

ASSESSMENT OF CLIMATE VULNERABILITY IN ORANGE FARMING SYSTEM IN BATOLA

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Abstract. The Siamese orange is a superior commodity because it has economic value and is specific to the characteristics of the tidal swamp agroecosystems. Uncertainty triggered by natural conditions and the market causes farmers to lose money, fail to harvest, and suffer, thus affecting the sustainability of their farming business. The final result of the farmer's business describes the magnitude of the Impact felt by the farmer and the farmer's ability to support the losses that can be experienced. This assessment aims to have a comprehensive CVA (Climate Vulnerability Assessment) for the primary commodities in 3 sub-districts in Batola (*Carbon, Mandasatana, and Marabahan*) and translate the results of activities with recommendations for these various districts. The research was conducted using survey methods, direct observations in the field, Focus Group Discussions, and in-depth interviews with respondents, namely farmers, traders, as well as community leaders and related agencies (Department of Food Crops and Horticulture (DTPH) and District Agricultural Extension Center) totaling 100 people. The DTPH of Batola Regency also collected secondary data. The data collected were analyzed descriptively. In the district of Cerbon (type A), the highest choice is citrus, then seasonal and mixed crops. The major decisions in the Mandastana sub-district (type B) are monoculture oranges, then seasonal crops, diverse crops, and Galam forest plants. In the Marabahan sub-district (type C), apart from citrus, oil palm and rubber have been developed as industrial support plants.

Keywords: CVA; Banjar siamese oranges; oil palm; lowland rice; vegetables

INTRODUCTION

For hundreds of years, oranges cultivation in swamps has long been known to local people, especially in South Kalimantan. The development of tidal land for agricultural land is faced with biophysical constraints. The land is marginal and very fragile/perishable. Tidal swamp farming developed by Banjar farmers in South Kalimantan has proven sustainable and stable over a long period (Qomariah et al., 2016). The success of managing this land follows the rhythm of nature or adapts to natural conditions and considers social and economic aspects (Abdurachman & Ananto, 2000).

Cultivation of Siamese oranges in swamps can be done with a stretch system (paddy field), but generally with a system end (mound) or gradual *surjan* (system dressing). Gradually, farmers make supports in their paddy fields (Sudana, 2005). This system support is recommended only for swamps with mineral or peat soil types but also begins to propagate into peatlands of various thicknesses from shallow to medium. The shape of the support is generally rectangular, with a height of 60-75 cm and a side width of between 2-3 meters. Spacing between plants in rows 4-6 meters. The distance between rows is 10-14 meters depending on the area of land and the operational capability of the tractor in tilling the soil for rice plants. If the choice of land arrangement with a *surjan* system is required, a control channel on one side with a width of 1.0 meters and a depth of 0.6 meters for easy drainage of water out and also equipped with a dam overflow

system.

Siamese oranges from tidal lands have good quality with a distinctive sweet taste, but not all crops produce good fruit quality. Oranges fruit yields in tidal land type A have a sweeter taste than type B or C (Noorginayuwati & Noor, n.d.).

All agricultural activities that depress the environment have caused significant changes in the micro, meso, and even microclimates. In turn, climate change returns to its deleterious effects on commodity productivity and suitability in a region (Panjaitan et al., 2016). Climate change has brought challenges to commodities and local communities (Van Aalst et al., 2008). Today, climate change has significant implications for the future of commodity production and people's livelihoods in many parts of Indonesia, including South Kalimantan (Munadi, 2021). Rainfall variability and other extreme weather/climate events continue to affect several aspects of district areas in South Kalimantan due to increased temperature and rainfall variability and the potential to exacerbate environmental degradation in commodity-producing areas. In addition, economic factors such as falling prices, inefficient supply chains have hit the commodity and farmer sectors in several districts to their lowest levels (Isakson, 2014).

A farmer dependent on a single commodity was the worst hit, as was the regional economy in the region. Market forces have directed farmers and their territories to a single commodity. Such a perspective must change with capacity building and a comprehensive assessment

of alternatives that can solve the problem. Based on the scenario above, building the resilience of palm oil and other crop production systems to withstand the negative impacts of climate change until productivity remains stable and increase socially, economically, and environmentally in the face of climate change is part of the agenda for increasing production with an Assessment approach. Climate Vulnerability Assessment (CVA). The CVA approach uses three factors: exposure to climate stressors, sensitivity to these stressors, and adaptive capacity to manage stressors.

