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Research Paper

Impact of Agricultural Land Changes on Farmers' Income in Cirasea Watershed, Bandung Regency, West Java

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Abstract

Changes from agricultural land to non-agricultural land are continuously occurring, especially in areas adjacent to cities. Land changes from agricultural to non-agricultural land will eliminate crops' hydrological function, impacting rivers, including the Cirasea River. Besides, changes in agricultural land have an impact on the resulting agricultural productivity and income. This study's main objective is to determine land area changes, productivity, and farmers' income in 2011 - 2018 in the Cirasea watershed. A literature study was applied to this study. Secondary data were obtained from the Central Bureau of Statistics of Ciparay, Ibun, Kertasari, Majalaya, Pacet, and Paseh Districts, Bandung Regency in Cirasea River Upstream. The study results showed an increase in land area, productivity, and agricultural income for vegetables (75%, 50%, and 68%, respectively) and rice field (16%, 0.32%, and 0.32%). In addition, there was a decrease in land area followed by a decrease in agricultural productivity and income for fruit commodities (-88%, -35%, -33%) and plantations (-97%, -1%, -1%). For eight years, farmers have relied on their income from vegetable commodities in Cirasea Watershed.

Keywords

Agricultural Productivity, Citarum Upstream, Land Use

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1. INTRODUCTION

Land use and land cover change are significant environmental changes occurring around the globe today. The interaction of land use and land cover change with climate, ecosystem processes, biogeochemical cycles, biodiversity, and human activities is paramount (Guida-Johnson and Zuleta, 2013). Land-use change and land cover are closely linked with socio-economic development sustainability. They affect essential parts of our natural capital, such as vegetation, water resources, and biodiversity (Keller et al., 2015).

Land is one of the vital aspects of life. In agricultural production, the land role, as the primary input, is irreplaceable. Economically, the land is the most efficient wealth-generating asset for farmers (Sitko and Jayne, 2014; Muyanga et al., 2013) and is also an essential factor for economic growth (Li, 2014). However, the limited and unrenewable land supply creates fierce land-use competition between the agricultural and non-agricultural sectors. These give rise to Agricultural Land Conversion (ALC), which significantly reduces cropland availability and threatens food security (Azadi et al., 2010).

The development of cities and infrastructure is often observed in areas with high-quality cropland, which as a consequence, leads to irreversible losses in the productivity of agriculture, such as in the European Union (van der Putten et al., 2018; Vejchodská and Pelucha, 2019). The European landscape is, to a large extent, dominated by crops. More than 35% of all land in the EU has agricultural use. Thus, cropland utilization plays a vital role in the potential effect of land use on Europe's environment's sustainable development. Hence, understanding the spatial dynamics of cropland coverage is of crucial importance. The more than changes in land use are closely connected with multiple economic, social, political, and environmental processes (Ustaoglu et al., 2016; Strek and Noga, 2020). Therefore, it is necessary to monitor land-use changes (Noszczyk et al., 2017; Noszczyk, 2018).

The previous study conducted by Nuryartono et al. (2017) revealed that the increasing land conversion into non-agricultural lands, such as the expansion of housing, shops, industrial estates, and roads, has led to reducing paddy fields area and will ultimately reduce the rice production from West Java. Benu et al. (2013) study the factors that affect the conversion of land function in Tomohon. They conclude that the factors influencing land conversion from economic aspects are farmers' income level, financial activities, and land price. The factors that affect the land conversion from the food safety aspect are the diversity of foods, land productivity, and fertility. Halim et al. (2014) conduct a study on the land conversion function in metropolitan city Rajshahi, Bangladesh. They conclude that the variables that positively affect conversion rate are population growth, infrastructure, business profit, price, and business cost. In contrast, the variables that negatively affect conversion are civil facility, institution, and tax.

