Effect of Forest Encroachment in Cisangkuy Sub Watershed

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Abstract. This research aims to identify encroacher characteristics, applied agricultural systems and analyze factors that are considered by encroacher in determining agricultural systems in Cisangkuy Sub Watershed, data was collected specifically in 3 villages in forest area, namely: Margamulya, Warnasari, and Pulosari Villages. Data collecting techniques is in the form of observation, interviews, literature studies and analysis through descriptive analysis technique. It is identified that agricultural system which applied in this area is a dry land agricultural system with horticulture crops as the main plant types. The factors that led to the conversion of forest land into agriculture are in the form of physical and social factors, while supporting physical factors include climate conditions and soil types, climate conditions and soil types, forest areas that can be utilized as agricultural areas, while supporting social factors including the factors of education, culture and economy of the community.

1. Introduction
Forests are very important ecosystems on the earth’s surface, with its existence the diversity of flora and fauna can be preserved, besides other important forest functions are as absorbers of carbon concentrations in the atmosphere. According to Siahaan, Indonesia's forests are one of the tropical forests which is placed in the third largest position in the world, with a total forest area of 144 million hectares or around 75% of Indonesia's land area [1]. Forests that previously functioned as forests that function as storing water reserves are now turning into agricultural and settlement areas.

As the case in the upstream Cisangkuy sub watershed, it is part of the upstream Ci Tarum Watershed located in Bandung District. This sub watershed has a total area of 35.306 hectares with a raw water discharge of 1,600 liters/second [2], which is the main buffer for the fulfillment of raw water in the City of Bandung and Bandung District. Cisangkuy is a watershed that if overflow will causing flood.

The reduction in forest area is also a problem that occurs in the upstream Cisangkuy sub watershed, this has a direct effect on the downstream area so that flooding is the main impact of forest destruction in this region. Forest damage that occurs anywhere is caused by one of the causes, namely forest encroachment by communities around the forest area. Forest encroachment in Cisangkuy sub watershed, Bandung District is expected to have been going on for a long time and shows no signs of decreasing. Although this encroachment has been followed up through existing legal procedures, it is still occurred.

Land use for agriculture is thought to be one of the main problems in encroachment cases. Therefore, in this research several questions were asked, which are: (1) What are the characteristics of the encroachers in the forest area of Cisangkuy sub watershed; (2) How is the agricultural system developed...
in the area of forest encroachment, based on water supply; and (3) What factors are considered by the encroachers in determining the agricultural system that applied.

Forest is an environmental component that provide many benefits to the needs of human life, the need for fuel, as a regulator of water systems, and climate stabilizers on this earth. Forests are the lungs of the world (planet earth) so we need to protect them because otherwise they will only have a bad impact on us today and in the future.

According to the Law of the Republic of Indonesia Number 41 of 1999 concerning forestry stated that forest is defined as an ecosystem unit in the form of spread land area containing biological natural resources which are dominated by trees in the fellowship of their natural environment, which cannot be separated from one another [3]. In another work, Arief states that forests are a natural ecosystem that has reached a climax balance and is the largest plant community that has the ability to grow back from the changes it suffered [4] Whereas the definition of forest according to the main forestry constitution No. 5 of 1967 is "... a field of growth of trees which as a whole is a partnership of living natural life, the natural environment and which is determined by the government as a forest." [5]

The types of forests can be described in the Republic of Indonesia Constitution No. 41 of 1999 below:

1) Protected Forest, is a forest that has a main function as a protector of water buffer systems, preventing erosion, seawater intrusion and maintaining soil fertility. According to Indriyanto based on the forestry Masterplan naming protected forests is divided into two main parts [6], namely:
   a. Absolute Protection Forest
   b. Limited Protection Forest
   c. Production forest

2) Production Forest, is a forest that has the main function of producing forest products, which are divided into three main parts, namely: Limited Production Forest, Permanent Production Forest and Conversion Forest.

3) Conservation Forest. According to Nugroho Conservation area is a conservation area consisting of the Natural Reserve Area [7].

4) Nature Reserve Forest. According to Law of 1990 the Nature Reserve area has a function as a preservation area of plant and animal diversity and its ecosystem, also functions as a protector area of the life buffer system.

5) Nature Conservation Forests are forests designated for conservation areas, such as National Parks, Great Forest Parks and Nature Parks.

   Based on its function according to Siahaan, forests can be classified into three main functions, namely: First, as natural resources that function as factors of production, second as natural resources that function as commodities for development and third, natural resources which is a guarantee of debt for transactions in development [1]. In Law No. 41 of 1999 Article 6 Forests have three main functions, namely the functions of conservation, protection functions, and production forests. Ecologically the function of the forest is to absorb rainwater to prevent erosion.

