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## **Formulation of Agroforestry Type for Decent Income for the Farmers in Ciliwung Hulu Watershed of West Java Province**

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### **Abstract**

The problems faced by agroforestry farmers in Ciliwung Hulu Watershed (DAS) of West Java Province include fluctuating commodity prices, limited maintenance capital, and low selling value at the farmer level so that the income of agroforestry farmers has not been sustainable. The objectives of this study are to determine the formulation of agroforestry type and income feasibility of the agroforestry farmers in Ciliwung Hulu basin of West Java Province. This research used the survey method and direct interviews with the respondents. Data analysis was conducted to identify the characteristics of agroforestry farmer respondents and analysis on their income. The results showed that the actual farmer income of the agroforestry farmers in Ciliwung Hulu Watershed in West Java Province is generally still low and has not fulfilled the needs of decent living. The actual type of agroforestry applied by the farmers has produced the lowest income of Rp 8,287,750/ha/year in the Cibalok sub-watershed whereas the highest income is Rp 103,333,500/ha/year in Cisukabirus sub-watershed. Formulation of farmer income of the agroforestry type in Ciliwung Hulu Watershed of West Java Province after improvements with the addition of goats has been able to provide income that can support decent living.

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The income of agroforestry farmers in Ciliwung Hulu Watershed of West Java Province has fulfilled the needs for decent living because the net income that the farmers receive is over Rp. 36,000,000/household/year so that the life of agroforestry farmers and their families has been sustainable. This research is expected to be useful not only for farmers, but also for agricultural extension workers, policy makers at the district and provincial levels.

**Keywords:** agroforestry; income; sustainable; watershed; West Java.

## **1. Introduction**

Agroforestry is an agricultural system that maximizes the multipurpose land utilization consisting of timber, shrubs, fruit plants, annual crops and livestock. The agroforestry system provides important economic and ecological benefits for farmers, one of which can provide income for farmers [1]. Agroforestry has a role to contribute to the increase of people's income including the economy of the farmer households.

Agroforestry plants developed can produce products such as food, fruits, horticulture, buildings, firewood and fodder. The prospect of agroforestry development can encourage a greater economic aspect of local business ventures with various policies and support of human resources, capital, market availability and appropriate technology application. The development of agroforestry in terms of economic aspects should be directed as a commercial business activity managed optimally to generate maximum revenues on limited resources [2]. The concept of agroforestry produces benefits in the land management system in some areas, and the concept is being developed seriously both in technology and socio-economic applications [3].

The application of the agroforestry system will earn a sustainable income where seasonal crops and plantations are utilized to meet daily needs. Revenue from annual crops or wood can be used for daily needs as well as for temporal needs such as the needs of school for the children, celebrations, home buildings, and other urgent needs [4]. Ciliwung Hulu Watershed of West Java province has potentials for the agroforestry development, and this is due to the suitability of biophysical condition, socio-culture, marketing and government supports. One of the government's efforts in this case is the activity of Management Center of Forest and Environment of Citarum-Ciliwung Watershed in developing agroforestry of 500 hectares [5]. The form of agroforestry type existing in Ciliwung Hulu Watershed West Java Province is generally agrosilvopastura. The agrosilvopastura agroforestry type is land use that combines wood crops, plantations, fruits, crops and livestock. The problems faced by the farmers of this agroforestry type in the Watershed of Ciliwung Hulu West Java include the fluctuating prices of the commodities, limited maintenance capital, and low selling value at the level of farmers resulting in an unsustainable agroforestry farming income.

Low productivity in Ciliwung Hulu Watershed of West Java Province has resulted in low income of the agroforestry farmers i.e. Rp 8,287,750/ha/year. This low income is insufficient in meeting the needs of decent living (KHL). This condition indicates that the Ciliwung Hulu Watershed has experienced the process of mutual impoverishment; therefore, this must be stopped with the implementation of conservation farming system (SPK) in order to increase productivity and farmers' income [6]. Agroforestry type formulation in Ciliwung Hulu Watershed of West Java Province is one of the promising options for increasing agroforestry productivity and

improving farmers' income. Therefore, based on the problems in this area, efforts are needed to increase the productivity of agroforestry by adding commodities and combining crops and livestock in order to generate a viable and sustainable agroforestry income for the farmers. This study aims to determine the formulation of agroforestry type and the feasibility of agricultural income in Ciliwung Hulu Watershed of West Java Province.