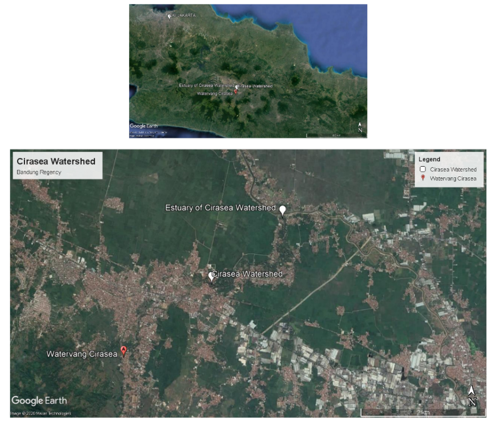
Based on a previous study in Bogor Regency, Agricultural Land Conversion (ALC) tends to increase from time to time. The factors that influence agricultural land conversion, including cropland location adjacent to urban, industrial, real estate, and growing populations, influence private parties (transfer of rights) (Sejati et al., 2020). In Indonesia, rapid urbanization increases housing demand, resulting in high demand for land for housing development, thus increasing cropland value for non-agricultural land use. The rise in land economic value for housing is translated into massive ALC and creates an area called a peri-urban area (Pribadi and Pauleit, 2015)

Cirasea Watershed, as one of the Citarum River Upstream, influenced the entire Citarum Watershed environment. Cirasea Watershed can support the agricultural needs, primarily agricultural land in Ciparay, Ibun, Kertasari, Majalaya, Pacet, and Paseh District. The high rate of conversion of agricultural land to development and infrastructure impacts food security. Besides, the decline in the farmland area will also affect the farm economy's decline and, at worst, the loss of livelihood as a farmer. Therefore, it is necessary to reveal the agricultural economy due to changes in agricultural land area. Based on the introduction, this study was conducted to show the changes in land area, productivity, and farmers' income that occurred in the Cirasea watershed, Bandung Regency, West Java.

2. EXPERIMENTAL SECTION

2.1. Study Area

Cirasea Watershed is one of the sub-catchment of the Citarum River in Bandung Regency. The Upper Citarum River covers



Source: Google Earth (2020)

Figure 1. Study Areas in Cirasea Watershed, Bandung Regency; Cirasea Watershed (7° 2'3.40"S 107°43'14.63"E), Estuary of Cirasea Watershed (7° 1'29.26"S 107°43'51.59"E)

West Bandung Regency, Bandung Regency, Bandung City, Cimahi City, and Sumedang Regency. The upper Citarum area is in the Bandung with an elevation of 625-2600 m asl. The northern region of the upper Citarum is Mount Tangkuban Perahu. The eastern part is Mount Munggang and Mandalawangi. The southern region is Mount Malabar, Puncak Besar, Puntang, Haruman, Mount Tilu, Mount Tikukur, and Mount Guha. The western region has irregular mountain ridges (BBWS Citarum, 2016). Most of the Bandung Regency is a mountainous area with a tropical climate and an average rainfall of 207.4 mm per year in 2018 (Statistics of Bandung Regency, 2019). Cirasea Watershed covers six districts in Bandung Regency, including Ciparay, Ibun, Kertasari, Majalaya, Pacet, and Paseh Districts. Information on the area of Districts can be seen in Table 1.

2.2. Methods

A literature study was conducted to obtain data on cropland and agricultural productivity at the district level in the Cirasea watershed during 2012 - 2019. Secondary data were obtained from the Statistics Central Bureau of Ciparay, Ibun, Kertasari, Majalaya, Pacet, and Paseh Districts. Besides, information on the agricultural income in the Cirasea Watershed is known based on the prices of agricultural and plantation commodities at the West Java and National levels in 2017 - 2019. Although the data series used are from 2012 to 2019, this study's commodity prices are from 2017 – 2019. Data was performed as the table and analyzed qualitatively.