Encroachment is a human activity to eliminate forest products in the form of wood or non-timber which is used illegally and does not get permission from Perhutani. In the Constitution No. 41 of 1999 concerning forestry, according to South Bandung FMU there are several factors that cause forest encroachment, namely:

   1. Easy access to forest areas,
   2. Poverty,
   3. Unemployment,
   4. Poor education level,
   5. Limited staff to supervise the field and high soil fertility.

Sarjono states that the cause of high forest encroachment is the motivation of farmers to own land in protected areas (tenure) [8]. Whereas according to Effendi (in Subarna 2011 p. 266) the limited number of forestry supervisors encourages the development and economic actors to practice so as to cause the entry of forest encroachers.
There are several factors that cause people to do forest encroachment, namely: economic factors, educational factors, natural factors, sponsorship, limited supervision of officers and implementation of legal sanctions. From a series of encroachment activities that occur there are several important impacts caused by encroachment activities, [9], as follows:

1. Causing loss for the country
2. Disruption of water supply
3. Natural failure of reforestation activities
4. Causes surface erosion

In the cultivating land and agricultural systems, it will be mentioned about the concept of conservation, in this case interpreted as a concept of an agricultural system that functions as a land manager so that land is protected from surface erosion. The concept of the agricultural system can be grouped into three main parts, namely:

1. Agricultural systems group with vegetative techniques
2. Agricultural systems group with mechanical engineering, and
3. Group farming with mechanical systems

2. Methods

The method used in this research is descriptive analysis method. This research was conducted in the upstream Cisangkuy sub watershed, astronomically according to the Map of Rupa Bumi Indonesia in the sheets of Pangalengan, Barutunggul and Lebaksari, Cisangkuy sub watershed is located between 107°28'55" - 107°39'84" EL and 06°59'24" - 07°13'51" SL. It is noted that the extent of the upstream area of Cisangkuy sub watershed based on the calculations on the map of the earth in the Barutunggul sheet, Pangalengan sheet and Lebaksari sheet was 8.885 Ha. The largest village is in the upstream area of Cisangkuy sub watershed, namely Sukaluyu Village, which is 2.207 Ha, and the smallest village in Cisangkuy sub watershed is Wanasuka Village with 15.20 Ha which is included in this research.

Population in this study was all residents who did encroachment in the forest area. Of the nine villages that are population, three of them are villages that were used as the main population in this study, this is because the three villages are classified as villages that are prone to encroachment. As stated by the South Bandung KPH that the three villages which are encroached areas among the nine villages are Pulosari Village, Margamulya Village, and Wanasari Village [11]. The sampling in this research was divided into two main parts, namely the sample research area and the sample population or population. Of the nine villages, 3 of them were villages that were sampled in this research, namely Pulosari, Wanasuka, and Margamulya Villages. Determination of this sample is based on the following : the area is included in Cisangkuy sub watershed, the area is very close to the forest area, the area that engages in socio-economic interaction around the forest and the area is belong to the forest encroachment area.

The determination of human samples in this research was by using the Snowball Sampling method, this was due to the uncertainty of the number of encroachers recorded in the encroachment area.
Figure 1. Map of land use in research area

| Independent Variable | Dependent Variables                  |
|----------------------|--------------------------------------|
| Forest encroachment  | - Holticulture crops                 |
|                      | - Plantation crops                   |
|                      | - Agricultural system                |
|                      | - Field system                       |
|                      | - Upland system                      |
|                      | - Agricultural efforts to preserve   |
|                      | soil condition                       |

Figure 2. Research Variables

Data that needed in this research can be obtained through these collecting data technique: (1) Interview; (2) Observation; and (3) Literature study, and Documentation study. Data that obtained from those techniques can be analyzed with descriptive analysis.

3. Result and Discussion

3.1. Encroachment and Characteristics of Forest Squatters
Encroachment is an activity to convert forest functions into agriculture or plantations and settlements. The rise of encroachment carried out by community in several villages. The main reason for the population (in this case the population who work as farmers) to do forest encroachment is as follows:

1. Changes in government regulation from production forest into protected forest
2. Economical reasons
3. Relatively huge agricultural investors
4. Limitation of agricultural land
5. Limitation of forest guard

These are the explaining of encroacher characteristics of this research area: Amount of encroacher, The encroachers that encroach in research area is about 52 person. This data were taken from three different villages. Land ownership area, Majority of encroacher has more than 1 hectare of land area with percentage of 76.92% or 40 person and it also mentioned that 78.83% or about 43 person does not have any land in the outer forest area. This means that most of farmer here were depend on agricultural product from forest as a form of fulfilling their needs. Age level, as seen from the age level, encroachers are in productive age which is between 15 – 64 years old, but many of them were categorized in non productive age too which is > 64 years old. Education level from the three villages, education level of the encroachers were relatively low. There are respondents who never go to school and not finished elementary school that reach 39 person (75%), junior high school of 9 person (17.3%) and only 4 person (7.7%) who reach the level of senior high school. The lack of formal education level of people in research area was one of the main factor of encroachment. Education principle which are demoratic, fair, and not discriminative uphold human rights, religious value, cultural value and nation pluralism, culture and empowerment that lasts a lifetime was encourage the encroachers to choose informal education that runs in family environment rather than being in formal education.

