Ekonomi dan Bisnis
Vol.12, No.1, 2025, 59-87
DOI: 10.35590/jeb.v12i1.10285
P-ISSN 2356-0282 | E-ISSN 2684-7582

Received : 03 January 2025
Revised : 11 June 2025
Accepted : 30 July 2025

Assessment of Adaptive Capacity for Climate Change in Indonesia to Maintain Food Security

Matthew Rafael Rajagukguk[1*)] and Indri Arrafi Juliannisa[2]
2110115079@mahasiswa.upnvj.ac.id[1]; indri.arrafi@upnvj.ac.id[2]
Universitas Pembangunan Nasional "Veteran" Jakarta, Indonesia[1,2]

Abstrak

- **Tujuan:** Penelitian ini bertujuan untuk menganalisis dan memeringkat faktor-faktor yang mempengaruhi ketahanan pangan di Indonesia dalam menghadapi perubahan iklim, dengan menekankan peran perubahan suhu, kekeringan dan kebakaran lahan, polusi, banjir, lahan sawah irigasi, jumlah petani, PDRB pertanian, dan jumlah pasar.
- **Desain/metodologi/pendekatan:** Studi ini menggunakan metode Multi Criteria Decision Making (MCDM) dengan pendekatan Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) yang diterapkan pada data 34 provinsi di Indonesia.
- **Temuan**: Hasil analisis menunjukkan 17 provinsi memiliki nilai Phi positif yang menandakan ketahanan pangan relatif lebih baik, sementara 17 provinsi lainnya dengan nilai Phi negatif menunjukkan kerentanan lebih tinggi terhadap perubahan iklim.
- **Batasan penelitian/dampak:** Penelitian ini terbatas pada pemilihan variabel dan ketersediaan data sekunder, sehingga faktor eksternal seperti kebijakan pemerintah, kondisi geopolitik, atau dinamika pasar global belum dianalisis. Hal ini membuka peluang untuk penelitian lanjutan dengan menambahkan variabel baru atau menerapkan model di tingkat kabupaten/kota.
- **Implikasi praktis:** Hasil pemeringkatan provinsi dapat digunakan oleh pembuat kebijakan, praktisi, dan pemangku kepentingan untuk merancang strategi peningkatan ketahanan pangan yang adaptif terhadap perubahan iklim serta menentukan prioritas intervensi dan alokasi sumber daya.
- **Keaslian/nilai**: Kontribusi penelitian ini terletak pada penerapan metode PROMETHEE dalam analisis ketahanan pangan di Indonesia, yang menegaskan nilai kebaruan serta relevansinya dalam mendukung pencapaian ketahanan pangan nasional yang berkelanjutan.
- **Jenis makalah:** Makalah penelitian.

Kata Kunci: Ketahanan Pangan, *Adaptive Capacity*, Perubahan Iklim, PROMETHEE.

Cite This As: Rajagukguk M.R. & Juliannisa, I. A. 2025. Assessment of Adaptive Capacity for Climate Change in Indonesia to Maintain Food Security. *Ekonomi dan Bisnis*, 12(1), 59-87. doi.org/10.35590/jeb.v12i1.10285

Abstract

- ***Purpose:** This study aims to analyze and rank the factors influencing food security in Indonesia under climate change, focusing on the role of variables such as temperature change, drought and land fires, pollution, floods, irrigated rice fields, number of farmers, agricultural GRDP, and number of markets.*
- ***Design/methodology/approach:** The research employs the Multi Criteria Decision Making (MCDM) method using the Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE), applied to data from 34 provinces in Indonesia.*
- ***Findings:** The results indicate that 17 provinces have positive Phi values, reflecting relatively higher food security, while the other 17 provinces with negative Phi values show greater vulnerability to climate change.*
- ***Research limitations/implications:** The study is limited by the selected variables and secondary data availability, excluding external factors such as government policies, geopolitical conditions, and global market dynamics. This opens opportunities for future research to add new variables or apply the model at the district or city level.*
- ***Practical implications:** The provincial rankings provide a basis for policymakers, practitioners, and stakeholders in designing adaptive strategies to strengthen food security and prioritize interventions and resource allocation.*
- ***Originality/value:** The originality of this study lies in the application of the PROMETHEE method in analyzing food security in Indonesia, highlighting its novelty and importance in supporting sustainable national food security.*
- ***Paper type:** Research paper**.***

***Keywords**: Food Security, Adaptive Capacity, Climate Change, PROMETHEE.*

Introduction

Climate change is one of the factors contributing to food security vulnerability in Indonesia. Therefore, this study aims to identify the impact of climate change on food security in Indonesia. Climate change is a significant change that occurs over a period of time, which includes drastic changes in temperature, rainfall and wind patterns. The threat of climate change to food security is very serious as it can affect food availability, access and quality (Environmental Protection Agency, 2017). Climate change around the world has a very important influence on feed production. Universally, climate change is anticipated to reduce food crop production, especially in rural areas located in the lowlands will experience negative impacts (Perdinan, Atmaja, & Adi, 2019) Climate change has affected food availability with rising temperatures and changing rainfall patterns altering crop yields. In addition, extreme weather events such as temperature-induced droughts, floods and heatwaves are becoming more frequent, further impacting food production. Climate change also impacts food quality, as rising temperatures and changes in water availability can lead to lower nutrient levels in food (Sugianto, 2023).

In the agricultural sector, climate change is causing extreme weather changes such as prolonged droughts, unpredictable rainfall, and increased temperatures that impact crop productivity. Most farmers rely on a stable climate to grow their crops, so when the climate is unstable or extreme changes occur, it has a devastating impact on farmers. In the long run, this will affect food availability which leads to food security in a region (Pardosi, Damayanti, Devi, & Sumedi, 2020). Thus, an adaptive capacity assessment is needed, which will affect climate change. Adaptive capacity is the ability of individuals, communities or systems to adjust to change, including risks or opportunities, so that negative impacts are minimized and benefits are maximized. In the context of climate change, adaptive capacity includes the ability to cope with, respond to, and recover from impacts such as rising temperatures, floods, droughts, or shifting weather patterns (Purifyningtyas & Wijaya, 2016). This relates to one of the goals of the Sustainable Development Goal (SDGs), which is to end hunger, achieve food security and improved nutrition and promote sustainable agriculture (Vioni Nurhaliza, et al., 2023). With this goal in the SDGs, it can be said that hunger, food security and improved nutrition are still problems that the world is concerned about. Because it cannot be denied, many countries are still difficult to deal with this case. This problem occurs especially in small countries with low per capita income and insufficient resources. Although Indonesia is a fairly large country and its per capita income is not so small or poor, solving this problem must be a goal for a country to get better.

Food security is one of the most important issues related to climate change. When food production is disrupted due to weather changes, the imbalance between food demand and supply can cause prices to spike, leading to food crises, especially in developing countries (Vioni Nurhaliza, et al., 2023). Food price instability not only affects the welfare of people, especially low-income groups, but can also cause social and political instability. In the long term, food security threatened by climate change can hamper economic growth, exacerbate global poverty and reinforce cycles of poverty and vulnerability (Sugianto, 2023). Food security is an important issue for countries in the ASEAN region, given challenges such as climate change, population growth, and economic instability. The index provides an overview of how well countries in the region are able to ensure the availability, access and quality of food for their people.