3. RESULTS AND DISCUSSION

3.1 RESULT

Farmers plant various agricultural commodities, including rice, vegetables, fruit, plantations, and biopharma, in the

Table 1. Land Area and Total Villages in Cirasea Watershed

Districts	Ciparay	Ibun	Kertasari	Majalaya	Pacet	Paseh
Number of Villages	14	12	8	11	13	12
Land Areas (km^2)	46.18	54.57	152.07	25.36	91.94	51.03

Source: Statistics of Bandung Regency (2019)

Table 2. Commodities in Cirasea Watershed

	Commodities			
Ricefields	Vegetables		Fruits	Plantations
Dry-ricefield	Welch Onions	Potato	Avocado	Clove
Wet-ricefield	Shallots	Cabbage	Starfruit	Coconut
	Garlic	Cucumber	Orange	Coffee
	Broccoli	Chinese Cabbage	Mango	Tea
	Beans	Napa Cabbage	Jackfruit	Tobacco
	Chili	Choy Sum	Papaya	
	Maize	Eggplants	Banana	
	Soybeans	Tomato	Snake Fruit	
	Red Beans	Sweet Potato	Sapodilla	
	Long Beans	Cassava		
	Peanuts	Carrot		

Sources: Statistics of Ciparay, Ibun, Kertasari, Majalaya, Pacet, and Paseh Districts in 2012 – 2019

Cirasea watershed. Biopharma plant commodities were not studied in this study due to a lack of information. A total of 51 commodities are planted in the Cirasea watershed (Table 2). The zero data in Table 3 and Table 4 is assumed to be no planting of specific commodities or experiencing crop failure.

The area of land, productivity, and agricultural economic value in the Cirasea watershed tended to fluctuate (Table 3) during 2011 - 2018. During 2011 - 2018, ricefield and vegetable commodities increased land area by 16% and 75%. This increase in size was followed by an increase in agricultural productivity and vice versa. Based on the percentage change in economic value in the Cirasea watershed, vegetable commodities increased by 68% from 2011, followed by ricefields with an increase in farmers' income by 32% (Figure 2). When viewed by livelihood aspect, the agricultural sector has decreased compared to other (non-agricultural) livelihoods (Figure 3).

3.2 DISCUSSION

3.2.1 AGRICULTURAL LAND AND PRODUCTIVITY

Based on the percentage in Figure 2, it is known that most of the changes in the cropland area are in line with changes in agricultural productivity in the Cirasea Watershed. Besides, it is assumed that the farming community in the Cirasea Watershed, Bandung Regency, relies on their income on vegetable commodities, as evidenced by the increase in agricultural area and productivity after eight years.

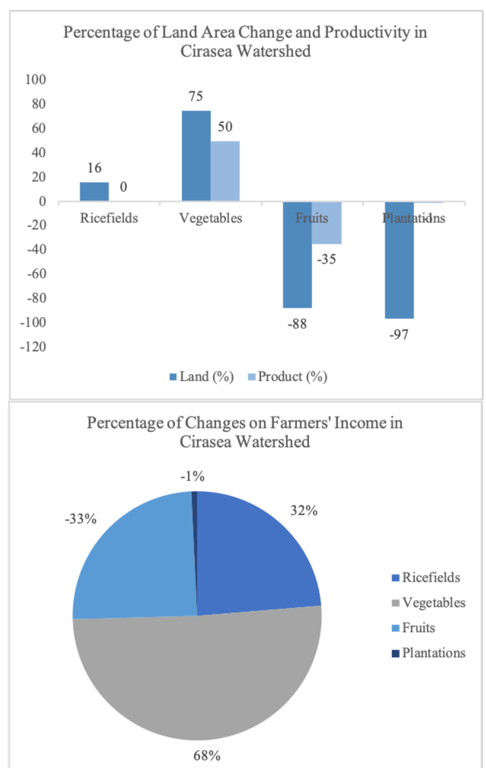


Figure 2. Percentage of Land Area Change, Productivity, and Farmers' Income in Cirasea Watershed, Bandung Regency

