The impact of climate change on poverty in the pandemic of Covid-19 in Bengawan Solo Watershed, Wonogiri District, Central Java

E S Rahayu1*, Setyowati1, and R Rahwadiati2.

1Study Program of Agribusiness, Faculty of Agriculture, Universitas Sebelas Maret, Indonesia
2Study Program of Forestry Management, Faculty of Agriculture, Universitas Sebelas Maret, Indonesia
*Corresponding author: buendang@yahoo.co.id

Abstract. Early Warning Early Action: Report on Food Security and Agriculture released by FAO April 2020 warns countries worldwide to be alerted to potential food crises caused by the Covid-19 pandemic. Almost all countries worldwide are experiencing Covid-19 is no exception impacting the agricultural sector. This decrease in production and welfare level is due to the reduction of agricultural crop production. One of the risk factors for food security in the Covid pandemic era is extreme weather. Climate change causes global and domestic food stocks to decline and causes fluctuations in food prices and the food logistics system. This condition impacted the decrease in farmers’ income and welfare (NTP = Farmer Exchange Rate) and resulted in the poverty of farmers’ households. This study aims to (1) identify the production and income reductions from climate change and the impact of the Covid-19 pandemic, (2) analyze the poverty level of farmer households, (3) knowing the coping mechanism of farmer households to address climate change and the impact of Covid-19. The method used is the Bengawan Solo watershed area survey method with sample locations in 3 sub-districts with 120 farmer respondents interviewed with a structured questionnaire guide and FGD. The analysis method used descriptive analysis, income analysis, and poverty analysis. The results showed that farmers’ incomes decreased by 43.2%. The poverty rate of farmers increased with a shift of 9.8%; coping mechanism farmers persisted by paying attention and adhering to the health protocols of Covid-19 and trying to increase land productivity to meet daily needs.

1. Background
Early Warning Early Action: Report on Food Security and Agriculture released by FAO April 2020 warns countries worldwide to be alert to potential food crises caused by the Covid-19 pandemic. Almost all countries in the world are experiencing Covid-19 is no exception impacting the agricultural sector. In Indonesia, in 2020 FAO predicted is not affected when viewed from the performance of Food Security Indonesia ranked 62nd out of 113 countries globally, with a total of 61.7 [1]. Still, the data shows that NTP (Farmer Exchange Rate) decreased by 3.69%, and Indonesian Statistics record farmer welfare rate decreased in almost all agricultural subsectors with NTP value reduced by around 1.73% [2]. This decrease in production and welfare level is due to the reduction of agricultural crop production. Siregar
stated that Indonesia's food security risk factors in the era of the Covid pandemic are Covid-19 factors as the root cause, another factor is extreme weather as a result of Climate change that causes global and domestic food stocks to fall and causes fluctuations in food prices and food logistics systems. This condition impacted the decrease in farmers’ income and welfare (NTP = Farmer Exchange Rate) and resulted in the poverty of farmers’ households.

Pandemic Covid-19 developed into wide economic shocks because of the original Root cause (root cause). Still, the impact and spread of the virus wide-ranging and developed into a "broad economic shock" that continued in agriculture can shake Aggregate Demand and Aggregate Supply at once [4]. If this virus's existence and spread take a long time, then the risk to the farming system is higher. The direct impact of farmers and traders’ inputs and agricultural products face the risk of Covid-19 when left to work as usual. Without adequate health protocols, the availability and distribution of farming inputs may be disrupted, so farmers are difficult to cultivate. As usual, the Marketing of agricultural products will also experience disruptions. The impact is that there is a need to limit the spread of Covid-19 (PSBB) to essentially reduce the mobility of production facilities and agricultural products despite the exceptions because it lowers the frequency of vehicles, increases time for health protocols, etc. Food security at the national level may be maintained. Still, the challenges at the micro-level of farmers' households are some of the most vulnerable areas of food security. The biggest challenge is food security at the household level is very susceptible to the affected groups.