Figure 1. Food Security Index (IKP) in 34 provinces in Indonesia in 2022

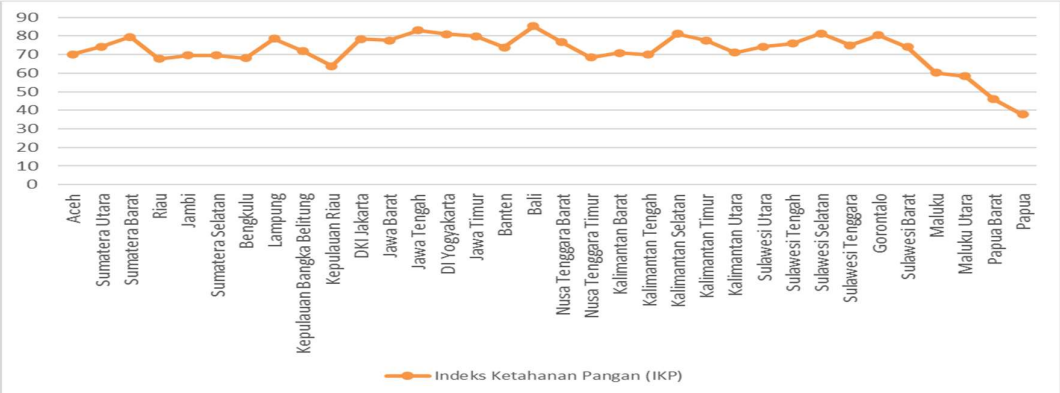


Figure 1 shows the achievement of the Food Security Index (IKP) in 34 provinces in Indonesia in 2022. With an average score of 72.06, Indonesia is in a fairly strong position in food security, but if we look deeper, there are still provinces with low food security conditions so that the IKP score is still below average. Bali is the province with the highest Food Security Index, while North Maluku, West Papua, and Papua are still ranked in the lowest 3 with vulnerable score status. The IKP score of provinces in Indonesia is still quite good with the dominating status of resistant and very resistant, but it does not mean that it is in a safe position, especially when compared to other countries (Badan Pangan Nasional, 2022).

According to Wahyuanto et al., 2024; Ruminta et al., 2020; Feifei Sun, et al., 2017; Gusti, et al., 2024; Increasing global temperatures have led to shifts in the growing season and changes in the growth cycle of wheat crops. Higher temperatures can accelerate plant growth, but also increase heat stress that can hinder development. In some areas, climate change is causing irregular rainfall. These changes in rainfall patterns greatly affect wheat crops, putting an area at risk of flooding or drought. One of the most noticeable natural problems is air pollution. Pollution in general can jeopardize the agricultural sector, and upset the harmony of food markets. Pollution can affect the quantity and quality of inputs in the food supply chain and thus indirectly affect food safety. In addition, changes in rainfall patterns make areas vulnerable to flooding or drought, damaging crops or food. Exceptional climate changes such as storms and droughts have an adverse effect on food security resulting in major financial misfortunes. Climate change also affects soil richness and the spread of pests and plant diseases, and ultimately crop productivity. There are also factors that have a positive impact on food security, namely land/farm irrigation, agricultural GRDP, farmers and markets. According to Zainuddin, 2021; Misran, 2014; Sri et al, 2020; Irrigation has had a positive impact on the expansion of rice planting areas, production and regional food security. Irrigation as an artificial application of water to crops for the purpose of food production and overcoming rainfall shortages and helping to stabilize agricultural production and productivity.

Food security is a very important condition because it serves to maintain national stability, the economy and people's welfare. Most importantly, it guarantees sufficient food availability for the entire population in Indonesia. With that said, there must be factors that affect food security, which in this case is climate change. Climate change plays an important role in ensuring and guaranteeing food security in Indonesia. From the background presented, there are many provinces that are still in a bad position. The level of adaptive capacity in each region of Indonesia to deal with this threat varies, influenced by factors such as access to technology, economic resources, education, and local policies. Therefore, an in-depth assessment of the extent to which the adaptive capacity of Indonesian regions is able to support food security amidst climate change is needed. This is due to climate change which includes several criteria. Changes in temperature, drought levels, flood levels, and air pollution negatively affect food security. Meanwhile, agricultural land irrigation, agricultural GRDP, the number of farmers, and the number of markets have a positive effect on food security. The existence of good and bad indicators can help identify by ranking which regions have food security that can survive when affected by climate change. This condition can be seen through the

criteria that are thought to be factors affecting food security in each province in 2021-2022. With this assessment, the ranking or outranking of each province can be determined. This analysis will assess whether climate change affects food security in all Indonesian provinces and how each region is able to maintain food security.

Literature review and hypothesis development

According to the Economic Theory of Food Security, it examines how financial frameworks, government approaches, and advertising conditions affect the accessibility, availability, and stability of food supply for the community. This theory is based on the guideline that food security is not merely about providing enough food, but how food can be obtained reasonably by all levels of society in the long run. One important aspect of this theory is the mediating role of the government in keeping food prices stable and reasonable, especially for powerless groups who have no right to control. In addition, the expansion of food sources and efforts to increase community efficiency are also part of the way to reduce dependence on food imports that can affect the health of national food security (Aldrianto, 2023). The economic theory of asset-based food security can be the main point of view of this system. It highlights the importance of beneficial factors such as agriculture, capital and skills to achieve food security. The social, financial and political components are not limited to climate change, struggles and food security, but have an impact on determining food security in a particular country or region (Aldrianto, 2023).

According to Robert Malthus, food is essential for survival, human appetite cannot be suppressed and population growth is much faster than food. Malthus' theory states that population growth follows geometric progression, while the increase in food availability follows arithmetic progression. In this case, the problem was that cities experienced explosive population growth that was not matched by a decrease in food availability. This unfavorable balance goes back to Malthus' theory. This theory, commonly called “Malthusian Theory”, has significant relevance to issues of food security and climate change. Although the theory prioritizes the context of population growth and natural resource availability, it is relevant to the issues raised. When we apply Malthusian theory to the context of climate change, we see that climate change can exacerbate the tension between population growth and food availability. Climate change can reduce agricultural productivity, leading to a decline in crop yields and food availability. This could exacerbate the food security problems predicted by Malthus, especially in regions already suffering from food scarcity (Kurniawan B., 2016).

Thus, in the context of climate change, Malthusian theory can provide a basis for considering potential risks related to food security and encourage efforts to improve food security through innovation, adaptation and appropriate policies (Kurniawan B., 2016). Population has a significant impact on food security. Population growth not only leads to an increase in food consumption, but also increases the number of people which can lead to a reduction in agricultural land. This is because, as the population increases, vacant land replaces paddy fields that are converted into residential areas, which has a positive impact on the increase in

residential areas. Malthus proposed a solution consisting of two main points, namely developing more land and encouraging agriculture wherever possible. If this method of combating food insecurity proved ineffective, another option would be to curb population growth. If there are no restrictions in place to curb population growth, then the population will suffer from food shortages and become the first step to poverty (Pieris, 2015).

