



The Impact of the Sulawesi Earthquake on Maize Farmers in Sigi District Central Sulawesi: A Value Chain Analysis

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Abstract. The 2018 Sulawesi earthquake and tsunami, followed by the COVID-19 pandemic, have caused problems for most people in Sigi District, Central Sulawesi Province. Poor farmer groups are the ones most affected by the earthquake and Covid-19. This study analyzes the strategy for strengthening maize farmers in the Sigi district, Central Sulawesi, after the 2018 earthquake and tsunami. The researcher has chosen maize commodity because it considered the number of farmers involved and the commodity prospect in the future. This study uses a value chain approach to find out more about the market conditions for maize commodities, including inhibiting and supporting factors, as well as what factors are needed for improvement to achieve better efficiency in developing and maintaining the existence of maize commodities. Primary data were collected through interviews, in-depth interviews, and FGDs. Data were analyzed quantitatively and qualitatively. This study found that 93.3% of farmers said the disaster impacted their maize commodity. Damage to agricultural land due to flooding (tsunami and liquefaction) and irrigation canals are also damaged. This condition disrupts their maize commodity cultivation activities. This study also found market potential to expand maize production and productivity in Sigi District. Demand projection for maize products is to continue to grow in line with population and income growth in Indonesia. National production is currently insufficient to meet industrial demand. Domestic demand at the district and provincial levels for industrial needs is also increasing. However, farmers have weaknesses and threats to the sustainability of maize commodity cultivation. The main drawback is related to cultivation, which significantly increases productivity. In addition, the bargaining power of farmers is low, especially in determining the price of maize. The significant threat related to maize cultivation is that there is only one off-taker in Sigi, which risks stopping their purchasing and operations at Sigi.

Keywords: Earthquake · Maize · Farmers · Sulawesi · Value Chain

1 Introduction

A devastating Mw 7.5 earthquake and tsunami struck northwestern Sulawesi, Indonesia, on 28 September 2018, causing over 4000 fatalities and severe damage to several areas in

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and around Palu City [1]. One of the impacts is that hundreds of hectares of agricultural land in the Sigi District are lost and damaged [2]. Tondi's research found damage to around 185 Ha in the form of roads, housing, and most of the rice fields managed by farmers in Jono Oge Village, Sigi District [3]. The disaster's most significant impact changed agricultural land's condition. One of the findings in the case of the 2018 Sulawesi earthquake and tsunami disaster was that rice fields were damaged, which could be seen from the surface structure of the land becoming uneven, broken, and fragmented, which made it difficult for farmers to re-cultivate their agricultural land [3, 4]. The damage to agricultural land then affects some farmers who lose their agricultural land and the income of some existing communities [5, 6].

This study aims to determine the impact of the 2018 Sulawesi earthquake and tsunami on farmers' maize and analyze strategies for strengthening maize farmers in the Sigi district after the 2018 tsunami. One of the commodities that farmers in Sigi District widely cultivate is maize. Maize is a multifunctional crop, as well as the second most important food crop commodity after rice. Based on the order of staple foods in the world, maize ranks 3rd after wheat and rice [7]. Maize has many uses, and almost all plant parts can be used for various purposes. Sigi District itself is one of the centers of maize producers in Central Sulawesi. Despite varying amounts, all sub-districts are recorded in Sigi, totaling 15 districts in maize production. The sub-district with the highest harvested area is Palolo, with a harvested area of 2,412 Ha. The sub-district with the lowest harvested area is Lindu, with a harvested area of only 43 Ha. Data shows that maize is the second main commodity after rice [8]. More extensive than other food crops, such as soybeans, peanuts, green beans, cassava, and sweet potatoes. Production in 2015 shows that the people of Sigi prioritize planting maize on their agricultural land. It is proven that maize has been successfully harvested in an area of 8,485 Ha, far outperforming other commodities, only losing to rice, the primary source of staple food for the Sigi people and the Indonesian people in general. This maize-harvested area can continue to increase in line with government policies that target Sigi as the center of maize producers in Central Sulawesi.

