needs.

Perception of Local Community About the Existence of the GHNP – GSPF Corridor

Result of the study shows that community perception of Purwabakti and Cipeuteuy Villagers about the existence of the corridor were generally at moderate level, i.e., 53.3% and 46.7% (Figure 1).

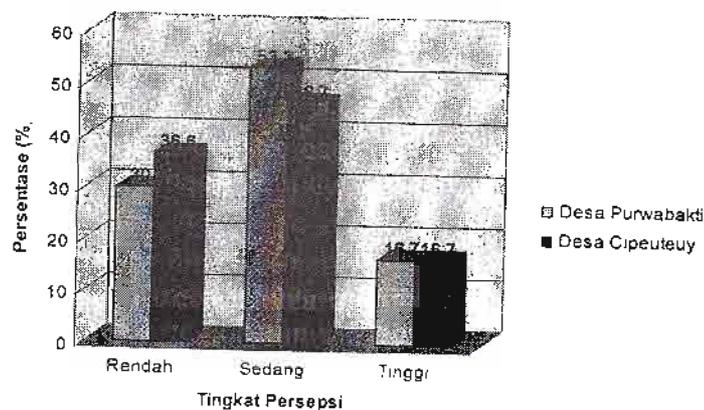


Figure 1. Histogram of Perception Level Distribution of Respondents about the Existence of GHNP - GSPF Corridor

In general, communities in both villages have knowledge only that there is a forest, not so far from their home base, use to be utilized for their daily living. However, they do not know about the regulations of natural resource utilization and conservation implied for communities living in the region. People who already know about the status of the forest have generally only a little bit information about the existence of Gunung Halimun National Park and Gunung Salak Protection Forest, without sufficient knowledge about the established regulation to be complied, while the others were less the informed about the function of this forest area as corridor in GHNP – GSPF.

Activities of Natural Resources Utilization in GHNP – GSPF Corridor by Local Community

Result of the study shows that the majority of responden in Purwabakti Village showed a level of natural resource utilization in the corridor, which could be considered as quite high, i.e., 56.7 %, whereas those in Cipeuteuy Village showed a utilization level of a moderate degree, i.e., 43.3 % (Figure 2)

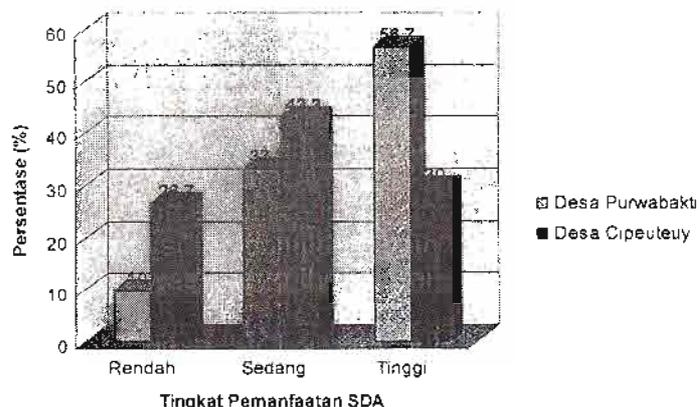


Figure 2. Histogram of Natural Resources Utilization in GHNP – GSPF Corridor by Local Community, Distribution among Purwabakti and Cipeuteuy Villagers

Type of natural resources in the corridor utilized by community in Purwabakti Village (as expressed by respondents) were : fuel wood (100%), reundeu (65.5%), pohpohan (62.1%), construction wood (58.6%), grasses (55.2%), bamboo (20.7%), tepus (20.7%), jfungi (17.2%), kicantung (6.9%), canar (6.9%), sintoh (3.4%), keras tulang (3.4%), and rattan fruits (3.4%). Figure of natural resource utilization for community in Cipeuteuy Village on the other hand, were :fuel wood (100%), reundeu (60.7%), pohpohan (50%), grasses (50%), construction wood (32.1%), rane (7.1%), bamboo (3.6%), tepus (3.6%), rattan tops/iwung (3.6%), and cangkore (3.6%).