## **2. Research Method**

The study was conducted in Ciliwung Hulu Watershed of West Java Province from April 2016 to May 2017. Geographically, the study area is located between 6°37'-6°46' LS and 106°50'-107°0' BT. Administratively, Ciliwung Hulu watershed is located in Bogor Regency and Bogor City of West Java Province.

### **2.1. Materials and Tools**

The materials and tools used in this research included the land of the agroforestry farmers, agroforestry plant species, administrative map, watershed and sub-watershed boundary map, work map, Geographical Position System (GPS), digital camera, demographic data, stationery, calculator, questionnaires, a set of computers, office software 2013, and recording device.

### **2.2. Data Types**

The data used in this study were the primary data and secondary data, and the primary data were obtained from direct interviews with the respondents. The respondent data needed included the characteristics of the respondents and the data of farmers' income from the results of agroforestry management. The secondary data included general conditions of the research location i.e. physical environment, socioeconomic society, population identity statistics data, and other literature books related to farmer income and other data related to research sourced from the library or related institutions.

### **2.3. Data Collection Technique**

This research used a survey method while data collection technique was conducted through direct interviews with the agroforestry farmers in Ciliwung Hulu Watershed of West Java Province and literature study. The interviews with agroforestry type farmers were conducted as an attempt to obtain the primary data. Library study is a method of collecting secondary data by way of reading and citing theories derived from books and other writings relevant to the research. There were 48 respondents involved as samples of agroforestry farmers. The sample selection was conducted by purposive sampling [7] with the consideration that the respondents are farmers who manage the agroforestry types in Ciliwung Hulu Watershed of Province of West Java.

### **2.4. Data Analysis**

**Identification of Agroforestry Type Characteristics.** The actual agroforestry type characteristics in Ciliwung Hulu Watershed of West Java Province after direct observations at the research sites were then analyzed descriptively. Analysis on the actual type of agroforestry was aimed to obtain the characteristics of agroforestry

types, combination of agroforestry types, agroforestry farmer profile, and area width of the agroforestry activities, input used, labor, production and capital.

### **2.5. Analysis on Agroforestry Farmer Income**

Analysis on the agroforestry farmer income at the study sites included agroforestry farming cost and net income or farm profit earned by the agroforestry farmers based on all commodities on agroforestry types cultivated by agroforestry farmers in Ciliwung Hulu Watershed of West Java Province. The agroforestry farmer income was calculated by the following equation:

$$\pi = TR - TC$$

where:

$\pi$  : net income (Rp)

TR : total of revenue (Rp)

TC : total of cost (Rp)

### **2.6. Formulation of Income of Agroforestry Types**

The agroforestry farmers' income formulation aimed to perfect the farmers' actual income that is still low and has not met the needs of decent living. Their actual agroforestry income is improved by increasing the number of forestry crops, seasonal plants, and combination of crops and livestock.

The agroforestry farmers' income formulation in Ciliwung Hulu Watershed of West Java Province was arranged based on the analysis on the agroforestry type characteristics, combination of agroforestry type crops, agroforestry farmer income analysis and results of agroforestry farmer income improvement.

## **3. Results and Discussions**

### **3.1. Characteristics of the Farmer Respondents of Agroforestry Type**

The characteristics of agroforestry farmer respondents in this study consisted of farmer age, education level, number of family member and land ownership. These characteristics of the agroforestry farmers in Ciliwung Hulu watershed in West Java were observed on 7 (seven) sub-watersheds of Cisuren 14 respondents, Ciliwung Hulu of 12 respondents, Cisukabirus of 3 respondents, Ciesek of 5 respondents, Ciseseupan of 10 respondents, Cisarua of 2 respondents and Cibalok of 2 respondents.

The identified characteristics of the agroforestry type farmers i.e. respondent age, education level, number of family member and land ownership in Ciliwung Hulu Watershed in West Java Province are presented in Table 1.