2 Methods

Research on the impact of the 2018 Sulawesi earthquake and tsunami on maize farmers was carried out in Sigi District, Central Sulawesi Province (Fig. 1). This research was conducted using a value chain approach. The value chain approach provides systemic insights into developers' economic dreams, especially commodity-based ones [9]. The value chain approach seeks to include all the activities necessary to bring a product through the various stages of production, from the cultivation stage to the final product to the consumer [10]. The value chain approach helps to increase the productivity of the existing sector or commodity through all the actors involved in the value chain. The choice of the value chain and commodity market approach is expected to describe a horizontal network that includes relationships between actors and a vertical network of maize production to distribution. Value chain analysis is carried out by examining the profit margins of each actor, the established marketing channels, access to information, the capacity of local individuals and organizations, and government support. Using this

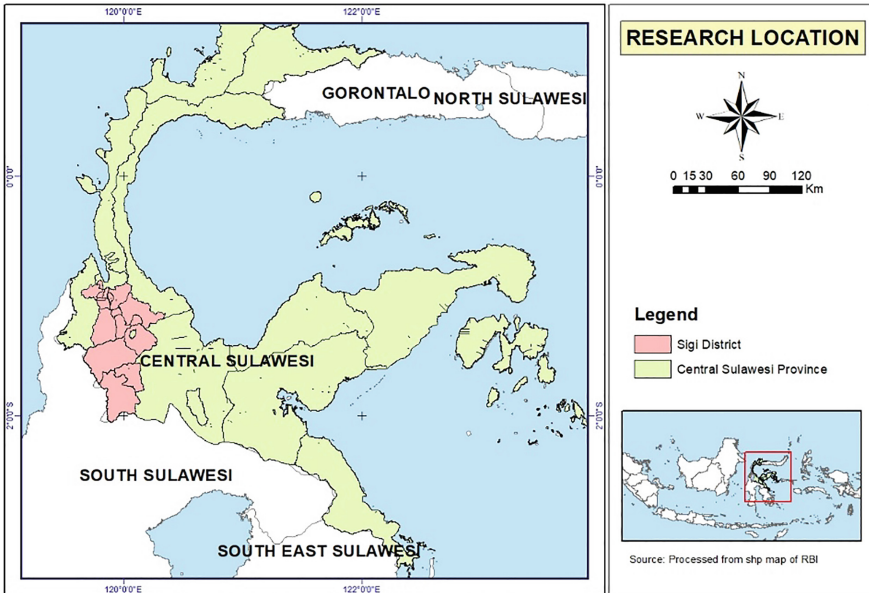


Fig. 1. Research Location. Source: Processed from SHP map of RBI

approach can guide how to act to bring about positive change in the market system for the weak. Combining these two elements - a framework for analysis and action - makes this approach more than just an attractive analytical tool but also provides a valuable set of operational tips. The goal is to provide coherence and consistency in how we understand the world and, keeping this in mind, how we intervene to bring about change. By addressing the underlying cause (not the symptom) of weak performance.

Research data were collected through surveys, in-depth interviews, and FGDs. A series of interviews should be conducted with the main actors along the selected value chain (input suppliers, producers, traders) and their supporting institutions (e.g., local governments, banks/microfinance institutions, vocational training, and others). Using the quantitative data at the farmers' level is to obtain the main problem of the farmers. The number of quantitative samples is 30 farmers who were selected using systematic random sampling from a list of existing farmers. The number of 30 people is based on consideration of the minimum sample size, as stated by Roscoe [11]. Quantitative data at the farmer level was collected using a questionnaire guide. Data will be collected using ODK data collect and then analyzed using SPSS. A series of FGDs and in-depth interviews will be conducted along the value chain and with the stakeholders involved to see further the actors and issues involved in the value chain. FGDs were conducted twice, the first with farmers and the second with stakeholders. Meanwhile, there were two in-depth interviews with actors in the maize commodity value chain: farmers, level 1 and 2 collectors, wholesalers, input suppliers, government, NGOs, and supporting institutions (finance, universities, transportation service providers).