Types of natural resources utilization in the corridor by the community in Purwabakti Village was more varied, compared with those utilized by the community in Cipeuteuy Village, and this was due to the nearer distance of the corridor from the first mentioned.

Based on result of Spearman correlation test, it could be concluded that communities in both villages showed only a less strong correlation between variables of household characteristics and perception level about the existence of the corridor (correlation coefficient < 0,5; Table 2)The correlation coefficient could range between 0 (no correlation at all) and 1 (perfect correlation). Negative sign on output refer to the opposite direction, while the positive sign refer to the same direction (Santoso, 2001:230).

Table 2. Spearman Correlation Test Result between Household Characteristics and perception Level of Respondents, and Level of Natural Resources Utilization in GHNP - GSPF Corridor

Variables	Purwabakti Village		Cipeuteuy Village	
	Corellation Coeffisien Value	Significancy (Probability)	Corellation Coeffisien Value	Significancy (Probability)
Distribution of age of working household heads (X1)	- 0.270	0.149	- 0.253	0.178
Number of household members (X2)	- 0.488	0.006**	- 0.217	0.249
Formal education level (X3)	0.282	0.131	- 0.150	0.427
Chief means of livelihood (X4)	- 0.129	0.498	0.243	0.197
Income level (X5)	0.328	0.076	- 0.025	0.894
Access time to forest (X6)	- 0.236	0.209	- 0.183	0.334
Size of land ownership (X7)	- 0.192	0.310	- 0.074	0.697
Perception level (X8)	0.166	0.380	0.194	0.303

Explanation: ** : Highly significantly correlated at confidence level 99%

* : Significantly correlated at confidence level 95%

Activities of Natural Resources Conservation in GHNP – GSPF Corridor by Local Community

63.3 % of respondents of Purwabakti Village and 73.3 % of those of Cipeuteuy Village stated that have been participating in natural resources conservation in GHNP – GSPF corridor. Types of activities performed by the community in Purwabakti Village were generally greening at the border (greenbelt) of the corridor (33.3%), and inviting others to conserv the forest (30%). Greening at the greenbelt of the corridor in Purwabakti Village was sponsored by Perum Perhutani dan PTPN VIII (Cianten Estate).

In the context of natural resource conservation in the corridor, respondents of Cipeuteuy Village stated that general form of activities participated by the community was reforestation of bare forest (stated by 50% respondents), and greening of the greenbelt (20%). These two activities were sponsored by Perum Perhutani and the Institute of Gunung Halimun National Park. Aside from this, a social forestry program launced by Perum Perhutani was also participated by the community through activities of greening/tree planting.

Roles Played by Interest Groups (Stakeholders) of the Corridor

Several institutions having some in the existence of the corridor include : the Institute of Gunung Halimun National Park, Perum Perhutani Unit III (KPH Bogor dan KPH Sukabumi), PTPN VIII (Cianten Estate), and Regional Government (Dinas Kehutanan Bogor and Dinas Kehutanan Sukabumi). Each of which has its own vision and mission which could affect their role in maintaining the existence of GHNP – GSPF corridor. Observing the various visions and missions, one can easily see that each stakeholders has some concern in conserving natural resources and environment in performing their buisness, besides of their concern in achieving community welfare.

However, in implying their vision and mission related to the maintenance of the GHNP – GSPF corridor, those stakeholders frequently have to face various constraints/problem. Some factors of constraints include : insufficient human resources, insufficient or too small budgetary resources, and insufficients support from environmental situation and condition. These were the reasons why their conserving activities had its ups and downs, both in quantity and quality. Stakeholders, who have interest in the excistence of corridor, play a role in preserving natural resources in the corridor, which most of activities are conducted individually (separately), depend on their interest, make a preserved and managed of natural resource in the corridor are very weak .

Management Analysis of the GHNP – GSPF Corridor

By overlay the map of mandate resorts it can be seen that the greatest part of the corridor as situated in the mandate resort (management region) of the Institute of Gunung Halimun National Park, and the smaller part is in the mandate resort of Perum Perhutani KPH Bogor (RPH Cianten, BKPH Leuwiliang) dan Perum Perhutani KPH Sukabumi (RPH Kabandungan, BKPH Cicurug). Until present, the corridor area have not been managed specially as a corridor. Management on the corridor area was conducted separately, depend on their interest.