Informal education in family environment is suspected to give the exact information compared to formal education which only gives theory. Experience in doing encroachment and agricultural land cultivating are not enough if getting only by studying the theory, it should also through experience of field activities which can be done in informal education that teaches by their families and environment.

Need of formal education of the encroachers is limited to elementary education. This is proven by collected data by researchers that about 52 encroachers that became respondent, all of them stated that the skill of farming and encroachment is derived from their parent skills. It means 100% encroachers agreed that they got education related with encroachment and farming from informal education.

Total liabilities, majority of respondent in research area who was encroachers has total liabilities of 1 – 3. It is about 62% encroacher has 1 – 3 of liabilities and 36% has 4 – 6 liabilities. Income of Encroacher, most of the encroacher has monthly income about Rp 500.000 – 1.500.000, and all of them does not have addition income. This was causing by physical factor of non forest land condition that available is relatively not much, makes the forest exploitation that they use as agricultural land higher.

3.2. Agricultural system that Developed in Encroachment Area
Agricultural system that developed in the research area is the agricultural system of settle dry land with plants variety of cabbage, chilli, tomato, potato, carrot, coffee, nuts, corn, and onions.

Consideration factors of encroacher in determining agricultural system (1) Physical factor: Climate condition, rainfall and temperature are natural components that counted in agriculture. Temperature in this agriculture area is about 15°C – 25°C and categorized as relatively cool temperature. Rainfall in research area is about 1.000 – 2.500 mm/year makes the holticulture farming condition can develop well. Soil condition in research area is andosol that has higher humus and the loose soil were optimalized agricultural activity.

Forestry agricultural system that applied in encroachment area, As for agricultural efforts that applied in encroachment area consists of: (1) Wanatani/agroforestry: Wanatani is one of agricultural efforts that usually applied on the forests that cultivated by community.Unirrigated agricultural field

This means the activity of deforestation then converted temporary to be agricultural land and usually planted by corn, rice, cassava, or other seasonal crops. This activity in research area was in a piece of forest land area that becomes agricultural land of holticulture, coffee, vegetables like cabbage, chili, tomato, etc. This activity should be done in short time for about several years, but in research area it was applied in long enough time. Its utilization is done without considering environment condition. Intercropping, in research area that is forest area, this system were common to be applied but the consideration to reforestation is just a little bit. Planting the seasonal crops in forest with intercropping were done, but hard crop trees that recommended were not planted as it should. Planting pattern
application. This is one of agricultural effort by the encroachers to keep soil condition fertile and can be used continously. Mulsa usage is done by farmer in research area to avoid soil erosion, because the function is to muffle precipitation energy that could breaks soil structure and keep the soil away from erosion. Terraces, It is one of agricultural efforts to avoid erosion on the relatively sloping land. This activity was done only by some encroacher, but this technique requires a lot of money and time so that the most of farmer here are avoiding this agricultural effort.

Considerable factors of encroacher in determining the developed forestry agricultural system. Agricultural system that applied by community in forest area of Cisangkuy sub watershed is very related with the background of education and social economic condition of the community. Most of them applied various agricultural system that not based on ecological consideration of the area, but based on the experience and profit they could gain. Education factor is not being an important factor here, because farmer has assumption that succeeded agricultural productivity in this area were depend on how long the farmer cultivate the land, not depend on education they have through.

4. Conclusion
Agricultural system that developed in encroachment area of upper course Cisangkuy sub watershed is agricultural system of settle dry land. Experience becomes important factor that used to determine agricultural land system, and other than that there are social economic condition of community, a lot of agricultural effort in form of conservation technique needs intensively work and relatively longer time makes the farmer choose to not applying conservation with the reason of not effective and efficient. Plant types that develop in ecroachment area of upper course Cisangkuy sub watershed are dominated with holticulture and plantation crops. As for holticulture crop consists of chili, tomato, potato, cabbage, nuts, and onions, and for plantation crops is the hard crop trees with high value such as coffee. Considerable factors of encroacher in determining agricultural system and cultivated plant types is physical factor and social factor such as culture and economic factors. Agricultural effort type that applied in encroachment area is wanatani or agroforestry. Factors that encroacher considered in determining the developed forestry agricultural system is cultural and economic factors.

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