The data collected was analyzed using value chain analysis to identify the actors involved, including supporting services, changes in form, and prices of maize commodities. Further analysis is to find out the root of the problems along the value chain, especially those faced by farmers. The existing problem map becomes the basis for compiling recommendations for strengthening the value chain. Recommendations for value chain strengthening, especially to increase farmers income using SWOT analysis. This SWOT analysis assessment results can help determine which priorities should take precedence [12].

3 Results and Discussion

3.1 Overview of Maize Farmers in Sigi District

It is estimated that the area of maize in Sigi is 10,105 Ha, an increase from 2015, which was 8,485 Ha. The number of areas and maize farmers in Sigi is estimated to increase after the earthquake. Maize plants are spread in all sub-districts in Sigi District with a cultivated plant area. The sub-districts with the largest area of maize planted are the sub-districts of Palolo, South Doso, and West Dolo. Some rice and cocoa farmers have turned to maize farmers because of the damage to irrigation and land caused by the earthquake and liquefaction landslides in 2018. Land conversion to maize fields from other crops after the earthquake is mainly due to the damage to existing irrigation channels.

As many as 93.3% of farmers said the disaster impacted their agricultural commodities. Damage to agricultural land due to flooding (tsunami and liquefaction) and irrigation canals is also damaged, disrupting their cultivation activities. In addition to the disaster, 86.67% of farmers said climate change affected their cultivation. The climate change most felt is the rainy and dry seasons change.

In some cases, erratic and high-intensity rains cause damage to maize crops. If the dry season is too long, the maize plants will become stunted or stunted. Meanwhile, if it rains too often and heavily, the plants can die or rot due to being submerged. As for the maize commodity, it cannot grow without water. The need for more water during its vegetative growth during flowering and fruiting is hoping that it will not be disturbed by rain so that if there is a change in season that comes, it will affect maize production, even when the maize harvest arrives. When it rains, a lot of aflatoxins and fungi will cause the quality of maize to be low, and its value is also low.

Although some buy from existing shops, maize farmers in Sigi District mostly rely on collectors/traders to meet their capital needs for maize production, seeds, and fertilizer (Table 1). In addition to farmers' dependence on seeds and farmers' seeds on collectors/traders, the results of the FGD also found that farmers depend on collectors/traders to meet their daily needs. Farmers are already in debt to collectors/traders, and their bargaining position has become weak. As a result, farmers have to accept that their harvest price is far below the market price at the time of purchase with a difference between 700–800 per kg, still deducting the amount of debt that must be paid. Farmers' dependence on collectors/traders is due to the various conveniences of collectors/traders compared to other financial services—fast response in providing capital needs and funds for immediate needs. In addition, farmers are also faced with the high cost of seeds and

Table 1. Source of Seeds and Fertilizer (the answer can be more than 1)

Source of Seeds and Fertilizer	Source of Seeds (%)	Source of fertilizer (%)
Making (breeding) yourself	20.00	0.00
Buying from other farmers	0.00	0,00
Buying from shops	40.00	33.33
Buying from cooperatives	0.00	20.00
Government assistance	16.67	6.67
Buying from collectors/traders	40.00	36.67
Others	30.00	26.67

Source: Analysis of primary data, 2021

Table 2. Barriers to obtaining seeds and fertilizer (the answer can be more than 1)

Barriers to obtaining seeds and fertilizer	Seeds (%)	Fertilizer (%)
Rare items (not available all the time) or limited quantities	33.33	56,67
price	73,33	53,33
Quality not as expected	6,67	0,00
Access to a remote point of sale	13,33	16,67
Others	16,67	13,33

Source: Analysis of primary data, 2021

fertilizer (Table 2). As a result, farmers are forced to owe money to collectors and then pay them at harvest.