Table 3. Land Area and Agricultural Productivity in Cirasea Watershed

Commodities — Districts	Land Area and Agricultural Productivity							
	2011		2012		2013		2014	
	Area	Yield	Area	Yield	Area	Yield	Area	Yield
Ciparay								
Ricefields	2,680	256,020	2,819	352,916	5,383	320,019	7,390	458,440
Vegetables	246	47,908	240	9,811	425	93,641	206	27,589
Fruits	5	460	0	0	0	0	0	0
Ibun								
Ricefields	1,589	79,808	1,212	61,621	1,904	97,073	2,709	175,010
Vegetables	497	80,240	218	18,173	607	65,568	290	27,530
Fruits	0	0	0	0	20	931	20	931
Plantations	64	1,197	0	0	170	5,914	170	5,914
Majalaya								
Ricefields	0	0	1,285	74,954	2,718	142,209	2,955	194,720
Vegetables	0	0	199	21,135	119	10,273	151	22,507
Plantations	0	0	0	0	3	31	3	31
Pacet								
Ricefields	1,656	582,521	2,542	86,616	2,685	144,323	0	0
Vegetables	774	13,369	761	46,325	1,573	132,373	1,496	160,181
Fruits	467	903.28	1	50	12	2,001	12	2,001
Plantations	2,322	113.22	4	136	371.2	4,778	371	4,778
Paseh								
Ricefields	1,444	9,686	1,428	55,449	2,663	134,806	3,005	190,410
Vegetables	593	32,570	412	20,939	484	44,960	729	82,364
Fruits	1,714	15,195	247	4,957	247	4,957	247	4,957
Plantations	563,420	2,900	156	3,531	395	3,707	395	3,707
Kertasari								
Ricefields	5	70	13	33	564	107,160	564	10,706
Vegetables	537	79,043	118,599	468,618	1,546	184,503	119	582
Fruits	5,696	32,674	23	2,208	14	56	0	0
Plantations	331,815	165,731	5,038	16,273	6,640	6,108,164	0	0

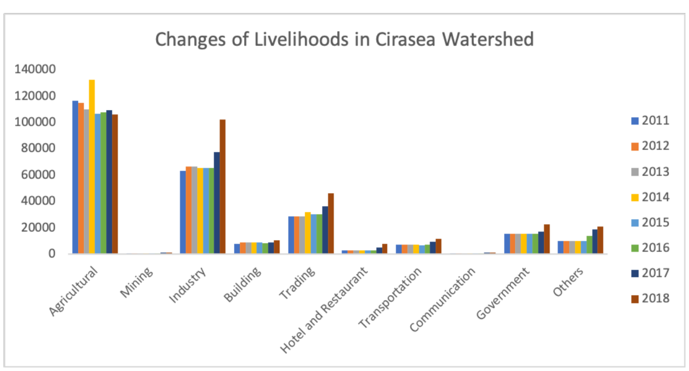


Figure 3. Changes of Livelihoods in the Cirasea Watershed

After eight years, the Cirasea Watershed experienced an increase in ricefield by 69,511.81 ha (16%), while the land for vegetable commodities had an additional land area of 114,616.5 ha (75%). The highest reduction in the area occurred in plantation land, amounting to 897,620.25 ha (97%), followed by a decrease in fruit land area by 7,882 ha (88%). It is assumed that the decline in fruit and plantation land has occurred because it has been converted into residential, infrastructure land, or another agricultural land. According to Ali et al. (2020), the farmers in Tadokkong Village, South Sulawesi, chose to convert land (into paddy fields) because the condition of garden land was previously less productive anymore. According to Wati and Munir (2016), land conversion activities can increase land use due to less productive land regeneration. Thus, the existence of land conversion activities is considered to be able to make land productive again. According to Murdaningsih et al. (2017), land improvement can result in favorable land quality changes.