**Table 1:** The characteristics of the farmer respondents of agroforestry type in Ciliwung Hulu Watershed of West Java Province

No	Description	Total (person)	Percentage
1	Age		
	a. < 30 years old	7	14.6
	b. 30 – 55 years old	24	50
	c. > 55 years old	17	35.4
2	Education Level		
	a. Elementary School	22	45.8
	b. Junior High School	15	31.2
	c. Senior High School	11	23
	d. University	-	
3	Number of family members		
	< 3 persons	16	33.3
	3 - 6 persons	27	56.3
	> 6 person	5	10.4

Source: The results of field observations (2016)

The status of land ownership of agroforestry farmers in Ciliwung Hulu Watershed of West Java Province varies i.e. land owned, rented and cultivated by the farmers. The land owned by the farmers comes from the inheritance or from customary land. The distribution of the land width of the agroforestry type farmers spread on the scale of <0.5 ha, 0.5-1 ha, 1-1.5 ha and> .5 ha, and the distribution of land ownership can be seen in Table 2.

**Table 2:** Distribution of the respondents based on land ownership in Ciliwung Hulu Watershed of West Java Province

No	Land Ownership (ha)	Respondents	
		Total	(%)
1	<0.5	10	20.8
2	0.5-1	9	18.7
3	1-1.5	18	37.5
4	>1.5	11	23
		48	100

Source: The results of the field observations (2016)

### 3.2 Management of the Actual Agroforestry Type in Ciliwung Hulu of West Java Province

The management of the actual types of agroforestry in Ciliwung Hulu Watershed of West Java Province consists

of agroforestry activities on the land owned by the farmers and agroforestry activities run by the Management Center for Watershed and Environment in Quik Quin activity.

The number of agroforestry farmers in each sub-watershed of Cisuren Sub-watershed was 140 respondents, 120 respondents in Ciliwung Hulu, 30 respondents in Cisukabirus, 50 respondents in Ciesek, 100 respondents in Ciseusepan, 20 respondents in Cibalok, and 20 respondents in Cisarua. Types of agroforestry, number of respondent farmers and average land ownership in the study sites are presented in Table 3.

**Table 3:** Number of farmers, respondents and width of land ownership of each type of agroforestry at the observation sites in Ciliwung Hulu Watershed of West Java Province

Sub-watersheds	Number of Farmers (Family)	Number of Samples	Average width of land ownership (ha/family)
Cisuren	140	14	0.5
Ciliwung Hulu	120	12	1.5
Cisukabirus	30	3	1.5
Ciesek	50	5	1.0
Ciseusepan	100	10	1.0
Cibalok	20	2	0.5
Cisarua	20	2	1.0
<b>Total</b>	<b>480</b>	<b>48</b>	

### **3.3. Characteristics of the Agroforestry Types in Ciliwung Hulu Watershed of West Java Province**

The combination of crops in the actual agroforestry type in Ciliwung Hulu Watershed of West Java Province is generally classified into 4 groups: (1) Annual plant commodity consisting of forest and fruit crops, (2) tree crop commodity (africa), (3) agricultural or seasonal crops, and (4) livestock.

Therefore, if viewed from the combination of the actual agroforestry types applied by the farmers in Ciliwung Hulu Watershed of West Java Province, there are 2 (two) types of agroforestry, namely, agrisilviculture and agrosilvopastura.

However, what characterizes and distinguishes the types of agroforestry agrisilviculture and agrosilvopastura in each sub-watershed is its forestry crops including damar, mindi, teak, sengon and africa (agrosilvopastura-d, agrosilvopastura-m, agrisilviculture-j, agrisilviculture-d, agrisilviculture-a and agrosilvopastura-a).

The combination of plant species in the actual agroforestry type in each Sub-Watershed in Ciliwung Hulu Watershed of Province of West Java is presented in Table 4.

**Table 4:** Combination of plant species on agroforestry type of each Sub-watershed in Ciliwung Hulu Watersheds of West Java Province