METHODS

Time and Place

The location of the study was determined purposively, namely in the center of Siamese oranges development according to the type of tidal swampland, namely Barito Kuala Regency, South Kalimantan Province. Tidal type C in Marabahan sub-district (SP1 and SP2), type B in Mandastana sub-district (Karang Bunga and Karang Indah villages) and type A in Cerbon sub-district (Simpang Nungki village and Sungai Kambat).

Types and Sources of Data

The research was carried out using survey methods, FGD (Focus Group Discussion), interviews, and direct observations in the field. The data was dug in-depth (in-depth interview) to the research respondents, namely: oranges farmers, fruit traders, and related agencies (Department of Food Crops and Horticulture of Barito Kuala Regency,

Department of Agriculture of Food Crops and Horticulture of South Kalimantan Province, and BPP Carbon District Barito Kuala Regency). The number of respondents from the three sub-districts is 90 people, while the number of respondents from related agencies is 10 people, so the total respondents are 100 people. The data collected was then analyzed descriptively.

Oranges Production Data

Oranges production was obtained from the Department of Agriculture, Food Crops, and Horticulture 2015 – 2019.

Methods of Analysis

1. Orange Crop Yield

The Impact of climate variability on the growth and development of oranges was assessed through a qualitative approach on the correlation between characters' phenological plant and climatic conditions. The Impact on the results was calculated using regression analysis. The results were obtained from the average per tidal category (A, B, and C). The weight of the average result is $1/\sigma^2$, where σ^2 is the variance of results. Mean future yields are also estimated using the same equations as climate projections. The assumption is that the correlation between yields and climate variables remains the same for now and in the future (excluding technological developments in oranges cultivation).

2. Respondents

FGD participants came from several villages or specific to one village, depending on the scope of the

study to be carried out. Participants were separated into male and female discussion groups. Each discussion group consists of about 8-10 people. Participants in the discussion are farmers who understand the farming system and tree resilience to climate change in the study area. Leaders of farmer groups, independent extension farmers, collector farmers, traditional leaders, youth, village officials, and communities whose main livelihood is the agricultural sector are ideal participants.

3. Tools and materials

The tools and materials used in the group discussions are: a) 20-30 sheets

of A1-sized flipchart paper, b) Permanent markers, c) Colorful markers for drawing maps of the study area, d) Paper tape or double-sided tape, e) paper Meta plan and f) Table of discussion material.

RESULTS AND DISCUSSION

Oranges Farming System in x Sub-district

An extraordinary event (shock) that affects the productivity of the farming system and trees in Simpang Nungki Village, Carbon District, is presented in the following tabulation.

Table 1. Extraordinary events that affect the productivity of farming systems and trees in Simpang Nungki Village, Carbon District

Years	Extraordinary event category	Description
2008	Long drought/land fires	Many oranges plants died/drought
2010	Floods	Some rice plants, puso, and oranges died
2013	Floods	Many plants food crops failed, and production decreased
2014	tungro pest attack on rice plants	Many plants were attacked, production decreased up to 50%
2015	Land fires due to a prolonged drought	Many rice plants puso (\pm 50%) and oranges production decreased, and even oranges plants died
2016	Floods	Caprice production decreased and even crop failure, oranges production decreased by 50%
2018	Long Drought	Oranges and rice production decreased even up to 50%

2020	1) Heavy rain and strong winds in the dry season 2) The selling price of oranges is meager due to abundant harvests	1) Many rice plants are grown, the harvest will collapse/break (30% to 50%) due to heavy rain and wind n fast 2) People's purchasing power has decreased due to the Covid 19 pandemic.
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Source: Primary data processing results, 2020

From 2008 to 2020, extraordinary events were droughts, floods, pest attacks, and land fires resulting from the incident in

fallen plants, crop failure, puso, and death. The most common and essential farming systems are as follows (Kamaliah & Marlina, 2021).