Research Method

This research is using two method, which is *outranking* with PROMETHEE and ROC. ROC stands for Rank Order Centroid which is a method for obtaining the desired weighted results from rankings in a decision support system that is very easy to use. ROC emphasizes that the first criterion is more important than the second, the second is more important than the next, and so on. In the ROC method, each criterion is assigned a weight that is calculated based on the order or rank of the criteria. This ranking is usually obtained from the subjective preference or judgment of the decision maker (Farosa, Kasih, & Irawan, 2022).

This research will examine 34 Province in Indonesia using Multi Criteria Decision Making (MCDM) analysis technique with PROMETHEE software. PROMETHEE is a technique in multicriteria analysis that performs "outranking" based ranking based on a binary number system relationship between two alternatives. The superiority of this method is known for its efficient and easy concept, so it is widely applied, especially in the identification and evaluation of policies and decisions from best to worst (Fauzi, 2019).

PROMETHEE uses a decision matrix that contains alternatives or options and sustainability criteria that include social, environmental, and economic aspects. Once the decision matrix is compiled, researchers can apply the preference functions needed to conduct the analysis with the PROMETHEE method. The first stage in PROMETHEE is the determination of criteria, where in this study there are eight criteria with five criteria in maximum preference namely GRDP, investment, TPAK, HDI, inflation, and technology users and two criteria in minimum preference namely gini ratio and government spending. After the criteria are determined, the weights of the criteria will be inputted, and the third stage is the determination of the selected option (outranking) in this method which is calculated based on the value of Ø+ (a) which is referred to as outgoing flow and Ø- (a) or incoming flow, so that a value for netflow (Φ) will be obtained. The netflow value is obtained based on the equation, which is as follows:

$$\phi\,(a) = \phi\,+(a) - \phi\,-(a)$$

Figure 2. Netflow Value Equation

The third stage of the decision matrix requires precision in identifying "good indicators" that need to be optimized, such as agricultural GRDP, land irrigation,

number of farmers, and number of markets, and "bad indicators" that must be minimized, such as temperature changes, floods, droughts, and pollution.

Result and discussion

Table of Ranking Results

The resulting output can be used as a method for decision making in determining outranking and knowing which criteria affect the results obtained. Table results in this method can show the order or outranking of each province, where in determining the province with the highest to lowest order is influenced by the results of netflow (Φ) or Phi value, with the calculation that the Phi value closest to one, it will place the best position.

Table 1. Table of Ranking Provinces that are Adaptive to Climate Change in 2021 and 2022

Action	TAHUN 2021		TAHUN 2022		IKP
	Rank	Phi	Rank	Phi	
Aceh	21	-0,0261	21	-0,0226	70,16
Sumatera Utara	18	-0,0069	10	0,1046	74,3
Sumatera Barat	4	0,2581	3	0,3149	79,45
Riau	22	-0,0276	19	-0,0125	67,59
Jambi	13	0,0523	9	0,131	69,5
Sumatera Selatan	5	0,2506	16	0,0166	69,64
Bengkulu	17	0,0119	15	0,0318	67,99
Lampung	1	0,4274	8	0,1841	78,61
Kepulauan Bangka Belitung	30	-0,2586	32	-0,3707	71,71
Kepulauan Riau	33	-0,3632	12	0,06	63,83
DKI Jakarta	34	-0,4006	33	-0,3882	78,25
Jawa Barat	3	0,318	4	0,2984	77,55
Jawa Tengah	14	0,0336	14	0,0439	82,95
DI Yogyakarta	2	0,3213	2	0,3201	80,88
Jawa Timur	11	0,0855	11	0,0807	79,85
Banten	19	-0,0098	20	-0,0222	73,78
Bali	10	0,1297	7	0,2056	85,19
Nusa Tenggara Barat	7	0,1996	5	0,2599	76,58
Nusa Tenggara Timur	25	-0,1122	6	0,2068	68,42
Kalimantan Barat	15	0,0318	13	0,0523	70,81
Kalimantan Tengah	26	-0,1471	25	-0,1514	69,96
Kalimantan Selatan	12	0,0855	30	-0,1802	81,05
Kalimantan Timur	29	-0,2275	27	-0,1529	77,65
Kalimantan Utara	31	-0,3166	34	-0,4576	71,04

Action	TAHUN 2021		TAHUN 2022		IKP
	Rank	Phi	Rank	Phi	
Sulawesi Utara	23	-0,0422	18	-0,0121	74,3
Sulawesi Tengah	8	0,1986	23	-0,0695	75,92
Sulawesi Selatan	6	0,237	1	0,3222	81,38
Sulawesi Tenggara	9	0,1497	22	-0,0425	75,04
Gorontalo	20	-0,0253	29	-0,1624	80,35
Sulawesi Barat	24	-0,107	24	-0,0953	74,04
Maluku	27	-0,186	31	-0,1895	60,2
Maluku Utara	16	0,0136	26	-0,1526	58,39
Papua Barat	32	-0,3427	28	-0,1577	45,92
Papua	28	-0,2046	17	0,0068	37,8

Source: PROMETHEE Software, Data Processed (2024)

Based on the table above, it can be seen that the results of table visualization in the PROMETHEE method show a comparison of the results of the ranking of provinces that are adaptive to climate change in 2021 and 2022. Lampung Province is in first place with a Phi value of 0.4274 which then drops in 2022 to eighth place with a Phi value of 0.3222. Next is the province that ranks second in 2021, namely DI Yogyakarta province with a Phi value of 0.3213 which in 2022 remains in second place. Then finally, the third place is West Java province with a Phi value of 0.3180 which in 2022 decreases and ranks 4th. When compared to IKP data, Lampung is in a high position with 78.61%, DI Yogyakarta is in a medium position with 76.58% and West Java with 77.55%. This shows that the province contributes positively to the netflow score (Φ) with the criteria included being able to provide a high score in determining the outranking order (Fauzi, 2019).

The decline in Lampung province's ranking from first place in 2021 to eighth place in 2022 is certainly a phenomenon. This can also be seen through the drastically declining Phi value which is certainly caused by the existing criteria. The criteria that are the biggest impacts or problems in this province are temperature changes and pollution. Lampung experiences a drastic change in temperature from year to year, which certainly has an impact on the process and quality of food production produced. In addition, the pollution produced by Lampung province is certainly a very bad thing for the environment and the development of crops, plants and other food. There is also the influence of government policies that have not been optimal and maximized, namely policies regarding transportation. One of the causes of this policy is that the growth of motorized vehicles in Lampung is not matched by strict supervision of exhaust emissions so that the lack of emission testing policies on motorized vehicles exacerbates air pollution in urban areas such as Bandar Lampung. Thus, Lampung's adaptive level in dealing with climate change criteria decreased in 2022 (Wakhid, 2018).