Currently, produced maize in Sigi District is still lower than the national average productivity. Maize productivity in Sigi is still below 4 tons per hectare, far below the national productivity, reaching above 5 tons/ha. In cultivation, farmers do not consider the seasonal calendar, and farmers only calculate that the land will be rested for 1.5 months and then replanted with maize. Farmers can plant three times in one year but sometimes only two times. It depends on the current weather.

3.2 Maize Commodity Value Chain in Sigi

Farmers in Sigi District grow maize twice a year. The resulting product is shelled maize. Farmers sold most of the maize to PT. JAPFA Comfeed. Farmers sold a small part to chicken farmers in Sigi District. Generally, maize sold to chicken farmers is of lower quality than that sold to PT. JAPFA. The business model in the maize commodity chain sold by PT. JAPFA Comfeed involves several actors, namely village collectors and wholesalers associated with PT. JAPFA Comfeed (Fig. 2). In some instances, especially if the farmers are close to PT JAPFA Comfeed, they can sell maize directly to the company at a relatively better price.

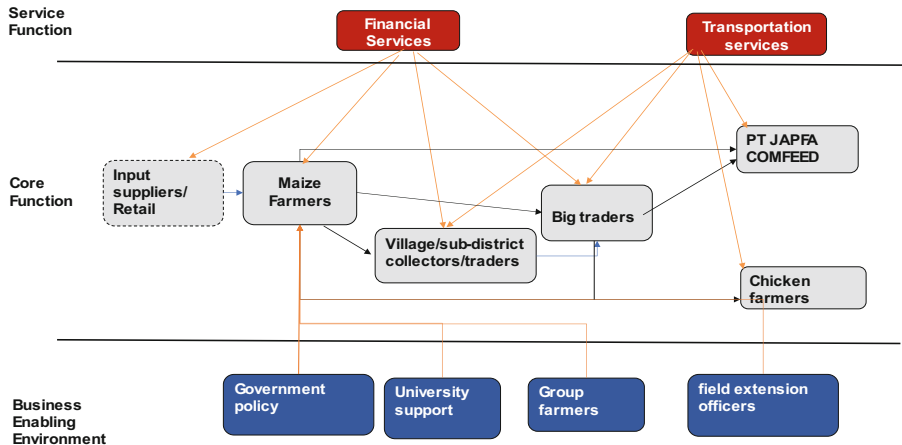


Fig. 2. Maize Value Chain and Commodity Market in Sigi. Source: Analysis of primary data, 2021

However, not all farmers sell directly to PT JAPFA Comfeed because of considerations of transportation costs (distance) and also because of their ties to collectors. These ties usually relate to borrowing and borrowing for production capital (fertilizer and others). Most farmers get their seeds from fertilizer from collectors and retail shops for agricultural production facilities (more than 80% of farmers get seeds from collectors and agricultural shops in the sub-district). Retail of agricultural production facilities or farmer's shops in the Sigi district is estimated to number between 2–3 shops per sub-district. Maize collectors are in the village. In each village, there are about two collectors. Collectors buy almost all maize sold by farmers. Relationship between farmers and collectors, sometimes providing agricultural production facilities as well. Farmers can access it by going into debt first and then getting paid for maize harvest at a lower price.

Meanwhile, these wholesalers exist in two sub-districts, West Dolo and South Dolo. These wholesalers, besides receiving maize, also receive other commodities such as coconut (copra), coconut shell charcoal, candlenut, chicken, and others. However, the most dominant commodity is maize. They receive maize from several sub-districts in Sigi District (four sub-districts) and maize from outside the district, such as from Poso. This trader has a strong relationship with PT. JAPFA Comfeed. This wholesaler also plays a role in developing maize commodities in Sigi, especially in efforts to increase maize productivity, including providing training and demonstration plots for maize plants to become models in maize cultivation. The guidance has been socialization since 2015 and has increased the production and productivity of maize in Sigi.