Commodities — Districts	Land Area and Agricultural Productivity 2015 Area	2015 Yield	2016 Area	2016 Yield	2017 Area	2017 Yield	2018 Area	2018 Yield
Ciparay								
Ricefields	7,562	505,070	0	0	7,390	458,435	0	0
Vegetables	1,031	144,456	0	0	642	114,168	10	19,240
Fruits	0	0	0	0	0	0	0	0
Ibun								
Ricefields	2,576	161,220	2,576	160,879	2,576	151,489	3,033	192,810
Vegetables	379	32,056	312	31,852	312	42,217	277	48,640
Fruits	20	931	20	931	20	931	0	0
Plantations	170	5,914	170	5,914	170	5,914	0	0
Majalaya								
Ricefields	3,697	244,330	3,697	194,720	3,697	194,720	1,481	62,670
Vegetables	21	332	109	1,925	109	1,925	407	111,550
Plantations	3	31	3	31	3	31	0	0
Pacet								
Ricefields	4,081	261,060	4,081	261,060	4,081	269,134	8,150	503,900
Vegetables	1,691	87,841	1,691	87,841	1,691	421,098	1,607	2,247,120
Fruits	12	1,999	12	1,999	12	1,984.80	0	0
Plantations	371	4,797	371	4,797	371	6,491	0	0.03
Paseh								
Ricefields	155,849	112,450	0	0	155,849	112,450	3,033	192,810
Vegetables	123	46,921	0	0	123	46,921	927	1,700,930
Fruits	34	2,132	0	0	34	2,132	0	0
Plantations	142	2,291	0	0	142	2,291	0	0
Kertasari								
Ricefields	208	19,839	15	616	15	9,240	0	0
Vegetables	2,373	319,407	1,103	280,010	3,398	910,717	2,893	639,269
Fruits	14	56	35	27,749	35	27,712	0	0
Plantations	6,640	6,108,164	4,118	95,823	5,368	95,823	0	0

Sources: Statistics of Ciparay, Ibun, Kertasari, Majalaya, Pacet, and Paseh Districts in 2012 – 2019; Area (hectares); Yield (quintals)

To determine the improvement effort type that can be carried out, We must consider the land characteristics incorporated in each land quality. In other words, the conversion of garden land into paddy fields can increase land potential. Land potential has an essential meaning in land management and use. Land that has a high potential for agriculture can produce high-quality plants and more agricultural crop production. Land use should be following the potential of the land owned. Each land has different characteristics. It needs a more in-depth understanding to study the potency of land use. A high potential land certainly has a positive impact on land use results. Potential land in paddy fields illustrates the ideal and suitable conditions for paddy fields. It is expected to produce high-quality rice and has high economic value (Hamranani, 2014).

Apart from turning unproductive land into productive land, the land price is another reason for agricultural land changes. The other factors that affect the conversion of agricultural lands function are the area of the land Quasem (2011), farmer's income (Azadi et al., 2010; Quasem, 2011), location of land Quasem (2011), and farmer education level (Quasem, 2011). According to Harini et al. (2012), the area adjacent to the downtown land prices would be higher than the far to the city center. It indicates that the location is a factor affecting the level of land prices. Besides, the region located near the city center will save transport costs. The farmer who owns the land close to the city center will convert the land to obtain a more favorable outcome. The conversion can be done directly or indirectly, like by selling land belonging to other parties. Abelairas-Etxebarria and Astorkiza (2012) mentioned that the agricultural land conversion to housing in the peri-urban area increased land prices. Land conversion can increase the price a hundred times more than the land's initial cost, which strongly incites landowners to convert agricultural lands for non-agricultural uses (Neimark et al., 2018).

Farmers often converted their land because the agricultural sector's incentive is much less enticing than other