On the one hand, there is a new phenomenon about the risk of shock weather, which based on Indonesia's Oceanic Nino Index (ONI) report, 2011-2018 amounted to ONI > 0.5 as a result of El Nino; ONI < -0.5 impact of La Nina Climate Prediction Centre, NOAA, 2020 [4]. Siregar [3] further explained that this condition causes high rainfall until early 2020, plus observations in 1918-2020 there is Spanish Flu, and in 2020 there is Covid-19, causing food availability to be disrupted. The intensity of the rain in 15 Provinces affected by El Nino and La Nina, including one of Central Java province, where Wonogiri regency is one of the regencies in Central Java Province, it becomes an exciting study to discuss the impact of climate change on poverty in the era of the Covid pandemic in Wonogiri Regency. Wonogiri regency as one of the regencies in Central Java Province is a district that is affected by climate change conditions with high rainfall. Besides, the condition of the Covid-19 Pandemic further exacerbates the simultaneous impact on income. One side of poverty in Wonogiri Regency is high enough that it becomes an interesting study to discuss the impact of climate change on poverty during the Covid-19 pandemic era in Wonogiri Regency. Research objectives for (1) identification of production and income reductions from climate change and the impact of the Covid-19 pandemic, (2) analyzing the poverty level of farmer households, (3) knowing the coping mechanism of farmer households to address climate change and the impact of Covid-19.

2. Methodology
The research method used is the survey method in the Bengawan Solo Watershed area of Wonogiri Regency with samples of locations spread across three sub-districts (east taken Girimarto Subdistrict, south in Tirtomoyo subdistrict and west side in Eromoko Subdistrict) each subdistrict taken by 40 respondents farmer households so that the total respondents as many as 120 respondents of farmer households taken random sampling. The collection can be done by interview, referring to the questionnaire guide in a structured manner, and focus group discussion (FGD). The analysis method used descriptive analysis, cost and income analysis in agricultural business, and poverty analysis that refers to BPS (2020) [2].
3. Result and discussion

3.1. Analysis of the impact of climate change and Covid-19 on agricultural businesses

The state of the climate is essential for people's lives, especially in the agricultural sector. Based on Wonogiri District Meteorological Station (2020), the air temperature in Wonogiri Regency in the dry season and the rainy season is a maximum of 36.5°C and a minimum of 18.26°C. The maximum humidity in the Wonogiri regency is 91% and at least 80%, with an average humidity of 85.3%. The rainfall in Wonogiri Regency is 1,488 mm year\(^{-1}\), with the number of rainy days 106 rainy days year\(^{-1}\). The number of rainy days in the dry season is five rainy days. The number of rainy days in the rainy season is 101 rainy days. Rainfall in Wonogiri Regency is close to optimal (1,500-2,500 mm year\(^{-1}\)) [5]. With rainfall of that magnitude means the climate position in Wonogiri Regency following the Bureau of Meteorology and Geophysics/BMKG [5] included in extreme weather conditions in 2019 years with rainfall 125.2 mm day\(^{-1}\). At the beginning of 2020, maximum rainfall reaches 377 mm day\(^{-1}\); towards the end of 2020, the impact of El Nino causes an average of 377 mm day\(^{-1}\) of rain. This condition will affect the pattern of agriculture cultivated by the delay of the next growing season that causes a shift in planting and results in a decrease in the production and productivity of agricultural commodities cultivated by farmers. In Wonogiri Regency based on the results of research shows that climate change that occurs can decrease the production of agricultural products of food crops by 5-10%, horticultural crops by 20-30%, and annual crops, especially fruits, by 40-50% [6].

Wonogiri Regency has two hydrological characteristics, namely saltwater, and freshwater. Saltwater is the sea located at the southern end of the Wonogiri regency with a natural beach canyon (Sembukan) and ramps (Nampu Beach). Fresh water in the form of a lake located in a mountainous limestone area whose water can be used to meet the community's needs. Wonogiri regency also has irrigation facilities/dams which include irrigation Source Snapper in True Village (Giritonro Subdistrict), Muncar Temple Dam in Bubakan Village (Girimarto Subdistrict), Songputri Reservoir in Sindukarto Village (Eromoko Subdistrict), Baran Reservoir in Puloharjo Village (Eromoko Subdistrict), Parang Joho Reservoir in Eromoko Village (Eromoko Subdistrict), Kedunguling Reservoir in Ngunggahan Village (Eromoko Subdistrict), Tandon Lake in Pare Village (Selogiri Subdistrict), Ngancar Reservoir in Selopuro Village (Batuwarno District), Nawangan Reservoir in Platarejo Village (Giriwoyo Subdistrict) and Gunungsengon Reservoir in Giritronto Village (Giritronto Subdistrict). The potential of these water resources is in rural and urban areas. Water resources in the countryside are used for irrigation and daily use, while in urban areas are used by PDAM for drinking water. However, the use of irrigation water in crops is often insufficient and take water from the river by pumping. This condition will have an impact on the decrease in agricultural production and productivity.