The business model will have an impact on farmers' profits. The price of maize sold to collectors is usually lower than that of wholesalers or JAPFA Comfeed (see Fig. 3). The purchase price of dry-shelled maize by JAPFA Comfeed ranges from 3,500–3,800/kg. If it is not by JAPFA's Standard quality, then wholesalers will sell the maize to chicken farmers at around 2,500/kg. Farmers often only sell directly to JAPFA because of distance

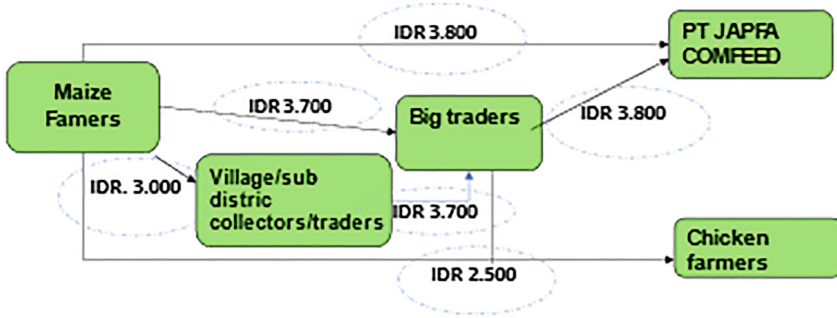


Fig. 3. Changes in maize prices in Sigi at the time the survey was conducted. Source: Analysis of primary data, 2021

issues and their strong relationship with collectors. This relationship is generally in the form of accounts payable. Farmers sell to collectors at a lower price difference of around 500–800/kg from the price of JAPFA Comfeed. If farmers sell to wholesalers, they still have a low-price difference between 100–200/kg from the price of JAPFA Comfeed. There is a maize quality standard that he received according to the request of the company PT. JAPFA Comfeed as the primary buyer, requires that the maize they receive has a moisture content of around 13% and that maize is free from mold and aflatoxins. If the quality of maize provided by farmers is not up to standard, traders will buy it at a low price and then sell it to chicken farms.

In Sigi District, government support for the development of maize commodities is relatively high. The central government provides support through a maize development program covering an area of 7,500 hectares. Meanwhile, Central Sulawesi's province supported the development of maize for 2,500 hectares. The form of support from the central government is in the form of seeds, post-harvest facilities, and power tresses. However, this government's support did not continue due to the earthquake. The government is relocating the budget for disaster recovery.

Nevertheless, efforts to increase productivity continue is by building the Gumbasa water channel, which damaged by the earthquake. The government plan for the tertiary canal for the Sigi District area can be completed, including the construction of a water pump at the end of 2022. The government, through the agriculture/food security department and field extension officer, also provides assistance and monitoring. However, during the Covid-19 pandemic, field visits were significantly reduced, including the relocated budget allocation for handling COVID-19.

3.3 Potential and Problems of Maize Commodities in Sigi District

The potential for maize in the future is getting bigger [13]. Maize is often used as a staple food raw material, industrial raw material, and animal feed raw material. Another significant benefit is as a raw material for ethanol, the type of alcohol often found in alcoholic beverages. To produce ethanol is need to do dry maize or wet maize milling. It also produces other by-products, such as *distillers' dried grains with solubles* (DDGS) which are useful as animal feed [14]. Maize is still the prima donna because many countries,

like Indonesia, use maize as a staple food instead of consuming rice. Lesotho, Malawi, Zambia, and Zimbabwe are the countries that have the highest maize consumption rates on the African continent. Lesotho recorded maize consumption of 328 g/person/day. While the people of Malawi consume maize at 293 g/person/day, Zambia consumes 243 g/person/day, and Zimbabwe consumes maize at 241 g/person/day. These data show that these countries depend on maize as a staple food.