The next province is DI Yogyakarta, which managed to stay in second place in 2021 and 2022. This condition goes hand in hand with the Phi value of DI Yogyakarta which is quite consistent each year, namely 0.3213 in 2021 and 0.3201 in 2022. This consistency can occur because there are only 2 criteria that are the weakness of this province, namely irrigated rice fields and a small agricultural

GRDP. One of the causes of agricultural GRDP in DI Yogyakarta is due to technological limitations that cause a lack of access to agricultural technology so that the resulting production is slow and not maximized. In addition, DI Yogyakarta still focuses on low-value commodities such as rice, corn, and cassava, while it should start focusing on high-value commodities such as horticulture and fruits. By doing so, the province's food production will be much better and increase agricultural GRDP. This can be seen more clearly later in the explanation of the Action Profile of each province which contains a calculation of which criteria are very influential on DI Yogyakarta (Ismiasih, Dinarti, & Adnanti, 2022).

The third place in 2021 is West Java province with a Phi value of 0.3180 and an IKP figure of 77.55% which is in the high group. Meanwhile, in 2022, West Java dropped one rank, namely in fourth place with a Phi value of 0.2984 and was replaced by West Sumatra province which in 2021 was also in fourth place. These two provinces are still in the top 5 throughout 2021-2022 which proves that this province is able to be adaptive in dealing with climate change criteria. The problem found in these two provinces is flooding, whose cases are increasing every year. When viewed in the data presented, West Java experienced an increase in flood cases by approximately 300%, from 72 cases to 258 cases. This is due in part to poor urban drainage planning, which results in dense areas such as Bandung, Bogor, and Bekasi often experiencing inundation or flooding after rainfall (Rizqullah, Feriska, & Tolani, 2023).

Based on the calculations that have been carried out, South Sulawesi is first in 2022 with a Phi value of 0.3222 which in 2021 is sixth with a Phi value of 0.2370. If you look at the existing criteria, South Sulawesi has succeeded in overcoming and overcoming the problem of minimum or negative criteria. One of the criteria that experienced a positive increase was in temperature change, which in 2021 this criterion was in a negative area while in 2022 this criterion was in a positive area. This can occur partly due to the application of renewable energy that focuses on the utilization of geothermal energy and the use of integrated hydropower (Adiyoga & Basuki, 2018). The increase that occurred in positive criteria also greatly helped improve South Sulawesi's position, namely in the criterion of the number of farmers. The number of farmers in South Sulawesi in 2021 was quite low compared to other leading provinces, namely only 91.61%, which managed to increase to 93.33% in 2022. Thus, South Sulawesi can be adaptive in dealing with climate change to achieve food security (Tenriawaru, Arsyad, Amiruddin, Viantika, & Meilani, 2021).

Food security ensures that everyone in a region has sufficient access to nutritious food to fulfill their daily needs, which in turn supports the efficiency and well-being of the community. In addition, regions with good food security are much better able to deal with external threats, such as climate change, natural failures and global economic disparities, which can disrupt food production and distribution. In this case, climate change is the highest stressor affecting food security and it can be seen through the ranking presented that even provinces that actually have low IKP values in this case are in positive Phi, which indicates that the positive preferences of an alternative are better and superior to other alternatives (Fauzi, 2019).

The province at the bottom of the calculation results in 2021 is DKI Jakarta province with a Phi value of -0.4006 which in 2022 also ranks in the bottom three, namely in the IKP position, DKI Jakarta is in the high group, namely in rank 10 with

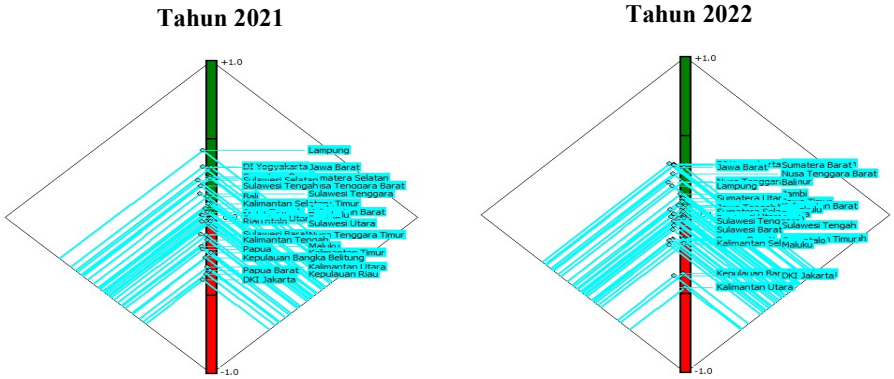
a figure of 78.25%. With DKI Jakarta in 2021 still being the capital of Indonesia, fundamentally, this province is already quite superior due to its position. This shows that DKI Jakarta is not dependent on the criteria listed alone as its IKP position still shows that the province can sustain its food. Other criteria such as imports, social & political conditions, geographical location, etc. also influence the province to achieve food security despite climate change (Fazri, Widodo, Ismawati, & Irawan, 2024).

Whereas in 2022, the lowest position or 34th was filled by the province of North Kalimantan with a Phi value of -0.4576 which in the previous year was ranked 31st with a Phi value of -0.3166. This figure has a gap that is quite far can occur due to the influence of criteria that experience quite drastic movements. The criteria that drastically affect the distance between the Phi values of this province are temperature changes, drought & land fires, and irrigated rice fields. These three criteria experience a movement that is still enough to affect the position of North Kalimantan. Temperature change and drought & land fires experienced a high increase. If seen in the available data, the temperature change that occurred in North Kalimantan reached 28.6 degrees Celsius in 2022 which was previously only at 27.4 degrees Celsius. This shows that North Kalimantan is in a vulnerable position to achieve food security. North Kalimantan faces great challenges in creating strong food security, given that the region is still in the development stage, especially in the agricultural sector. However, North Kalimantan has the potential to support national food security, especially with programs that focus on increasing rice production. This effort is particularly relevant given North Kalimantan's role as a buffer zone for the national capital, which requires food stability (Ronaldo & Syefani, 2023).

Diamond Visualization

Diamond visualization in PROMETHEE, can show that provinces with good food security conditions have positive Phi values close to one and are on the green color scale, while provinces with low food security conditions, include negative Phi values and are on the red color scale. For each province, a cone will be drawn from the action position in the plane, so that the cone will overlap with all other cones, which corresponds to the predefined criteria.

Figure 3. Diamond Visualization 2021 & 2022



Sumber : PROMETHEE Software, Data Processed (2024)

Based on the Diamond Visualization image in 2021 above, it can be seen the visualization of outranking determination, where provinces in the green color scale are provinces with positive Phi values, there are provinces that do not overlap between cones, namely Lampung province which is at the top, followed by DI Yogyakarta which follows the Lampung arc, followed by West Java which is able to follow the Lampung and DI Yogyakarta arcs. Provinces that are in the red area with lines drawn in cones far apart are provinces with negative Phi values, namely the province of North Kalimantan, followed by West Papua and Riau Islands, then the last is DKI Jakarta.

While based on the 2022 figure, it can be seen the visualization of the outranking determination, where the provinces in the green color scale are provinces with positive Phi values, there are provinces that do not overlap between cones, namely the province of South Sulawesi which is at the top, followed by DI Yogyakarta which follows the arc of South Sulawesi, followed by West Sumatra which is able to follow the arc of South Sulawesi and DI Yogyakarta. Other provinces in the middle and overlapping are Banten, Aceh, Central Kalimantan, North Maluku, East Kalimantan, West Papua, and Gorontalo. Provinces that are in the red area with lines drawn in cones far apart are provinces with negative Phi values, namely the province of Bangka Belitung Islands, followed by DKI Jakarta, and the last is North Kalimantan.