Table 2. The most common and essential farming systems in Simpang Nungki Village

Type of Farming System	Cash-generating (Yes/No)	Order of generating highest cash- (1 highest)	benefits other (list code*)	Order of food source (1 highest)
Seasonal Crops				
Rice	Yes	2	1	1
Bananas	Yes	9	1	10
Cucumber Suri	Yes	6	1	11
Watermelon	Yes	7	1	13
Eggplant	Yes	8	1	12
Papaya	Yes	10	1	14
Lombok	Yes	5	1	15
Other vegetables (katuk leaves, long beans), celery)	No	-	1	2
Annual Plants Mixed				
<i>Rambutan</i>	No	-	1	3
<i>Kwesi</i>	No	-	1	4
Mango	No	-	1	5
<i>Nangka</i>	No	-	1	6
Guava	No	-	1	7
Avocado		-	1	8
<i>Ketapi</i>	No		1	9

Annual Plants monoculture	Yes	1	2	
Orange	Yes	4	-	
Rubber	Yes	3	-	
Palm				
Scrub/Sleeping Land (uncultivated)	-	-	-	-
Galam Forest		11	3	-

Source: Primary data processing results, 2020

Description *) 1=Source of food; 2=Drugs; 3=Building materials; 4=Energy; 5=Craft raw materials; 6=Aesthetics and culture; 7=Livestock; 8=Game animals;9=other

Based on Table 2 and Table 3, the most common and essential tree species, according to the importance of money-making and as a source of food, are obtained.

Table 3. Most common and important tree species in Simpang Nungki Village Carbon Sub-district

Tree Type	Earning money (Yes/No)	Order of earning money (1 highest)	Other benefits (code list *)	Order of food source (1 highest)
Type fruit trees				
1. Oranges	Yes	1	1	1
2. <i>Rambutan</i>	No		1	6
3. <i>Nangka</i>	No		1	2
4. <i>Kwesi</i>	No		1	5
5. <i>Ketapi</i>	No		1	4
6. Guava	No		1	3
7. Avocado	No		1	7
Types of trees Plantation				
1. oil palm	Yes	2	-	-
2. Rubber	Yes	3	-	-
type of forest trees				
Mangrove	None	-	-	-
Galam Forest	Yes	4	3	-

Source: Primary data processing results, 2020

Description: *) 1=Source of food; 2=Drugs; 3=Building materials; 4=Energy; 5=Craft raw materials; 6=Aesthetics and culture; 7=fodder; 8=Others.

Oranges plants, oil palm, rubber, and glam are the types of trees used because

they are the primary income earners, and glam forests are also used for other purposes. Only tree species used as food sources are oranges, jackfruit, guava, tapioca, *rambutan*, and avocado. Therefore, there are many options for farming systems that are applied, as presented in Table 4.

Table 4. Options for farming systems or tree species to be analyzed using the ranking method in Simpang Nungki Village, Carbon District

No	Options for farming systems or tree types	Notes/descriptions	Ranking
1.	Seasonal Crops	(rice, vegetables, watermelon, cucumber Suri, Lombok, papaya)	2
2.	Mixed crops	Fruits (<i>rambutan</i> , jackfruit, <i>kiwi</i> , tapioca, guava, avocado)	3
3.	Oranges	Monoculture	1

Source: Primary data processing results, 2020.

The highest choice for oranges and then crops annuals and mixed crops. In addition to money-producing plants, orange plants are also food crops and have other benefits. Oranges on type A overflow

land are sweeter than overflow types B and C. Surprise events (shock) that affect the productivity of farming systems and trees in Sungai Kambat Village, Carbon District are presented in the following tabulation.

Table 5. Extraordinary events affecting the productivity of farming systems and trees in Sungai Kambat Village, Carbon Sub-district

Year	Category of extraordinary events	Description
2000	Attack of the tungro pests on rice (Hamid & Nirwanto, 2012)	crops Decreased rice production
2011	Drought (Maarif, 2011)	Early dry season, abnormal/more high tides receding, low rainfall so that many oranges plants do not bear fruit, orange leaves wilt, many rice plants are puso
2017	Floods are pretty large for up to one week (Kakanga et al., 2017)v	Many newly planted oranges seedlings die

2018	Drought and land fires (Sutikno & Rinaldi, n.d.)	Low rainfall, rice fields even cracked - cracked, abnormal tides (river water recedes more), some oranges plants even die
2019	Drought	Deficient rainfall, rice, and oranges plants dry up, production declines
2020	The selling price of oranges is meager due to low purchasing power due to the Impact of the covid pandemic 19 (Azhari, 2021)	Orange harvest and very high production resulted in the selling price of oranges dropping to Rp 2.000/kg at farmer level

Source: Primary data processing results, 2020

Extraordinary events (shock) from 2000 to 2020 pest attacks, droughts, floods, oranges prices plummeted. Farming systems applied by farmers are as in Table 6.