Sub-watersheds	Agroforestry Type	Combination of plant and livestock
Cisuren	Agrosilvopastura-d*	Damar+banana+corn+goat livestock
	Agrisilviculture-d	Damar+Banana+cassava
	Agrisilviculture-j	Teak+banana
Ciliwung Hulu	Agrosilvopastura-m*	Mindi+banana+chili+goat livestock
	Agrisilvikultur-a	Africa+teak+cassava+papaya+banana+jackfruit
	Agrisilviculture-a	Africa+teak+banana
Cisukabirus	Agrosilvopastura-d*	Damar+banana+chili+ goat livestock
	Agrisilviculture-j	Teak+banana+chili+jahe+papaya+cassava
	Agrisilviculture-j	Teak+chili+banana+papaya+jackfruit
Ciesek	Agrosilvopastura-d*	Damar+banana+corn+goat livestock
	Agrisilviculture-a	Africa+banana+spring onion
	Agrosilvopastura-s	Sengon+banana+jackfruit+goat
Ciseseupan	Agrosilvopastura-a*	Africa+papaya+chili+goat livestock
	Agrisilviculture-a	Africa+teak+durian+sirsak+jackfruit
	Agrisilvopastura-a	Africa+jabon+durian+goat
Cibalok	Agrisilviculture-a	Africa+cassava
	Agrisilviculture-a	Africa+banana+durian+cassava
Cisarua	Agrosilvopastura-d	Damar+jabon+durian+tomato+sirsak+goat
	Agrisilviculture-a	Africa+banana

Note: *Agrosilvopastura-d* = damar agrosilvopastura damar, *Agrosilvopastura-m* = mindi agrosilvopastura, *Agrisilvikultur-j* = teak agrislvikultur teak, *Agrisilviculture-d* = damar agrislviculture, *Agrisilviculture-a* = africa agrislviculture and *Agrosilvopastura-a* = africa agrosilvopastura. \* is the agrosilvopastura agroforestry type guided by BPDASLHK.

### 3.4. Income of the Farmers of the Actual Agroforestry Types in Watershed of Ciliwung Hulu of West Java Province

The production cost component of the actual agroforestry types in Ciliwung Hulu Watershed of West Java Province applied by the farmers included seeds, tools, fertilizers, pesticides, herbicides and insecticides while the rent of land and labor were not all taken into account because there is land owned, cultivated and rented by the farmers in which the laborers were from the household members. The utilization of labor of family members was more intended to reduce the use of money for direct costs or capital [8]. The average cost of agroforestry type farming in Ciliwung Hulu Watershed of West Java Province is Rp 2,962,250-30,779,700/ha/year. The actual type of agroforestry applied by farmers produced the highest income of Rp 103,333,500/ha/year in

Cisukabirus sub-watershed whereas the lowest income was 8,287,750/ha/year in Cibalok sub-watershed. The low income which is associated with the decent living needs (KHL) has not been fulfilled i.e. Rp 36,000,000/household/year. The communities manage and utilize agroforestry for subsystem and commercial needs, and this is because agroforestry is a potential source of income for the family/community economy [9]. The average net income of the actual agroforestry type farmers in each sub-watershed is presented in Table 5.

**Table 5:** Income of the farmers of the actual agroforestry types in Ciliwung Hulu Watershed of West Java Province

Sub-watershed	Actual Agroforestry	Business Costs	Revenue	Net Income
Rp/ha/year				
Cisuren	D+P+Jg+K	25,616,468	52,167,500	26,551,032
Ciliwung Hulu	M+P+C+K	27,478,750	105,343,333	77,911,917
Cisukabirus	D+P+S+K	27,489,833	130,823,333	103,333,500
Ciesek	D+P+Jg+K	30,779,700	74,400,000	43,620,300
Ciseseupan	A+Pa+C+K	27,026,680	45,045,900	18,019,220
Cibalok	A+S+P	2,962,250	11,250,000	8,287,750
Cisarua	D+T+P+K	27,586,000	76,100,000	48,514,000

Note: D = *Damar*, P = Banana, Jg = Corn, M = *Mindi*, C = Chili, S = Cassava, Pa = Papaya, T = Tomato, K = Goat

The analysis result of the income of the farmers of the actual agroforestry types in Ciliwung Hulu Watershed of West Java Province shows that the income is still low and has not yet fulfilled the requirement of decent living. Agroforestry has important economic functions for the society, for its main role is not only for production of foodstuffs but also as a source of income and capital [10]. The income of the actual agroforestry type farmers in Ciliwung Hulu Watershed of West Java Province is still below the standard of decent life, and it is also unsustainable. The development of agroforestry is related to the regional development i.e. the utilization of space and forest resources that exist within a region to support the welfare of farmers in a sustainable manner [11]. The income of the agroforestry farmers is generally low, and it is also influenced by the types of commodities cultivated and land width [8]. The income of the actual agroforestry type farmers in Ciliwung Hulu Watershed of West Java Province needs improvement to obtain a viable and sustainable income.