Table 4. Farmers' income in Cirasea Watershed

Commodities — Districts	Farmers' Income (IDR/quintals) 2011	2012	2013	2014
Ciparay				
Ricefields	IDR 14,047,817.40	IDR 19,364,473.49	IDR 17,559,428.81	IDR 25,154,601.70
Vegetables	IDR 1,487,543.10	IDR 526,480.24	IDR 1,840,735.66	IDR 793,690.88
Fruits	IDR 11,558.40	IDR -	IDR -	IDR -
Ibun				
Ricefields	IDR 4,379,064.96	IDR 3,381,144.27	IDR 5,326,416.36	IDR 9,602,798.70
Vegetables	IDR 2,347,227.90	IDR 231,664.79	IDR 1,915,370.31	IDR 454,922.50
Fruits	IDR -	IDR -	IDR 22,840.29	IDR 22,840.29
Plantations	IDR 1,332,146.68	IDR -	IDR 25,421.71	IDR 25,421.71
Majalaya				
Ricefields	IDR -	IDR 4,112,728.72	IDR 7,803,011.12	IDR 10,684,286.40
Vegetables	IDR -	IDR 861,659.00	IDR 263,465.00	IDR 971,993.58
Plantations	IDR -	IDR -	IDR 448.16	IDR 448.16
Pacet				
Ricefields	IDR 31,962,932.76	IDR 4,752,619.92	IDR 7,919,020.57	IDR -
Vegetables	IDR 933,185.24	IDR 2,796,966.82	IDR 7,132,100.83	IDR 9,875,506.79
Fruits	IDR 17,581.84	IDR 917.00	IDR 44,246.66	IDR 44,246.66
Plantations	IDR 16,931.93	IDR -	IDR 36,670.45	IDR 36,670.45
Paseh				
Ricefields	IDR 531,470.82	IDR 3,042,486.63	IDR 7,396,826.62	IDR 10,447,796.15
Vegetables	IDR 968,379.00	IDR 841,941.82	IDR 2,012,283.26	IDR 1,980,794.55
Fruits	IDR 450,469.95	IDR 138,630.59	IDR 138,630.59	IDR138,630.59
Plantations	IDR 926,937.83	IDR 1,169,450.50	IDR 1,169,450.50	IDR 1,169,450.50
Kertasari				
Ricefields	IDR 3,840.90	IDR 1,783.28	IDR 5,879,869.20	IDR 587,438.22
Vegetables	IDR 4,365,142.60	IDR 24,533,899.76	IDR 10,344,224.60	IDR 6,416.76
Fruits	IDR 646,524.88	IDR 55,085.28	IDR 1,027.04	IDR -
Plantations	IDR 344,582.40	IDR 20,782.05	IDR 133,209,089.44	IDR -

sectors. Moreover, farmers are motivated to sell it for cash because of the high land price for housing(Nguyen et al., 2016). Based on a previous study in East Java, agricultural land yielded a higher economic value after being converted. On average, converted agricultural land produced IDR 7,917/m^2/year, ranging between IDR 7,917/m^2/year and IDR 42,230/m^2/year. These are significantly higher than retained as agricultural land. It gives them more significant financial benefits to converting their land than if they remain in agriculture (Rondhi et al., 2018).

Education grade has a positive and significant effect on farmers' decision to convert their land. Farmers who graduated from senior high school and higher education grades tend to convert their agricultural lands' function compared to farmers who graduated from junior high school. It is assumed that the higher the education grade means that someone can work in the other sector besides agriculture, they tend to convert their agricultural lands (Tsani et al., 2018).

The increase in vegetable land was followed by an increase in productivity by 4,513,618.46 quintals (50%) after eight years, followed by ricefield commodities with an increase in 24,084.9 quintals (0.32%). With increased agricultural productivity, labor employed will be declined. If the few workforces in agriculture can produce higher output, the surplus agricultural labor will migrate to other stages of the value chains (Madi et al., 2020).

The fruit commodities experienced a decrease in productivity of 48,772.28 quintals (35%), followed by plantation commodities with a reduction in productivity of 169,941.2 quintals (1%). Differences in agricultural land productivity are influenced by climatic conditions, geographic characteristics, and location biophysics. Often farmers experience weather constraints that result in crop failure and impact, reducing annual agricultural productivity. According to Tarigan and Tukayo (2013), the wet season's water supply usually is sufficient in years with average rainfall. However, in the dry season, a water deficit occurs typically. The agricultural sector's productivity is critically essential if agricultural production increases at a sufficiently rapid rate