Table 6. The most common and essential farming systems in Sungai Kambat Village, Carbon Sub-district

Type of Farming System	Generating cash (Yes/No)	Order of highest cash producer (1 highest)	Benefits other (code list*)	Order as food source (1 highest)
Seasonal Crops				
1. Rice	Yes	2	1	1
2. Vegetables (spinach, mustard greens, kale)	Yes	3	1	3
3. Bananas	Yes	4	1	4
Mixed Annual Crops				
1. <i>Kwesi</i>	No	-	1	10
2. Coconut	No	-	1	7
3. <i>Petai</i>	Yes	-	1	5
4. Guava	No	-	1	9
5. <i>Rambutan</i>	Yes	-	1	8
6. Mango	No	-	1	11
7. Jackfruit	No	-	1	6
Perennial Monoculture				
1. Oranges	Yes	1	1	2

Scrub/Sleeping Land (uncultivated)	-	-	-	-
Forest	-	-	-	-

Source: Primary data processing results, 2020

Description *) 1=Source of food; 2=Drugs; 3=Building materials; 4=Energy; 5=Craft raw materials; 6=Aesthetics and culture; 7=Livestock; 8=game; 9=others The choice of oranges crops is the priority, then rice, vegetables, and bananas are the money

earners. Rice became the first choice as a food source, then oranges, vegetables, bananas followed by other mixed crops.

The most common and essential tree species cultivated in Sungai Kambat village are presented in Table 7.

Table 7. The most common and important tree species in Sungai Kambat Village Carbon Sub-district

Tree Types	Earning money (Yes/No)	Order of generating money-(1 highest)	Other benefits (code list *)	Order as a food source (1 highest)
Type of Fruit Trees				
1. Orange	Yes	1	1	2
2. <i>Petai</i>	Yes	2	1	1
3. <i>Rambutan</i>	Yes	3	1	3
4. Coconut	No	-	1	4
5. <i>Kwesi</i>	No	-	1	7
6. Mango	No	-	1	8
7. Jackfruit	No	-	1	5
8. <i>Jambu</i>	No	-	1	6
Plantation tree species				
-	-	-	-	-
Forest tree species				
-	No	-	-	-

Source: Primary data processing results, 2020

Description *) 1=Source of food; 2=Drugs; 3=Building materials; 4=Energy; 5=Craft raw materials; 6=Aesthetics and culture; 7=fodder; 8= Others.

Oranges, *petai*, and *rambutan* are the options for earning money and are used as food sources. The highest sources of food

ingredients are *petai*, oranges, *rambutan*, coconut, jackfruit, guava, *kiwi*, and mango.

The more choices of valuable plants, the more choices of tree species in the farming system, as presented in Table 8.

Table 8. Table of options for farming systems or tree species to be analyzed using the ranking method in Sungai combat Village, Carbon District

No.	Options for farming systems or tree species	Notes/descriptions	Ranking
1.	Seasonal	RiceCrops	1
2.	greens	Mustard, spinach, kangkong	3
3.	oranges	Monoculture	2
4.	Mixed Crops	<i>Rambutan, petai, jackfruit, mango, guava, banana, kiwi, coconut</i>	4

Source: Primary data processing results, 2020

The most popular farming system options may be annuals, oranges, vegetables, and mixed crops dominated by horticultural crops other than oranges.

Oranges Farming System in Mandastana District (Tide and Low Type B)

Extraordinary events (shock) that affect the productivity of a farming system and trees in Karang Bunga Village, Mandastana District, are presented in Table 9.

Table 9. Extraordinary events that affect the productivity of farming systems and trees in Karang Bunga Village, Mandastana Subdistrict

Year	Category Extraordinary Event	Description
1997	Long drought more than 3 months	Seasonal crops (paddy, corn, and beans) failed to harvest. Many oranges plants died from drought
2005	Land fires due to a prolonged drought	Many oranges plants died
2015	Land fires due to a prolonged drought	Rice, corn and peanut crops failed to harvest, and production of oranges trees decreased, and even many burned to death
2016	Longer rainy season	Rice plants were abundant submerged/puso
2017	Attack of planthoppers on rice crops All rice	harvests failed
2018	Drought	Low rainfall, rice fields even cracked, tides were not expected (river water receded more) Oranges plants still dead TBM
2019	Drought	Rainfall is deficient, rice and oranges crops are drying up, rice and oranges production is declining
2020	Orange prices are dropping very cheap	Simultaneous harvest, abundant production, the condition of the covid 19

pandemic consumer purchasing power has decreased.