### 3.5. Formulation of Income of Agroforestry Types in Ciliwung Hulu Watershed of West Java Province

Based on the result of the analysis, the agroforestry farmer income in Ciliwung Hulu Watershed has not reached a decent standard of living. Based on the analysis on the actual types of agroforestry in terms of income for Decent Living Needs (KHL) at the research site (Ciliwung Hulu Watershed), it is assumed that each farmer household consists of 5 people with rice price of Rp. 9,000/kg (price at the research location). Therefore, the amount of money that must be met by the head of the agroforestry farmer family is 320/kg/year x 2.5 x 5



person/household x Rp 9,000 = Rp. 36,000,000/household/year. 2.5 is an index for household, education, clothing, health and recreation needs in rural areas.

The income of the actual agroforestry type farmers in this area is improved by designing more combinations of forestry crops, seasonal crops and by increasing number of livestock. The result of the income formulation of the agroforestry types after the revision shows that the net income of the farmers of agroforestry types is greater than Rp. 36,000,000/household/year and has reached the needs of decent living.

Table 6 shows that the agroforestry farmer income formulation in Ciliwung Hulu Watershed of West Java Province prepared after the revision has been able to provide income that can support decent living. Income of the agroforestry type farmers in this Watershed of has met the needs of decent living because of the net income received is over Rp. 36,000,000/household/year so that the life of the agroforestry farmers and their family can be sustainable. With the economic benefits of agroforestry, the farmers are able to meet their daily needs from the agroforestry on an ongoing basis, and agroforests can be utilized by various layers of society and all living things. [12] The agrosupvopastura agroforestry type formulation is recommended to the farmers in Ciliwung Hulu Watershed of Province of West Java.

**Table 6:** Formulation of income of the farmers of agroforestry types in Ciliwung Hulu Watershed of West Java Province

Sub-watershed	Agroforestry Formulation	Business Costs	Revenue Rp/ha/year	Net Income	Recommendation Agroforestry Types
Cisuren	D+P+J+K	30.592.111	83.172.143	50.068.568	<i>Agrosilvopastura-d</i>
Ciliwung Hulu	M+P+C+K	27.478.750	105.343.333	77.911.917	<i>Agrosilvopastura-m</i>
	D+P+C+K	27.489.833	130.823.333	103.333.500	<i>Agrosilvopastura-d</i>
Cisukabirus	J+S+Jg+K	30.779.700	74.400.000	43.620.300	<i>Agrosilvopastura-j</i>
Ciesek	A+Pa+C+K	33.026.680	74.395.900	38.510.120	<i>Agrosilvopastura-a</i>
Ciseseupan	A+Pa+P+Dr+C+K	48.162.250	91.250.000	43.087.750	<i>Agrosilvopastura-a</i>
Cibalok	D+Jb+T+K	27.586.000	76.100.000	48.514.000	<i>Agrosilvopastura-d</i>
Cisarua					

Note: D = Damar, P = Banana, Jg = Corn, M = *Mindi*, C = Chili, S = Cassava, Pa = Papaya, T = Tomato, Dr = Durian, Jb = Jabon, K = Goat

#### **4. Conclusion**

There are 2 actual agroforestry types applied by the farmers in Ciliwung Hulu Watershed of West Java Province, namely, agrisilviculture and agrosilvopastura. Based on the formulation results, the agrosilvopastura agroforestry type is recommended in Ciliwung Hulu Watershed of West Java Province. The income of the farmers of the actual agroforestry type in Ciliwung Hulu Watershed of West Java Province is still low income and has not fulfilled the decent living needs. The formulation of agroforestry farmers' income prepared after the improvement by the addition of the number of forestry crops, seasonal crops and livestock has been able to provide income supporting a decent life. Income of agroforestry type farmers in Ciliwung Hulu Watershed of West Java Province has met the needs of decent living because of the net income received is over Rp. 36,000,000/household/year so that the life of agroforestry farmers and their families can be sustainable.

#### **5. Recommendation**

The right type of agroforestry to apply to farmers in the Upper Ciliwung Basin of West Java Province is a combination of annual plant damar, banana crops, horticultural crops and goats can be selected by farmers to increase productivity and income. The related institutions provide superior seeds of annual crops, seasonal crops and horticultural crops in accordance with the biophysical conditions of the region as well as superior livestock seedlings. At the operational level in the field agricultural extension workers can prepare materials or modules for the application of selected agroforestry types.

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