As the country with the largest area in Southeast Asia, Indonesia has a high potential for maize production. Maize production continues to increase, making maize a food-crop commodity with great potential in the future, both for domestic and international maize needs. In 2018 Indonesia produced 30.2 million tons of maize and exported 372,000 tons of maize in the same year. However, on the other hand, Indonesia is still importing maize which can be a challenge for Indonesia to develop maize as an export commodity. In addition to meeting the needs of animal feed, maize imports are carried out because there is a striking disparity between domestic and international prices. The average selling price of Indonesian maize in 2014 was IDR 2,700/kg, while the world maize price in May 2014 was IDR 2,173/kg. These data show that domestic maize prices are more expensive than international prices, so Indonesian maize prices cannot compete in the international market. The increase in domestic maize prices results from rising input prices and increasing production costs. This situation causes farmers to allegedly prefer to import maize to meet animal feed needs because the price is lower [7]. Indonesian maize products for export are generally still in the form of primary goods or raw materials. This condition causes Indonesia's maize exports vulnerable to price fluctuations compared to other ASEAN countries, such as Singapore, Malaysia, and Thailand, which have produced downstream products that are more competitive than primary products.

An overview of the value chain shows the potential for maize development in Sigi. There are still opportunities for the current maize market needs. The market needs such as requests from PT. JAFPA Comfeed, which is still relatively large. The problems faced by farmers can be described in Fig. 4.

The main problem faced by farmers is that productivity is still low compared to the productivity of similar commodities both at the national level and the world. However, maize productivity in Sigi has increased (especially since 2016, most farmers (63.33%) also said that their productivity is better than the previous year. Currently, maize productivity in Sigi is 3.25 tons/ha, which is still below the national maize productivity of 5.52 tons/ha (Pusdatin, 2018). This data means that maize productivity is only about 50% of national productivity. Meanwhile, farmers say that their production has increased due to good care and fertilization, while farmers who experienced a decline in production said that the long dry season caused the growth of their maize crops to be disrupted.

The problems faced by farmers through other actors are collectors, wholesalers, and PT. JAFPA Comfeed. Collectors create debt dependence, and wholesalers buy at low prices while access to PT. JAFPA is constrained due to the distance and low production volume, which causes high shipping costs. The products produced by farmers are highly dependent on the company's industrial ability to absorb the current results. So far, all maize products have been absorbed by collectors and traders. However, not all maize can be absorbed by the company due to special requirements and criteria, including the existing moisture content. However, maize that does not go to the company can still

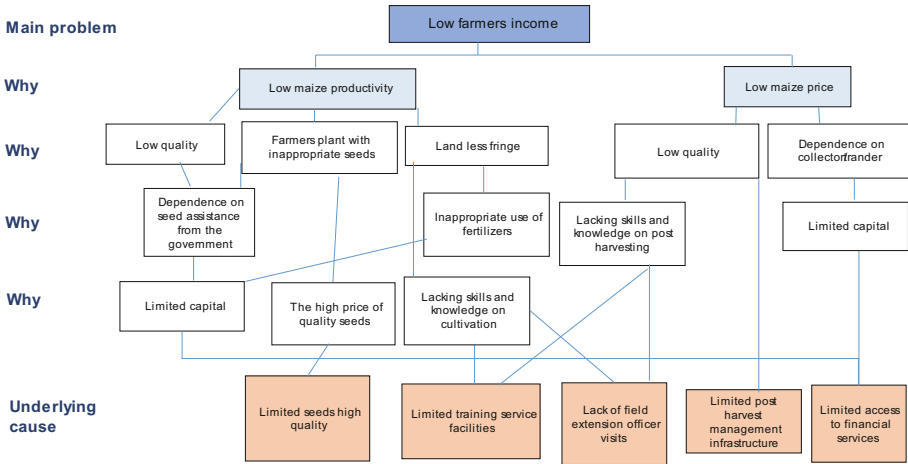


Fig. 4. Problems and Causes of maize Commodity Problems. Source: Analysis of primary data, 2021

be sold to local farmers. The fundamental weakness in the existing value chain is the dependence on one big company to absorb all the existing maize products.