The Institute of Gunung Halimun National Park was able to maintain a small part of the corridor (within its mandate resort) as a nucleus zone, and the greater part of the corridor (still within its mandate resort) as a forest zone. Perum Perhutani, on the other hand, was able to maintain one part of its mandate resort as an area of plantation and the other part (still in its mandate resort) as an area of protection forest.

Data scoring dan overlay of maps of soil types, rainfall, and slopes, in analyzing the function of forest area, shows that the corridor was dominated by a area within the category of Limited Production Forest, and the other smaller part was in the category of Protection Forest, whereas area around the corridor was dominated by the Production Forest category.

At present, management of the corridor by stakeholders, implemented in accordance with their interests, could still be considered legal due to the fact that they were still in line with the established function of a forest area. However, it would be wiser if all management practices exerted by those stakeholders take more attention to the existenc and function of the corridor for the lives of wild animals, while taking sufficient attention to the existence and welfare local communities the corridor, and thus creating an efficient buffer againts adverse pressure on the corridor. Taking attention for conservation of the corridor, and for increasing the welfare of the communities are absolutely important considering the fact that various vision and mission of those stakkeholders were actually in line with these two objectives.

Coordination among stakeholders to manage corridor are very weak, that make missmanagement in GHNP - GSPF corridor. Although an evaluative study has shown that the corridor is dominated by the Limited Production Forest category, considering the omportance of ecologicaly function of the corridor should be maintained through prevention of unwise natural resource utilization, for the sake of its ecologicaly function conservation.

Solution and Recommendation for Management of GHNP – GSPF Corridor

Management of GHNP – GSPF corridor is considered absolutely important due to the fact that this corridor is increasingly in danger caused by variation activities, particularly the utilization of natural resources within the corridor. In consideration of various stakeholders (interest groups) having some interest in the existence of the corridor, the management should be implemented based on a same perception that the corridor is a valuable asset of natural resources with its ecological function, which is very important in supporting the pivoting system of life. Its existence and conservation therefore, should be maintained. The management, both inside and around the corridor should be exerted in a integrated manner by stakeholders in the sake of corridor conservation. Stakeholders who have a management resort around the corridor should be able to utilize their management resort as a buffer for preventing or mitigating the threat/pressure on the corridor.

Management within the corridor should be implemented with the objective to maintain or reconstruct the condition of the corridor, to be functioning optimally, while still taking into consideration the ecological principles in its management. Management activities in the GHNP – GSPF corridor area need to be preserved and managed as corridor. There are three main activities which may be exercised in conserving the corridor, and these are as follows.

1. Rearrangement and protection of the corridor region, through:
 - a. Resetting the boundary poles, to clearly redefine the boundaries of the GHMP – GSPF corridor area. Former boundary poles are mostly lost or weared out.
 - b. Routinously exerting a patrol in the corridor area, with sufficient frequency but the time of patrolling should be taken randomly. This duty can be done by forest guards of the Institute of Gunung Halimun National Park and Perum Perhutani.
 - c. Firmly establishing the law of criminal deed for those who destruct natural resources within the corridor for economic reasons (not for subsistent reason)
2. Maintenance of the habitat, through :
 - a. Maintaining feeding grounds and breeding grounds for wild animals, including the provision of means for nesting and protection

- b. Rehabilitating the fragmented areas, or areas with ecological gaps, within the corridor.
3. Limiting the activities of natural resources utilization by the local community for minimizing the increasing adverse pressure on the corridor.

Management of areas outside or around the corridor should be implemented in terms of exerting activities for minimizing external pressure on the corridor, but at the same time increasing the welfare of local community. This could be done through creating buffering zones around the corridor, from which the communities could take economic advantages.

Mackinnon *et al.* (1993:100), define the buffering zone as a region located nearby a protected region, with limited land utilization, to provide additional protecting layer to the protected region, while providing economic advantages to the local community. In developing a buffering zone, condition of the local community should be taken into consideration.