Analysis of Climate Change Adaptive Capacity in Indonesia

Based on the results of data processing through the Multi Criteria Decision Making technique, it can be seen the order or outranking of 34 provinces in Indonesia. In 2021 and 2022, there are 17 provinces that have a positive Phi value so that they are in the green area when looking at Diamond's visualization.

Analysis of food security supporters can be seen through action profiles which function to see the contribution or linkage of each criterion owned by each province to the score that determines the outranking order. Action Profiles are depicted using a box that can show each criterion that can be an advantage is a criterion that is at the top (upward) with a positive score and getting closer to number one, while the criteria that are weaknesses, are at the bottom (downward) with a negative score.

1. Lampung

Based on the Table of Ranking results, Lampung province is at the top with a Phi value of 0.4274. This province has great potential in the agricultural sector, especially with commodities such as rice, corn, and cassava, which are the mainstay in maintaining food stability. Lampung has vast and fertile agricultural land, as well as experienced farmers, which is the main foundation of food production. In addition, strengthening infrastructure such as the construction of dams, irrigation channels and harvest storage warehouses has helped ensure water supply and reduce post-harvest losses (Indriani, 2022).

There are 6 criteria that are the advantages of Lampung province, the first criterion is Temperature Change (A1). Temperature change in Lampung is very close to 1, which shows that this criterion supports Lampung province to be in the first place from the results of data processing. Lampung's temperature in 2021 is quite low at 25.8 degrees Celsius, which shows that Lampung province in 2021 has

a temperature that is not too cold and not too hot to support its food. Stable temperature conditions also reduce the risk of crop failure due to heat stress which usually affects the flowering and seed formation process in plants. In addition, favorable temperatures extend the growing season, allowing Lampung farmers to utilize the land intensively with multiple cropping patterns or crop diversification. Another contributing factor is good infrastructure, ranging from irrigation to storage facilities, supporting the distribution of agricultural products and reducing post-harvest losses (Adhiguna C. , 2022).

The second criterion is the area of irrigated rice fields (A5), the area of irrigated rice fields in Lampung province is 253,583 Ha. This figure is quite large when compared to other provinces. Lampung not only has a large area of irrigated rice fields, but also can utilize and manage it well, so that the quality of irrigated rice fields is good and supports food security in this province. A good irrigation system ensures a steady supply of water to paddy fields, even during the dry season or when rainfall is uneven due to changing weather patterns. This irrigation allows farmers in Lampung to implement multiple rice cropping patterns or intercropping, resulting in increased land productivity. In addition, irrigation supports the use of modern agricultural technologies, such as fertilizers and superior rice varieties, which require consistent irrigation for optimal yields (Saputra, Prasmatiwi, Abidin, & Setiawan, 2023).

The third criterion is drought and land fires (A2), in 2021 it was recorded that Lampung province had no cases of drought and land fires, aka 0. Thus, this minimum criterion supports the food security of Lampung province. Since the cases of drought and land fires in Lampung are 0, no rice fields, farms, or forests are damaged or lost. Crops can be collected of course with good quality supported by other criteria. Without drought and land fires, soil organic matter is maintained and forests or buffer lands can still function to regulate moisture and prevent erosion. This sustainability creates a healthier and more supportive agricultural environment. With these conditions, Lampung is not only able to maintain local food security but also reduce the pressure from climate change, making it one of the regions with agricultural potential that remains productive amid global weather dynamics (Adhiguna & Rejo, 2018).

The next criterion is agricultural GRDP (A7), the agricultural GRDP of Lampung province in 2021 was recorded at IDR 105,267,640 above provinces that have high IKP figures such as Bali and DKI Jakarta. Agricultural GRDP is obtained through the results of production activities which include subsectors of food crops, plantations, livestock, fisheries, and forestry. Food crops such as rice, corn and cassava are the main contributors, considering that Lampung is one of the food production centers in Indonesia. Higher income from the agricultural sector allows the local government to provide subsidies or incentives for farmers, such as the provision of fertilizers, superior seeds, and training programs, which help them adapt to climate challenges. In addition, a strong agricultural economy also creates jobs and strengthens people's purchasing power, which is important to ensure food access remains stable (Wahyudi, Hermawan, & Ferdiansyah, 2023).

The fifth criterion is the number of markets (A8), in 2021 reaching 687 markets spread across all districts/cities in Lampung. The existence of markets in this case shows that how capable an area is of producing and selling food products

so that it can turn the wheels of the economy and maintain food security. It can also facilitate the distribution of agricultural products from producers to consumers, so that people's access to food will be more secure. The existence of a market also helps incentivize farmers to continue producing despite the uncertainty caused by climate change. The number of farmers (A6) is also an excellent criterion that supports food security in Lampung province. The existence of a market where buying and selling would not be possible if there were no producers behind it, namely farmers. Farmers in agriculture certainly have a very important role in the production cycle of crops and their utilization. The number of farmers in Lampung province reached 90.65%, which shows that Lampung has a lot of people who work as farmers to manage their land for crop production (Barusman, Gultom, Cucus, & Redaputri, 2021).

Although Lampung was in the first position in 2021, the province could not maintain its position and food security in 2022, which dropped to eighth place. This is quite a significant decrease of seven levels, which is certainly due to several improvements that occurred in 2022. Lampung is also still ranked ninth in the IKP rankings with 78.61%. This phenomenon can occur of course because there are criteria that are not only superior or upward but on the other hand, there are two criteria that are weaknesses with negative Phi values and are in a downward position, the two criteria are pollution (A3) and flooding (A4). The number of villages/sub-districts affected by air pollution in Lampung province in 2021 was 210 and increased in 2022 to 220 cases. This increase in cases occurs for several reasons, one of which is the considerable industrial activity in Lampung.

In achieving food security, many factors influence each province to experience an increase or decrease. This refers to the ability of a province to adapt to a shock, which in this case is climate change as conveyed through the theory of economic resilience (Sari, 2018).

2. DI Yogyakarta

Based on the test results that have been carried out, it can be seen that DI Yogyakarta province is the province that came second in 2021 with a Phi value of 0.3213. Even though DI Yogyakarta province is in second place, the province's IKP is in 5th position with 80.88%. This indicates that the criteria that have been determined are able to support DI Yogyakarta province to be able to maintain its food. Although DI Yogyakarta is known for its challenges related to water availability and uneven rainfall, the province has great potential in the agricultural sector, especially in the production of rice, corn, tobacco and horticulture.

Based on the figure above, there are five criteria that are superior with positive Phi values and are in an upward position. The first two criteria that are superior for DI Yogyakarta province are drought & land fires (A2) and the number of farmers (A6). Drought and land fire cases in Yogyakarta province amounted to 0 cases. This indicates that in 2021, DI Yogyakarta will not experience any drought or land fires. Thus, the province's crop production land does not experience shortages or damage, so this criterion is one of the advantages of DI Yogyakarta and is able to maintain its food by preventing drought and land fires (Sukmawati & Utomo, 2021). The number of farmers (A6) is also an advantage of this province, which touched 94.61%. DI Yogyakarta is one of the regions that relies on the agricultural sector to meet local food needs, despite its limited agricultural land area of only 75,990 Ha in

the entire DI Yogyakarta region. An adequate number of farmers helps to ensure that existing land can be optimally utilized for food production (Wati, et al., 2021).