Commodities — Districts	Farmers' Income (IDR/quintals) 2015	2016	2017	2018
Ciparay				
Ricefields	IDR 27,713,190.90	IDR -	IDR 25,154,328.45	IDR -
Vegetables	IDR 2,388,050.72	IDR -	IDR 941,785.72	IDR 1,991,305.70
Fruits	IDR -	IDR -	IDR -	IDR -
Ibun				
Ricefields	IDR 8,846,141.40	IDR 8,827,430.18	IDR 8,312,225.57	IDR 10,579,484.70
Vegetables	IDR 975,918.20	IDR 970,582.76	IDR 1,347,238.03	IDR 4,622,978.91
Fruits	IDR 22,840.29	IDR 22,840.29	IDR 22,840.29	IDR -
Plantations	IDR 25,421.71	IDR 25,421.71	IDR 25,421.71	IDR -
Majalaya				
Ricefields	IDR 13,406,387.10	IDR 10,684,286.40	IDR 10,684,286.40	IDR 3,438,702.90
Vegetables	IDR 887.28	IDR 78,165.82	IDR 78,165.82	IDR 4,757,872.30
Plantations	IDR 448.16	IDR 448.16	IDR 448.16	IDR -
Pacet				
Ricefields	IDR 14,324,362.20	IDR 14,324,362.20	IDR 14,767,368.86	IDR 27,648,993.00
Vegetables	IDR 7,017,524.05	IDR 7,017,524.05	IDR 21,423,456.13	IDR 232,979,073.40
Fruits	IDR 44,219.90	IDR 44,219.90	IDR 43,964.32	IDR -
Plantations	IDR 38,126.96	IDR 38,126.96	IDR 38,126.96	IDR 32.95
Paseh				
Ricefields	IDR 6,170,131.50	IDR -	IDR 6,170,131.50	IDR 10,579,484.70
Vegetables	IDR 1,060,536.52	IDR -	IDR 1,060,536.52	IDR 175,841,402.20
Fruits	IDR 65,852.21	IDR -	IDR 65,852.21	IDR -
Plantations	IDR 837,838.06	IDR -	IDR 837,838.06	IDR -
Kertasari				
Ricefields	IDR 1,088,565.93	IDR 33,799.92	IDR 506,998.80	IDR -
Vegetables	IDR 16,953,912.17	IDR 11,280,845.82	IDR 46,320,831.58	IDR 26,440,169.06
Fruits	IDR 1,027.04	IDR 695,590.31	IDR 694,911.73	IDR -
Plantations	IDR 133,209,089.44	IDR 2,063,965.28	IDR 2,063,965.28	IDR -

Sources: (Statistics Indonesia, 2017a; Statistics Indonesia, 2017b; Statistics Indonesia, 2019; Fajar, 2019)

to meet escalating demands for food (Begum and D'Haese, 1970). Climate change has been proven to have negative impacts on agricultural productivity. The sector is regarded as the primary contributor to the scourge (Pye-Smith, 2011). Several studies have noted that climate change impacts low agricultural production and increased food insecurity (Pereira et al., 2014; Maponya et al., 2013). Nwachukwu and Shisanya (2017) predicted that climate change could significantly decrease agricultural productivity in Africa.

3.2.2 FARMERS' INCOME

In 2018, vegetable farmers experienced an income of IDR 436,531,323.73 (68%) from 2011 while ricefield farmers received an income of IDR 1,321,538.46 (0.32%). The decline in agricultural income occurred in fruit farmers amounting to IDR 1,126,135.07 (-33%) and plantations of IDR 2,620,565.89 (-1%). The level of farmers' income depends on the area of land, land ownership, production costs, selling price, the length of time to work on farming, capital, and working hours. The selling price of a type of commodity tends to fluctuate, one of which is influenced by the high harvest season, which causes commodity prices to fall. The higher the farmer's income, the more welfare the farmer will be. An increase in farmers affects meeting the needs of their daily lives.