The Covid pandemic that occurred at the end of 2019 impacted the economy in 2020, with a significant impact felt by farmers' households (RTP) due to social restrictions and Covid health protocols. The perceived impact is the change in the price of agricultural products and changes in the prices of inputs in agricultural businesses (seeds, fertilizer, labour wages and so on). The results showed there are several indicators of price changes in food crops commodities (rice, rice, soybeans, corn, etc.) with variations ranging from 20% - 35.7% with an average of 26.2%. One side with the Covid-19 with PSBB policy becomes an obstacle in the distribution and distribution of logistics input factors that result in rising agricultural business costs. The results showed the increase in farm costs (cost production) ranged from 5.9% - 10.21% with an average of 7.89%. These changes affect the amount of income ladder farmers households. Changes in production as a result of climate change and changes in the price
of agricultural inputs and outputs as a result of Covid-19 in total affect the household income of farmers households resulting in an increase in poverty rates in Wonogiri Regency.

3.2. Farmer household income analysis (RTP)
Hadi Saputro [7] in farming theory cost and income farming analysis can be calculated for one year or one growing season. This study is calculated for one year on various land (rice fields, moor, yard) because in one year on each land can be planted 2 times or 3 times planting, then each planting season is calculated the costs incurred by farmers on various land cultivated and types of commodities. The results of the study analyze costs on agricultural businesses obtained results that can be seen in table 1.

| No. | Description                  | Farming Costs (Rp) | Percentage (%) |
|-----|-----------------------------|--------------------|----------------|
| 1.  | Seed and fertilizer costs   | 992,678.70         | 70.85          |
| 2.  | Labor costs                 | 390,651.38         | 27.88          |
| 3.  | Miscellaneous charges       | 17,739.86          | 1.26           |
|     | **Total**                   | **1,401,069.94**   | **100**        |

Source: Primary Data Analysis, 2021.

From Table 1, the average cost incurred by farmers is seeds and fertilizers by 70.85%. From when the input of the highest cost for fertilizer because when the presence of rare fertilizers triggers high prices, the cost of seedlings tends to rise compared to before Covid because of its small presence in the market. Can also be included in the tax paid once a year and for safety with the intention that the farm succeeds by 1.26%. Labour wages tend to fall because the labour market conditions are higher supply compared to the demand, from the original Rp. 70,000/day down to Rp. 65,000 or Rp. 60,000. The decrease in the wages of agricultural workers is due to the large number of workers who are laid off from the urban or from the industrial sector that goes into the agricultural sector. The Farmers Households received from the sale of agricultural commodities cultivated is calculated based on the prevailing price. The prices received by farmers for agricultural products vary depending on the form of commodities sold (dry or wet), types of commodities cultivated (food crops commodities such as corn, soybeans or rice, horticulture such as vegetables or fruits etc.), places of sale such as in rice fields, moor or in production or sold to the market and so on.