The next criterion that DI Yogyakarta excels at is flooding (A4). Similar to drought and land fires (A2), flood cases in DI Yogyakarta are 0 or nonexistent. This can happen because rainfall in DI Yogyakarta in 2021 is relatively controlled so that it does not experience extreme intensity which is usually the cause of major floods. Disaster mitigation programs carried out by local governments also play an important role in flood prevention. One of them is the maintenance of urban drainage systems, watershed management, and normalization of major rivers to increase water flow capacity. In the absence of flooding, farmers can manage land stably without major disruptions, so that the planting and harvesting cycle runs as expected. This also allows for increased productivity, as crops do not suffer damage from waterlogging or loss of nutrients from eroded soil (Yogyakarta City Regional Disaster Management Agency, 2022).

The next criteria that DI Yogyakarta excels in are temperature change (A1) and pollution (A3). The average temperature change of DI Yogyakarta province is at 26.3 degrees Celsius which is still quite far below the average temperature change of all provinces which is 27.0 degrees Celsius. This shows that the province has a stable temperature change and supports its food security. Temperature stability also reduces the risk of thermal stress on plants, which can affect the formation of crop yields for production. DI Yogyakarta also has a significant difference in day and night temperatures, which is very important to support the growth of certain crops. This gives farmers flexibility in choosing crop types that suit the season. The next criterion is pollution (A3) which in this case is also a negative criterion. From the data presented, only 41 urban villages in DI Yogyakarta are affected by air pollution. Thus, it can be indicated that air pollution in this province is low and even very low. Therefore, agricultural activities can be carried out well and the quality of the harvest will be maximized due to good air quality (Basuki, 2021).

The last superior criterion in DI Yogyakarta is the number of markets (A8), in 2021 the number of markets in DI Yogyakarta touched 458 markets which is actually still below the average of all provinces which is at 517 markets. However, DI Yogyakarta is in a position that is greatly helped by the number of markets. Of the other 5 criteria, the number of markets is the lowest superior criterion in DI Yogyakarta, but this still has a significant influence on DI Yogyakarta to achieve food security even though this criterion has not reached its maximum limit. With 458 markets throughout DI Yogyakarta, it shows that there is still a need to increase the number of markets which will certainly have a more significant impact on food security in this province (Yuliyani & Khoirudin, 2021).

With these superior criteria, it is certainly a support for DI Yogyakarta province to be adaptive in dealing with climate change to achieve food security, but this is not in line with the position or ranking of IKP DI Yogyakarta which is ranked fifth with 80.88%. The IKP figure can be said to be very high because it has entered the top 5, but in the table of ranking results, DI Yogyakarta is actually ranked 2nd consistently from 2021 and 2022. This can certainly occur due to the influence of criteria that show negative Phi values, namely the criteria for irrigated rice fields and agricultural GRDP. These two criteria are the weaknesses of this province because the area of irrigated rice fields in DI Yogyakarta in 2021 amounted to 75,990

Ha which then experienced a significant increase in 2022, namely to 76,273 Ha. The next criterion is agricultural GRDP (A7), which in 2021 only touched IDR 14,592,653 and increased the following year to IDR 16,517,991. If you look at the increase rate, this should be a positive thing for DI Yogyakarta province, but on the contrary, it is its weakness. This can happen because the gap in the increase in numbers is only small and insignificant. The area of irrigated rice fields and agricultural GRDP in DI Yogyakarta is very small compared to other provinces, so this is a weakness (Rahayu, 2020).

This situation is also supported by the theory of economic resilience which states that the economy of a region is said to be strong if it is able to absorb or minimize the shocks it experiences. Recovery programs are another solution that focuses on the important role of the government's approach to recovery in the face of various shocks, so that the region can mitigate the shocks that occur. Financial frameworks have great power and can not only reduce vulnerability to threats but also address future changes and challenges (Sari, 2018).

3. West Java

Based on the test results that have been carried out, it can be seen that West Java Province is the third province with a Phi value of 0.3180. In 2021, the IKP of West Java province is in 12th place with 77.55%. In the outranking results, West Java is ranked third, this ranking is supported by West Java's superiority in several criteria, such as Temperature Change, Irrigated Rice Fields, Agricultural GRDP, and Number of Markets.

There are 5 criteria that are the advantages of this province with a positive Phi value and are in an upward position, namely the criteria for temperature change (A1), irrigated rice fields (A5), agricultural GRDP (A7), and the number of markets (A8). The first criterion, namely temperature change (A1), the average temperature change of West Java province was recorded at 23.4 degrees Celsius in 2021. This can be said to be good and can also be said to be bad because it depends on conditions and regions. The figure of 23.4 degrees Celsius is quite cold when compared to the average temperature of the entire province and this can have a bad impact on crop yields because the temperature is too cold. However, it can be said to be good if the farming or harvest of the region is accustomed to cold temperatures, so that it will help the photosynthesis process of plants or maximize the quality of the harvest (Central Bureau of Statistics of West Java Province, 2021).

The second criterion that is the advantage of West Java province is irrigated rice fields (A5). In 2021, the area of irrigated rice fields in West Java is very large, namely 930,334 Ha. This size of land can be utilized by farmers, communities, and the government to help prevent disasters or lack of water availability for plants and crops. This is important to keep crops well hydrated so that the results obtained are appropriate and able to support food security despite climate change (Badan Pusat Statistik Provinsi Jawa Barat, 2021).

The next criterion is Agricultural GRDP (A7), in 2021 West Java's agricultural GRDP reached IDR. 188,594,034 which is classified as very high compared to other provinces. If we look back at the second criterion, namely the area of irrigated rice fields, this criterion is one of the proofs of the achievement of this figure in West Java's agricultural GRDP. With good management and utilization, the results of

processing irrigated rice fields can produce extraordinary GRDP. This is also in line with the position of West Java's IKP which is in the high group. The last criterion is the number of markets (A8) which also goes hand in hand with agricultural GRDP (A7) because how many markets show how much production can be sold and turn the wheels of the economy so that it can be calculated with agricultural GRDP. West Java has the third highest number of markets in 2021 with 1111 markets. The existence of markets also promotes food price stability because it accelerates the flow of distribution and reduces the risk of scarcity. In addition, markets support the diversification of food consumption, by providing various types of foodstuffs, both from local and outside the region (Badan Pusat Statistik Provinsi Jawa Barat, 2021).