3.4 Strategy for Strengthening Farmers and Development of Maize Commodities

There is potential to expand maize production and productivity in Sigi to meet market needs (See Fig. 5). Demand for maize products is projected to continue to grow in line with population and income growth in Indonesia. National production is currently insufficient to meet industrial demand, and domestic demand for industrial needs is also increasing. PT JAFPA Comfeed also still needs maize supplies from farmers. However, there are some weaknesses in farmers and threats to the sustainability of maize commodity cultivation. The main weakness is related to cultivation, which significantly increases productivity. In addition, the bargaining power of farmers is low, especially in determining the price of maize. The significant threat to maize cultivation is that there are only off-takers in Sigi. It is risky if PT JAFPA Comfeed stops its purchasing and operations in Sigi. Other threats are pests, climate change, and weather, which can hamper the growth and productivity of maize [16].

The vision of change offered is more focused on efforts to increase productivity and improve prices at the farm level, as described in the previous section. Vision changes can be made in the main chain, supporting services, or the existing policy environment. The vision of changing the maize commodity can be formulated as follows: Increasing the income of maize farmers through increasing productivity and improving prices at the farm level. At the level of supporting services and a conducive environment, a). They are increasing the capacity of field extension officers to provide GAP services to their member farmers, b). Ease of access to financial institutions to reduce dependence on collectors/traders c). Development of alternative maize markets to reduce dependence on one company, d). Anticipate climate change and disasters to reduce the failure of maize cultivation.

INTERNAL	EKSTERNAL
<p style="text-align: center;">Strengths</p> <ul style="list-style-type: none"> • Farmers have enough land to produce • Experience in maize cultivation 	<p style="text-align: center;">Opportunities</p> <ul style="list-style-type: none"> • JAFPA Comfeed, as an off-taker from maize, can still accept whatever production is produced as long as it is according to the standard. • World and national demand for maize continue to increase. • Support from government programs is a lot. • Maize farming production facilities are widely available and affordable.
<p style="text-align: center;">Weaknesses</p> <ul style="list-style-type: none"> • Some farmers have no experience growing corn because they are forced to change their commodity from their previous commodity (rice and cacao) due to the disaster. • Heavy dependence on collectors/traders • Bargaining power of farmers in determining low prices • Limited facilities/equipment for drying that are adequate so that the quality of corn is still not optimal to meet market standards 	<p style="text-align: center;">threats</p> <ul style="list-style-type: none"> • The threat of fungus and aflatoxin will reduce the quality of maize • There are still many irrigation infrastructures that have not been repaired after the disaster. • There is only one corn off-taker, so it is risky if the off-taker does not buy or leave Sigi. • Climate change and disasters

Fig. 5. SWOT Analysis of Maize commodities in Sigi District. Source: Analysis of primary data, 2021

To increase the potential of maize in Sigi by increasing the market service function. The ideas of several interventions are 1- Increasing the productivity of maize farmers through improving GAP. 2- Easy access of farmers to financial institutions reduces their dependence on collectors/traders. 3- Development of alternative maize markets to reduce dependence on one company. 4- Anticipate climate change and disasters to reduce the failure of maize cultivation by implementing climate-smart agriculture.

4 Conclusion

The study used chain analysis to map the problems faced by maize farmers. This study found that most maize farmers were affected by the 2018 Sulawesi Earthquake and Tsunami. However, on the other hand, there are indications that maize farmers are also increasing due to changes in crop commodities from rice to maize because of damage to rice fields and irrigation networks. The problem maize farmers face in the Sigi district is low productivity compared to the productivity of similar commodities at the national and world levels. The problems faced by farmers through other actors are collectors, wholesalers, and PT. JAFPA Comfeed. Collectors create debt dependence, and wholesalers buy at low prices while access to PT. JAPFA is constrained by the distance and low production volume, which causes high shipping costs. The company cannot absorb all maize due to special requirements and criteria, including the existing moisture content. However, maize that does not go to the company can still be sold to local farmers. The fundamental weakness in the existing value chain is the dependence on one big company to absorb all the existing maize products.

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