Source: Primary data processing results, 2020

From 1997 to 2020, extraordinary events that have an impact on farming systems and trees start with drought, land fires, wetness, pest attack, and price Oranges have fallen, which in addition to the decrease in purchasing power due to

Covid-19, the production of oranges is also massive, while the processing technology is still inadequate.

The most common and essential farming systems applied in Karang Bunga village are presented in Table 10.

Table 10. The most common and essential farming systems Karang Bunga Village, Mandastana District

Type of Farming System	Cash-generating (Yes/No)	generating order Highest cash- (1 highest)	Other benefits (code list*)	Order as food source (1 highest)
Annual Crops				
1. Rice	Yes	2	1	1
2. Long beans	Yes	3	1	8
3. Corn	Yes	4	1	3
4. Bananas	No	-	1	2
Mixed Annual Crops				
1. Jackfruit	No	-	1	5
2. <i>Rambutan</i>	No	-	1	6
3. Coconut	No	-	1	4
monoculture Annual Plant				
1. Orange	Yes	1	1	7
Scrub/Sleeping Land (uncultivated)				
	-	-	-	-
Forest				
1. Galam	-	-	9 (building material)	-

Source: Primary data processing results, 2020

Description *) 1=Source of food; 2=Drugs; 3=Building materials; 4=Energy; 5=Craft raw materials; 6=Aesthetics and culture; 7=Livestock; 8=game; 9=others

Oranges plants are the first choice compared to rice, long beans, and bananas because these farming systems generate the highest income apart from being used as a source of food. The highest food

sources are rice, bananas, corn, coconut, jackfruit, *rambutan*, oranges, and long beans. Oranges are little used as food because the absorption capacity outside the Batola area is enormous.

The selected farmers in Karang Bunga village are presented in Table 11. most common and essential tree species.

Table 11. The most common and important tree species in Karang Bunga Village, Mandastana Sub-district

Tree Type	Earning money (Yes/No)	Order of earning money (1 highest)	Other benefits (code list *)	Order as a food source (1 highest)
Fruit tree species				
1. Jackfruit	No			1
2. <i>Rambutan</i>	No			4
3. Banana	No			3
Tree species plantation				
1. Coconut	No	-		2
2. Oranges	Yes	1		5
Forest tree species				
1. Galam	No	-		-

Source: Primary data processing results, 2020

Description *) 1=Source of food; 2=Drugs; 3=Building materials; 4=Energy; 5=Craft raw materials; 6=Aesthetics and culture; 7=fodder; 8=Other

Types of cash-producing crops are the main reason for choosing oranges as the

primary commodity. The choice of food-producing crops such as jackfruit, coconut, banana, *rambutan*, and oranges. Many types of plants can create a more varied farming system to increase income, as presented in Table 12.

Table 12. Options for farming systems or tree species to be analyzed using the Karang Bunga ranking method, Mandastana District

No	Options for farming systems or types Trees	Notes/descriptions	Ranking
1.	Seasonal Crops	Rice, Long Beans, Corn	2
2.	Oranges	Monoculture	1
3.	Mixed Crops	Banana, Coconut, Jackfruit, <i>Rambutan</i>	3
4.	Forest	Galam	4

Source: Primary data processing results, 2020

Oranges crops are monoculture as the primary choice, and then a farming system is also selected annual crops, mixed crops, and natural forests. Extraordinary events

that affect the productivity of farming systems and tree species in Karang Indah Village, Mandastana District, are presented in Table 13.

Table 13. Extraordinary events that affect the productivity of farming systems and trees in Karang Indah Village, Mandastana District

Year	Extraordinary events category	Description
1997	Long drought more than 3 months	Many oranges plants died from drought
2005	Land fires due to a prolonged drought	Many oranges plants died
2015	Land fires due to a prolonged drought	Rice crops failed to produce, and oranges crops decreased production, and even many burned to death
2016	Longer rainy season	Crops lots of rice submerged/pusoPlanthopper
2017	attack on rice	Paddy harvest failure
2018	Drought	Rice production decreased Many oranges plants still died, oranges production decreased
2019	Drought	rice production decreased Many TBM oranges plants died Orange production decreased
2020	Oranges prices fell very low h	Simultaneous harvests, abundant production, the COVID-19 pandemic conditions decreased consumer purchasing power.