There are also criteria that provide weaknesses to West Java in achieving food security, as evidenced by the position of these criteria at the bottom (downward). These criteria are drought & land fires (A2), pollution (A3), flooding (A4), and the number of farmers (A6). These four criteria are the reason why while West Java ranked third in 2021, in 2022 it dropped to fourth. The first criterion is land drought & fire (A2), in 2021 the cases of land drought & fire in West Java were 18 cases and decreased in the following year, namely 8 cases. The decline that occurred did not become a benchmark for this criterion to be positive but instead became negative because the average case of drought & land fires throughout the province was 17 cases because many provinces did not experience the same case (Tavita, Ashari, Linda, Lestari, & Kurniadi, 2022). Next is the pollution criterion (A3), where the cases in 2021 were 556 cases and increased significantly in the following year to 869 cases. This can occur partly due to the rapid growth of motorized vehicles, especially in big cities such as Bandung, Depok, and Bekasi. In addition, uncontrolled industrial growth is also one of the causes, especially since West Java is the center of the manufacturing, automotive, and textile industries.

With this, it can be seen that the criteria that provide weaknesses are criteria with minimum preferences, which in this case are challenges or shocks for the province. But this actually proves the theory of economic resilience, namely when an area is able to survive shocks or challenges, which in this case are downward criteria, the area will be able to achieve food security (Wicaksana, 2023).

4. South Sulawesi

In 2021, South Sulawesi is in sixth place with a Phi value of 0.2370 and in 2022 this province can rise to occupy the first position. From the calculations carried out, it can be seen that South Sulawesi province is the province that is at the top in 2022 with a Phi value of 0.3222 which can be said to be balanced with the IKP of South Sulawesi, which is ranked third with a figure of 81.38%. This proves that the criteria that have been determined are able to influence regional movements to move up or down the rankings of course with their respective adaptability, which in this case to climate change to achieve food security. South Sulawesi has a tropical climate with sufficient rainfall, which makes this province one of the main food production centers in Indonesia. South Sulawesi is known as a granary of rice, corn and cocoa, and has great potential in the fisheries sector due to its access to the Flores Sea and the Gulf of Bone (Musyaqaat, 2021).

There are six criteria that are an advantage for South Sulawesi province, the first criterion is temperature change (A1), the average temperature change in South

Sulawesi province in 2022 is 27.3 degrees Celsius which only increased by 0.01 from 2021 which is 27.2 degrees Celsius. When viewed from the comparison of 2021 and 2022, South Sulawesi is in a stable and fairly consistent position. In 2021, South Sulawesi was in 6th position based on the results of the Table of Ranking and in 2022 managed to improve each of its criteria so that it was in first position. Consistent temperature is very necessary for a region, especially to produce quality food and enough to meet food availability so as to achieve food security. The second criterion is drought and land fires (A2), there are no droughts and land fires in South Sulawesi, aka 0. Based on the data found, there were no cases of drought and land fires that occurred in South Sulawesi in 2022, just like what happened in 2021. South Sulawesi is able to prevent droughts and fires of course because of the availability of water and good disaster mitigation, so that land is available to be managed as a food source (Maryani, 2020).

The next criterion is irrigated paddy fields (A5), the area of irrigated paddy fields in South Sulawesi province is 654,818 Ha, which is very large when compared to the average area of irrigated paddy fields throughout the province which is only 219,528 Ha. In 2021, the area of irrigated rice fields in South Sulawesi is also in the same range of 600,000 Ha, this proves that this province can utilize existing land and maximize the function and role of farmer actors in the region. This goes hand in hand with the previous criteria of drought and land fires, which shows that the absence of these cases means that the land is available to be managed and utilized by farmers as a source of food. This condition is supported by the vast amount of irrigated sawa land in South Sulawesi province. In addition to being able to maintain and increase the availability of water for rice fields, this condition also enables South Sulawesi to achieve food security (Mulyani A., 2022).

The next criterion is agricultural GRDP (A7), in 2022 the agricultural GRDP of South Sulawesi province reached a quite fantastic figure of Rp. 122,930,636. With the availability of a large area of irrigated rice fields, it supports the high agricultural GRDP produced by this province. The agricultural sector in South Sulawesi not only supports local food security but also supplies various other regions, including less agriculturally productive areas, such as DKI Jakarta. This contribution demonstrates the important role the province plays in supporting national food stability. South Sulawesi's agricultural GRDP continues to grow thanks to the adoption of modern technology, improved infrastructure and commodity diversification (Siswadharma & Burhanuddin, 2022).

The fifth criterion that is an advantage for South Sulawesi province is the number of farmers (A6), the percentage of the number of farmers in this province is 93.33%, which has increased by almost 2% from 2021, which is 91.61%. To manage crop productivity and harvest land, of course, farmers are needed in accordance with the land area. With the number of farmers touching numbers above 90%, it shows that South Sulawesi is able to maximize the role of farmers to manage land. This criterion is also related to the next criterion, namely the number of markets (A8). The number of markets in South Sulawesi is very high, totaling 814 markets spread throughout South Sulawesi. The high number of markets will certainly help increase productivity and the relationship between producers and the market itself. As is well known, one of the functions of the market is to turn the wheels of the economy so that the region can survive and adapt to the situation, which in this case

is climate change. The adaptive capacity of a region refers to the ability of communities, agricultural systems and governments to adjust to the impacts of climate change, such as changes in rainfall patterns, droughts, floods and increased temperatures, all of which can affect food production (Carpenter & Brock, 2008).

This condition is also supported by the theory of economic resilience, namely the economy in an area can be said to be strong if the area is able to absorb or even minimize the shocks faced. If a region can reduce the shocks that occur then another solution is the recovery program, which is how the government approach plays an important role in the recovery of handling the range of shocks. With great strength, a financial framework is not only able to reduce its vulnerability to hazards but also able to face future changes and challenges (Wicaksana, 2023).

5. North Kalimantan

In 2022, the lowest rank was obtained by North Kalimantan province and from the test results, it is known that the Phi value of North Kalimantan province is negative with a value of -0.4576. In 2021, North Kalimantan was ranked 31st with a Phi value of -0.3166, which indicates that North Kalimantan experienced the following year. North Kalimantan Province is one of the palm oil producing regions in Indonesia, The potential for the development of palm oil raw materials in North Kalimantan is supported by the opening of marketing channels to meet local consumer market demand and export demand (Siahaan, et al., 2021).

North Kalimantan's success in improving its economy through palm oil can be said to be quite good. The government and people of North Kalimantan, including local entrepreneurs, have made a lot of efforts in the development of the oil palm agricultural sector. There are 2 criteria that are the strengths or advantages of North Kalimantan in achieving food security in North Kalimantan, namely pollution (A3) and flooding (A4). The number of pollution cases in North Kalimantan has increased from 2021 to 2022, from 47 cases to 61 cases. This increase is actually a superior thing in this province because the increase that occurred was only 14 cases, while when compared to East Java, the increase in cases was 397 cases. This is an advantage for North Kalimantan, as well as evidence that the province is able to cope with air pollution cases. This condition is also aided by government policy to increase surveillance patrols in fire-prone areas, especially during the dry season, to detect potential fires early. In addition, community-based land management can be optimized by involving local residents in sustainable forest conservation programs, while providing education on the dangers of land clearing through burning (Hayong, 2024). The next criterion is flooding (A4), flood cases that occur in North Kalimantan are not so many, namely only 6 cases in 2021 and 19 cases in 2022. This number makes the flood criterion an advantage for North Kalimantan even though it remains in the lowest position of the calculation results. The strength of the criteria that weaken this province is stronger than the criteria that excel this province. This is a phenomenon if it is associated with the IKP of North Kalimantan province which is at 71.04 in 21st place. Thus, proving that the good IKP position, when faced with climate change criteria that aim to adapt in order to achieve food security, is not always in line with the results of the calculation (Singal, 2022).