Considering the differing typology of communities Purwabakti and Cipeuteuy Villagers, the type of buffering zones to be developed should be differ. The suitable type of buffering zone to be developed for the community of Purwabakti Village is of the buffer forest type, due to the fact that they are in a high need for fuel wood and construction wood. Other factors to be considered in choosing this type of buffering zone are the locality of natural resources, and the generally small sizes of land owned by the community.

The suitable buffering zone to be developed for the community of Cipeuteuy Village, on the other hand, is of the type of an economic buffer, due to the fact that the majority of people in the community are plant cultivators with larger sizes of land owned by them. Other factors to be taken into consideration for choosing this type of buffering zone are the moderate level of natural resource utilization from the corridor, and the moderate distance from this corridor.

CONCLUSIONS

1. Communities in Purwabakti Village and Cipeuteuy Village adjoining the GHNP – GSPF corridor area are generally showing a characteristic household condition with high potentiality of utilizing natural resources from the corridor.
2. Typologically, the community of Purwabakti Village differ from those of Cipeuteuy Village.
3. Perception about the existence of the corridor area of communities of both villages were at a moderate level.
4. Intensity level of natural resource utilization from the corridor by the community of Purwabakti Village was generally quite high, whereas the utilization intensity level by the community of Cipeuteuy Village was generally at a moderate level.
5. In general, correlation between variables of household characteristics and perception levels of respondents in both villages, and variables of natural resource utilization from the corridor, were statistically not very strong.
6. Activities for natural resource conservation in the corridor area by communities of both villages were generally implemented at a low frequency, depending on the availability of sponsoring agencies.
7. The stakeholders with their own vision and mission have some concern on the conservation of natural resources and on the welfare of local community in the corridor, however, their roles exerted and conservation of the corridor have its ups and downs both in quantity and quality.
8. The GHNP – GSPF corridor area, which is within the mandate region (wilayah kerja) of the Institute of Gunung Halimun National Park and Perum Perhutani, the greater part of which is within category of Limited Production Forest (based on the evaluative study of forest function) and the smaller part within the category of Protection Forest. The corridor area have not been managed specially as a

corridor, since most of activities are conducted individually (separately), which depend on their interest.

9. Because of importance the corridor function, the corridor area need to be managed as corridor. The corridor management activity can do in the corridor area and out/around the corridor area.

REFERENCES

- Badan Pusat Statistik. 2000. Statistik Indonesia 2000. Badan Pusat Statistik, Jakarta.
- _____. 2003. Indikator Ketenagakerjaan Nopember 2002. Badan Pusat Statistik, Jakarta.
- Bennett, A. F. 1999. Linkages in the Landscape: The Role of Corridors and Connectivity in Wildlife Conservation. IUCN Publications Services Unit, London.
- Cahyadi, I. 2003. Analisis Spasial Struktur dan Fungsi Koridor Hutan Antara Hutan Lindung Gunung Salak dengan Taman Nasional Gunung Halimun Menggunakan Sistem Informasi Geografis (SIG). *Tesis*. Program Pascasarjana, Institut Pertanian Bogor, Bogor.
- Departemen Pertanian. 1980. SK Menteri Pertanian No. 837/Kpts/Um/11/1980 tentang Kriteria dan Tata Cara Penetapan Hutan Lindung. Departemen Pertanian, Jakarta.
- Mackinnon, J., K. MacKinnon, G. Child, dan J. Thorseil. 1993. Pengelolaan Kawasan yang Dilindungi di Daerah Tropika. Amir, HH., penerjemah. Gajah Mada University Press, Yogyakarta. Terjemahan dari: Managing Protected Areas in the Tropics.
- Pemerintah Republik Indonesia. 1999. Undang-undang Republik Indonesia Nomor 41 Tahun 1999 tentang Kehutanan. Pemerintah Republik Indonesia, Jakarta.
- Santoso, S. 2001. SPSS Mengolah Data Statistik Secara Profesional. PT Elex Media Komputindo, Jakarta.