Source: Primary data processing results, 2020

Extraordinary events (shock) from 1997 to 2020 that impacted the productivity of farming systems and trees were drought, fire, rainy season, drought, and the price of

oranges low. The most common and essential farming systems applied and vary widely in Karang Indah Village are presented in Table 14.

Table 14. The most common and vital farming systems in Karang Indah Village, Mandastana District

Type of Farming System	Cash-generating (Yes/No)	Order of earning money highest cash (1 highest)	Other benefits (code list*)	Order as a food source (1 highest)
Annual Crops				
1. Rice	Yes	2	1	1
2. Cassava	No	-	1	2
3. Eggplant	Yes	4	1	6

4. Lombok	Yes	3	1	5
5. Long beans	No			4
6. Banana	No	-	1	3
Year Plant Mixed				
1. <i>Rambutan</i>	No	-	1	11
2. Mango	No	-	1	10
3. Guava	No	-	1	9
4. Jackfruit	No	-	1	7
Plants				
Thanmonoculture	Yes	1	1	8
1. Orange				
Scrub/Sleeping Land (uncultivated)				
	-	-	-	-
Forest				
1. Galam	No	-	9(building material)	-

Source: Primary data processing results, 2020

Description *) 1=Source of food; 2=Drugs; 3=Building materials; 4=Energy; 5=Craft raw materials; 6=Aesthetics and culture; 7=Livestock; 8=game; 9=others

Some annual crops such as rice, eggplant, and Lombok, perennial oranges monoculture as the highest choice, are an option because they generate money and other benefits. As a food source, rice is the

primary choice. Cassava, banana, long beans, Lombok, eggplant, jackfruit, oranges, guava, manga, and *rambutan*, are many diversified choices to improve a better life.

The types of trees that are commonly cultivated and important by farmers in Karang Indah village are presented in Table 15.

Table 15. The most common and important tree species in Karang Indah Village, Mandastana Sub-district

Tree Types	Earning Money (Yes/No)	Order of earning money (1 highest)	Other benefits (code list *)	Order as a food source (1 highest)
Type of fruit tree				
1. Mango	No		1	5
2. <i>Rambutan</i>	No		1	6
3. Jackfruit	No		1	2
4. Guava	No		1	3
5. Banana	No		1	1
Tree species plantation				
1. Oranges	Yes	1	1	4
Types of forest trees				
	-	-	-	-

Source: Primary data processing results, 2020

Description *) 1=Source of food; 2=Drugs; 3=Building materials; 4=Energy; 5=Craft raw materials; 6=Aesthetics and culture; 7=fodder; 8= Others.

Options for farming systems of tree species based on the degree of importance using the rankings as listed in Table 16.

Table 16. Options for farming systems or tree species to be analyzed using the ranking method Karang Indah, Mandastana District

No	Options for farming systems or species Trees	Notes/descriptions	Ranking
1.	Seasonal	Rice, Cassava, Peanut, Lombok, Eggplant	2
2.	monoculture	Oranges	1
3.	Mixed Plants of	Jackfruit, <i>Rambutan</i> , Mango, Banana	3
4.	Forest	Galam	4

Source: Primary data processing results, 2020

Plants Oranges crops are monoculture as the primary choice then annual crops, mixed crops, and natural forest plants.

Oranges Farming System in Marabahan Subdistrict (Tide and Retreat Type C)

Extraordinary events that affect the productivity of farming systems and trees in Sido Makmur Village (SP1) are presented in Table 17.

Table 17. Extraordinary events affecting the productivity of farming systems and trees in Sido Makmur Village, Marabahan Subdistrict

Year	Category of the extraordinary event	Description
2005	The prolonged drought and land fires	Vegetable and oranges production decreased
2007	Long drought	Vegetable and oranges production decreased
2016	Long drought	Production of vegetables, oranges, rubber, and oil palm decreased even oranges plants died
2019	Long drought	Oranges, rubber, and palm oil production declines
2019	Orange prices plummet.	Simultaneous oranges harvest and abundant production. Due to the COVID-19 pandemic, consumer purchasing power has decreased.

Source: Primary data processing results, 2020

An extraordinary event that occurred during the period from 2005 to 2019 was the drought, and the price of oranges plummeted due to simultaneous harvests

and weak purchasing power due to covid 19. This region has varied options to anticipate extreme climate events, which occur and repeat, as presented in Table 18.