The cost of production and fair price of agricultural produce are the two most important topics related to farm products' smooth marketing, significantly impacting a particular crop's production in successive years. Farmers always try to maximize their farm-gate price with the minimum cost of production. This controversial situation also affects the cultivation procedure as well as the overall production of agricultural products. Small and medium farmers in the remote rural areas remain ignorant about their products' current price in the market, their trends, demand, and supply, which create obstacles for the farmers in getting a fair price for their products. Consequently, the situation discourages farmers from producing agricultural products (Yeasmin et al., 2020).

Apart from those mentioned above, changes in farmers' income can also be affected by livelihoods changes. It can be assumed that some farmers sell their agricultural land,

Table 5. Percentage of Livelihoods in 2011-2018

Livelihoods	2011	2012	2013	2014	2015	2016	2017	2018	Changes (%)
Agricultural	116565	115118	109911	132419	106501.1	107741.5	109174.9	106022.2	-10%
Mining	639	632	632	632	632	632	814	916	30%
Industry	63122	66430	66259	65448	65448	65651.03	77468.03	102139	38%
Building	7450	8731	8593	8612	8612	8496.028	8718.03	10249.03	27%
Trading	28619	28719	28743	32102	30109.39	30389.42	36298.05	46167.05	38%
Hotel and Restaurant	2725	2621	2621	2621	2621	2621	5022	7414	63%
Transportation	7195	7195	7195	7235	6770.091	7315	9134	11513	38%
Communication	554	485	485	488	488	488	830	1151	52%
Government	15125	15246	15246	15246	15246	15246	16966	22286	32%
Others	10103	9852	9852	9877	9866	13890	18726	20891	52%

Sources: Statistics of Ciparay, Ibun, Kertasari, Majalaya, Pacet, and Paseh Districts in 2012 – 2019

then look for other jobs to get a higher income. As shown in Table 5 and Figure 3, the Cirasea watershed community is predominantly a farmer, followed by livelihoods in the industrial sector. Despite being the highest, agricultural livelihoods decreased (-10%), while other non-agricultural livelihoods increased. When viewed based on the percentage of livelihoods changes, the hotel and restaurant sector experienced the highest increase by 63%, followed by the communications sector and 52% each. It is assumed that during the eight years, there was an increase in the construction of hotels, restaurants, and communications followed by changes in livelihoods from farmers to employees in these sectors. However, some farmers also switched to other sectors, such as industry, with the highest number after the agricultural sector. Further studies are needed to determine changes in the livelihoods of communities around the Cirasea watershed.

Some suggestions could be applied to increase the farmer exchange rate, including decrease agricultural land conversion and increase agricultural productivity to decrease agricultural sector poverty in Indonesia. The recommendation can be formulated, such as increasing agricultural product price to increase farmer exchange rate. Hence, the government has a role in the price guarantee of farming products. The farm product's increasing price can be done if the farm product has competitive export value, so it needs to be done by improving the quality with export competitive. To increase agricultural productivity, We need to increase the total production of a farming result. The increase of the total output in agriculture can be increased by improving human resources quality, doing training and acknowledging the new technology toward farmers, and doing training from professional labor to each farmers group in the rural area. The development of ultimate seeds can increase the total production maximally, improving the whole production, affecting farmers' exchange rate and productivity. The agricultural land conversion control can be done to strengthen land conservation rule in the agricultural sector, mainly for the land that is high in quality and still productive. The maximally land preparation by taking attention toward land productivity and high-quality inland molding program can increase agricultural productivity progress (Setiyowati et al., 2018).

4. CONCLUSIONS

In conclusion, changes in agricultural land affect the productivity and income of farmers in the Cirasea watershed. The smaller the cropland area or the higher the conversion of agricultural land to non-agricultural land, the lower the farmer's income will result in a loss of livelihood. After eight years, the vegetable commodity in the Cirasea watershed has a more significant influence than other commodities on farmers' income. The vegetable commodities area has increased by 75%, with an increase in production by 50% and an increase in income by 68%. Another addition to the land area that occurs is ricefield land. The decrease in the land area also happened in the Cirasea watershed, namely fruit and plantation commodities.

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