The research results on farmers’ household income obtained an average receipt of Rp. 6,275,108.89. The largest revenue was obtained from rice fields amounting to Rp. 5,647,445.00 (89.99%) with the dominant type of commodity is rice plants as a staple plant and intermittent crops can be corn, peanuts, or cassava. Revenue from moorland amounted to Rp. 624,436.11 (9.99%) with the dominant crops of corn, cassava, bananas, medicinal plants, turmeric, ginger, and galangal. The lowest revenue was obtained from the yard with banana, chocolate and turmeric plants amounting to Rp. 3,227.78 (0.02%). The yield obtained this year is relatively down compared to the previous year caused by planting in rice fields backwards because of waiting for rainwater (climate change), resulting in a decrease in the production of about 7%. At the same time, the price received by farmers is also low because the price of dry grain harvest fell from the original Rp. 4,500/Kg to Rp. 3,600/Kg caused by the impact of the Covid pandemic and low quality. From this condition, the income received by farmers decreased by an average of Rp. 4,874,038.94. Based on the study of primary data, this income decreased by 40.3% compared to the year before Covid and climate change with plantings that retreated almost two weeks
than they should. This decrease in income for daily needs is also reduced so that RTP seeks additional income outside of farming, among others from side businesses (MSMEs) and other income as presented in table 2.

### Table 2. Total revenue of farmers households in Wonogiri Regency.

| No | Source of Income         | Revenue (Rp) | Average/month (Rp) | Percentage (%) |
|----|--------------------------|--------------|--------------------|----------------|
| 1. | Farm Revenue             | 4,874,038.94 | 1,218,509.74       | 60.16          |
| 2. | Livestock Business Revenue | 1,263,427.78 | 315,856.94        | 15.59          |
| 3. | Child submissions        | 1,320,000.00 | 330,000            | 16.29          |
| 4. | MSMEs                    | 35,022.22    | 8,755.56           | 0.43           |
| 5. | Plantation               | 609,621.11   | 152,405.28         | 7.52           |
|    | **Total Revenue**        | **8,102,110.05** | **2,025,527.51** | **100**       |

Source: Primary data analysis, 2021.

Based on Table 2, it is known that the average total income of farmers in Wonogiri Regency is Rp. 8,102,110.05 or Rp. 2,025,527.51/month. The highest income came from agricultural businesses by 60.16% and the smallest from home industry side jobs by 15.59%. This is because side work is done to obtain additional income to meet the needs of the family.

#### 3.3. Poverty analysis and coping mechanism

Farmers Households' total revenue analysis results include the largest agricultural businesses, where the condition of agricultural products is a commodity with a high level of uncertainty, either from changes in weather or changes in output prices and inputs. Although the total income of Farmers Households obtained from various sources increases the amount of income. However, judging from the poverty line, there is still 24.7% below the poverty line, with the reference poverty line in 2020 amounting to Rp 341,643 per capita per month. The high number of people below the poverty line is the impact of the Covid-19 pandemic and the early shift in commodity planting due to climate change. The existence of the Covid pandemic impacts the decrease in the marketing of agricultural products so that the revenue received by Farmers Households decreases. To address the uncertain conditions of climate change and price changes as a result of Covid, Farmers Households strives to survive in various ways. The results of the primary data study efforts to survive are carried out with strategies, among others by controlling RTP expenditure (10.4%), saving (7%), relying on government assistance (8.8%), do not have a strategy (39.4%) because of inability to read the situation, utilizing household resources (15.8%), looking for business opportunities that are in demand by the public when the pandemic turns to ornamental plant traders (3.7%), prioritize primary needs (food and beverages) to survive not sick and endurance from Covid (14.9%).

#### 4. Conclusion and Suggestion

The development in agricultural production (cassava, rice, horticulture, etc.) due to climate change that shifts the beginning of planting in agricultural businesses led to a higher number of productions by 5-10% plus price changes as a result of Covid-19 Pandemic - related to LSSR (Large-Scale Social Restrictions) led to a decrease in prices by 26.2%, and all of them impacted the change in income. This decrease in income caused the poverty rate to rise by 24.3% in Wonogiri Regency. Therefore farmers must be able to survive in the uncertainty of market conditions and income, the strategy is carried out to stay afloat, among others by controlling Farmers Households expenditure, relying on government
assistance, receiving roughly because of the inability to read the situation, utilizing household resources, looking for alternative business opportunities to turn to ornamental plant traders (as the public is interested in during the pandemic, prioritize primary needs (food and beverages)).

From this research, Farmers Households recommended for every information update and always be dynamic in addressing the changes that occur, whether climate change, changes due to the Covid-19 pandemic or other changes that make businesses in the agricultural sector always face uncertainty in their business activities. Always learn and improve your capabilities as a farmer who must be able to make decisions in all situations.

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