Table 18. List of the most common and vital farming systems in Sido Makmur Village, Marabahan Sub-district

Type of Farming System	Cash-generating (Yes/No)	Order of highest cash-generating (1 highest)	Benefit other (list code*)	Order as a food source (1 highest)
Seasonal Crops				
1. Lombok	Yes	4	1	12
2. Long beans	Yes	8	1	5
3. Spinach	Yes	9	1	6
4. Eggplant	Yes	10	1	7
5. Mustard	Yes	11	1	8
Greens	No	-	1	4
6. Cassava	Yes	5	1	13
7. Melon	Yes	6	1	11
8. Tomato	Yes	7	1	9
9. Cucumber				
Mixed Annual Plants				
1. Mango	No	-	1	14
2. <i>Rambutan</i>	No	-	1	15
3. Banana	No	-	1	1
4. Coconut	No	-	1	10
5. Jackfruit	No	-	1	2
6. Petai	Yes	12	1	16
7. Papaya	No	-	1	3
Monoculture				
Perennial Plant	Yes	1	9	17
1. Orange	Yes	3	(industry)	-
2. Rubber	Yes	2	9	-
3. Oil Palm			(industry)	
Scrub/Sleeping Land (uncultivated)	-	-	-	-
Galam Forest	No	-	9 (building)	-

Source: Primary data processing results, 2020

Description *) 1=Source of food; 2=Drugs; 3=Building materials; 4=Energy; 5=Craft raw materials; 6=Aesthetics and culture; 7=Livestock; 8=game; 9=other

The most common and essential tree species cultivated by farmers in Sido Makmur village are presented in Table 19.

Table 19. Most common and important tree species in Sido Makmur Village, Marabahan Sub-district

Tree Type	Generate money (Yes/No)	Order of earning money (1 highest)	Other benefits (code list *)	Order as a food source (1 highest)
Types of Fruit Trees				
1. Jackfruit	No	-	1	2

2. Mango	No	-	1	5
3. <i>Rambutan</i>	No	-	1	6
4. Coconut	No	-	1	4
5. Petai	Yes	5	1	7
6. Banana	No	-	1	1
7. Papaya	No	-	1	3
Tree species plantation				
1. Oranges	Yes	1	1	8
2. Rubber	Yes	3	9 (industry)	-
3. Palm Oil	Yes	2	9 (industry)	-
Forest tree species				
Galam	No	-	9 (building)	-

Source: Primary data processing results, 2020

Description *) 1=Source of food; 2=Drugs; 3=Building materials; 4=Energy; 5=Craft raw materials; 6=Aesthetics and culture; 7=Livestock; 8=Game animal; 9=others

Oranges plants are still the prima donna of choice other than oil palm,

rubber, and petai because they provide high yields in addition to other benefits. Rubber oil palm plantations are natural also being developed for industrial purposes. (Reuther, 1967) Therefore, the options for farming systems or tree species become more varied, as presented in Table 21.

Table 20. Table of options for farming systems or tree species to be analyzed using the ranking method in Sido Makmur Village, Marabahan Subdistrict

No	Options for farming systems or tree species	Notes /description	Ranking
1.	Vegetables	Lombok, Long Beans, Spinach, Eggplant, Mustard Greens, Cassava, Melon, Tomato, Cucumber	2
2.	Plantation	Oranges	1
3.	Monoculture	Rubber	4
4.	Monoculture	Oil Palm	3
5.	Mixed	Petai, Jackfruit, Banana, mango, coconut, <i>rambutan</i> , papaya,	5

Source: Primary data processing results, 2020

Primadonna oranges plants began to be followed by other annual crops such as oil palm and rubber, after vegetable crops followed by mixed crops such as petai, jackfruit, banana, mango, coconut, *rambutan*, and papaya.

Extraordinary events (shock) that impact the farming system's productivity in Suka Maju Village (SP 2), Marabahan Subdistrict, and the trees are shown in Table 21.

Table 21. Extraordinary events that affect the productivity of farming systems and trees in Karya Maju Village, Marabahan Subdistrict

Year	Extraordinary event category	Description
2005	The prolonged	is very little rain, so land fires occur. Production of

	drought and land fires There	vegetables and oranges declines
2007	Long drought	The rainy season shifts, rainfall is very little. Production of vegetables and oranges decreased
2016	Long drought	Production of vegetables, oranges, and rubber decreased. Even rubber and oranges plants died.
2017	Long drought	Entering the rainy season but very little rainfall, production of vegetables, oranges, and rubber decreases
2019	Long drought	Production of vegetables, oranges, and rubber decreases
2019	Prices of oranges drop	Simultaneous harvest of oranges and abundant production. Due to the COVID-19 pandemic, consumer purchasing power has decreased.

Source: Primary data processing results, 2020

An extreme event from 2005 to 2019 was a long drought, and the price of oranges plummeted. Many choices of commodities and farming systems that are commonly cultivated are shown in Table 22.

Table 22. List of the most common and essential farming systems in Karya Maju Village, Marabahan Subdistrict

Type of Farming System	Cash-generating (Yes/No)	Order of highest cash-generating (1st) highest	Other benefits (code list*)	Order as a food source (1 highest)
Seasonal Crops				
1. Lombok	Yes	2	1	14
2. Cassava	Yes	4	1	7
3. Spinach	Yes	7	1	10
4. Kangkung	Yes	8	1	9
5. Tomato	Yes	5	1	11
6. Long beans	Yes	9	1	8
Mixed Annual Plants				
1. Petai	Yes	6	1	13
2. Mango	No	-	1	4
3. Rambutan	No	-	1	12
4. Guava	No	-	1	5
5. Papaya	No	-	1	3
6. Banana	No	-	1	1
7. Coconut	No	-	1	2
8. Soursop	No	-	1	6
Monoculture Perennial Plants				
1. Orange	Yes	3	9 (industry)	-
2. Rubber	Yes	1	1	15
Scrub/Sleeping Land (uncultivated)	-	-	-	-
Galam Forest	No	-	9 (building)	-

Source: Primary data processing results, 2020

Description *) 1=Source of food; 2=Drugs; 3=Building materials; 4=Energy; 5=Craft raw materials; 6=Aesthetics and culture; 7=Livestock; 8=game; 9=other

The most common and essential tree species cultivated by farmers in Karya Maju village are presented in Table 23.

Table 23. Most common and important tree species in Karya Maju Village, Marabahan Sub-district

Tree Type	Earning money (Yes/No)	Order of producers money (1 being the highest)	other benefits (register code *)	Order as a source of food (1 being the highest)
type fruit trees				
1. Petai	Yes	3	1	7
2. Mango	No	-	1	4
3. <i>Rambutan</i>	No	-	1	6
4. Guava	No	-	1	5
5. Papaya	No	-	1	3
6. Banana	No	-	1	1
7. Coconut	No	-	1	2
Tree species plantation				
1. Orange	Yes	1	1	8
2. Rubber	Yes	2	9 (industrial)	-
forest tree species				
1. Galam	No	-	9 (building)	-

Source: Primary data processing results, 2020

Description *) 1=Source of food; 2=Drugs; 3=Building materials; 4=Energy; 5=Craft raw materials; 6=Aesthetics and culture; 7=Livestock; 8=game; 9=other

Some options for farming systems or tree species that farmers in Karya Maju village have applied are as shown in Table 24 below.

Table 24. Farming system options or tree species to be analyzed using the ranking method in Karya Maju Village, Marabahan Sub-district

No	Farming system options or tree species	Note/description	Ranking
1.	Vegetables	Lombok, Cassava, Spinach, Kangkung, Tomato, Long Beans	3
2.	plant monoculture	orange	1
3.	monoculture plant	rubber	2
4.	mix plants	petai, mango, <i>rambutan</i> , guava, papaya, banana, coconut,	4

Source: Primary data processing results, 2020

Orange monoculture farming became the primary choice of rubber plants, vegetable plants, and plant mix. Plantation

and horticultural crops have better potential to be developed in Batola Regency than food crops.

CONCLUSIONS

Citrus plants grown on all types of land in the Batola Regency are very resistant to exposure to climate stressors, namely drought and flood disasters and attacks by plant-disturbing organisms. In addition, citrus plants also remain a commodity that farmers rely on as the primary source of family income despite the decline in the selling price of oranges in the market. This proves that citrus plants are highly adaptive to climate change conditions. In the district of Cerbon (tidal type A), the highest choice is citrus plants, then seasonal crops and mixed crops. In addition to money-producing plants, Citrus plants are also food crops and have other benefits. The primary choice is monoculture citrus in the Mandastana sub-district (tidal type B). Citrus plants in monoculture are the leading choice, then annual crops, mixed crops, and natural forest plants. In the Marabahan sub-district (tidal type C), apart from citrus, oil palm and rubber plantations have been developed as industrial support plants.

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