There are six criteria that are weaknesses with negative Phi values and are in a downward position in food security in North Kalimantan, namely the first is the

temperature change criterion (A1). The average temperature change in North Kalimantan reached 28.6 degrees Celsius, which increased from 27.4 degrees Celsius in 2021. This is similar to what happened with DKI Jakarta. North Kalimantan, which is also a tropical region, has the potential to experience drastic changes in temperature, affecting crop conditions and other crop production processes. The second criterion is drought and land fires (A2), the number of cases of drought and land fires in the North Kalimantan region amounted to 3 cases, which decreased from 2021, which was 8 cases. This is quite a plus point for North Kalimantan. But when viewed from the results of the action profile, this criterion is still a high weakness for North Kalimantan. The area surrounded by forests and rice fields adjacent to trees creates the potential for drought and land fire cases. In addition, irrigation that is not maximized will also affect this criterion so that the availability of water cannot be maintained which results in land drought (Fau, Ihwan, & Adriat, 2021).

The third criterion is irrigated paddy fields (A5), the area of irrigated paddy fields in North Kalimantan province in 2022 is 11,922 hectares, which in 2021 was wider at 14,265 hectares. This decrease has a significant impact on North Kalimantan because of the decreasing availability of land to be used as a place to produce crops or other commodities. This is related to the previous criteria, namely drought and land fires which can result in a reduction in the area of irrigated rice fields. Irrigated rice fields function as water providers and also maintain soil quality and air to remain at the best quality to get the best results as well. The fourth criterion is the number of farmers (A6), the percentage of farmers in North Kalimantan province in 2022 is 79.49%, a decrease from the previous year of 81.86%. This can occur due to land conversion, where agricultural land is often converted into large plantations, especially oil palm, or land used for mining and infrastructure. In addition, economic factors have also contributed to the decline in the number of farmers. Agriculture is often perceived as a job with unstable and less profitable income (Suciyati, 2019).

The next criterion is agricultural GRDP (A7), the agricultural GRDP of North Kalimantan province in 2022 is IDR. 18,085,245 which has increased from 2021 which is IDR. 16,535,729. The total agricultural GRDP generated by North Kalimantan is very low when compared to the first rank of the highest agricultural GRDP producer, namely the province of East Java with a total of Rp. 303,202,052. This condition is often an obstacle for regions, especially when there is a lack of agricultural land, low human resources to manage it, and other criteria that worsen the situation (Nur & Wiryawan, 2022). The last criterion is the number of markets (A8), in 2022 North Kalimantan has a total of only 83 markets spread across the region. The number of markets spread across North Kalimantan is not proportional to its population of 746,201 people. This refers to limited access, especially for villages or remote areas that are far from markets and therefore cannot fulfill their food availability. All of these criteria lead to how capable an area is of maintaining its food security with adaptation to climate change assisted by the existence of these criteria (Wicaksana, 2023).

6. DKI Jakarta

The last province to be highlighted as interesting is DKI Jakarta. There are five criteria that are weaknesses in achieving food security in DKI Jakarta province. The first criterion that is closest to -1 is temperature change (A1), the number of farmers (A6), and agricultural GRDP (A7). These three criteria greatly weaken DKI Jakarta to achieve food security because all of them have touched -1, which indicates that these criteria have the worst or least favorable performance. The average temperature change of DKI Jakarta is 28.4 degrees Celsius, which is the highest average temperature change in 2021. With hot temperatures caused, among others, by massive urbanization and the urban heat island effect which exacerbates the temperature rise in the DKI Jakarta area. This condition has a direct impact on food security, as high temperatures can affect food quality and availability, especially those that depend on the fresh distribution chain (Pandiangan, Zulaikha, Warto, & Yudo, 2023).

The next criterion is the number of farmers (A6), in 2021 the number of DKI Jakarta farmers only touched a total of 52.53% which is far from the average number of farmers in all provinces which is 86.7%. This is due to the fact that there are not many rice fields available so there is no need for farmers to work. As the nation's capital and economic center, Jakarta is more focused on the service and trade sectors than the agrarian sector, so the space for agriculture is increasingly marginalized. In addition, the high cost of living in urban areas makes farming not an option for people as a profession. The third criterion is agricultural GRDP (A7), which in 2021 DKI Jakarta only produces GRDP of IDR 2,376,222 out of the total average agricultural GRDP of all provinces, namely IDR 63,579,333. This is related to the previous criterion, namely the number of farmers. As happened in the previous two provinces, DKI Jakarta also experienced the same thing. Because DKI Jakarta is an urban area that does not have many workers as farmers, it results in low agricultural GRDP results. When compared to the results of other sectors' GRDP, DKI Jakarta is certainly in a high position, but when in the agricultural sector DKI Jakarta cannot contribute much (Nur & Rakhman, 2019).

The next criterion is irrigated rice fields (A4), in 2021 DKI Jakarta's irrigated rice field area is only 451 Ha, which is the province with the lowest irrigated rice field area in Indonesia. This criterion reinforces the reason why DKI Jakarta occupies the lowest position in the 2021 Table of Ranking results. With the condition of the lack of farm workers so that not much can be produced, plus the land that is not widely available also makes DKI Jakarta unable to produce crops to meet food availability so that it can achieve food security. The last criterion that weakens DKI Jakarta to achieve food security is the number of markets (A8). In 2021, the number of markets available in DKI Jakarta is 318, which is still quite far from the average number of markets throughout the province, which is 517. If you look back at the available figures, the number of markets criterion is closer to 0 than -1, which shows that this criterion is a weakness but not as significant as other criteria. The existing markets in DKI Jakarta are still quite numerous and can sell products from various sectors, although they still rely on other regions as producers due to the lack of farmland, farmers, and low agricultural GRDP. Thus, proving that DKI Jakarta is in a very vulnerable position to achieve food security if these criteria are met (Nugraha & Ananda, 2023).

Conclusions

Based on the results of the research that has been carried out, it can be concluded that of the 34 provinces in Indonesia that have been ranked through the outranking system, there are 17 provinces that have a positive Phi value and 17 provinces that have a negative Phi value in 2021 and 2022. There are eight criteria that affect this value, namely temperature change, drought & land fires, pollution, flooding, irrigated rice fields, number of farmers, agricultural GRDP, and number of markets. Provinces that have a positive Phi value are dominated by provinces that are certainly in a high IKP position.

From the results obtained, it can be concluded that the province with the best ability to adapt to climate change is the province of South Sulawesi, which is in first place in 2022, which is also in line with the province's IKP position, which is ranked third with 81.38%. With six leading criteria whose Phi values are close to 1, namely temperature changes, drought & land fires, irrigated rice fields, the number of farmers, agricultural GRDP, and the number of markets. This also proves that these alternative provinces or regions are able to adapt to climate change in order to achieve food security. The province with the worst adaptability according to the calculations that have been carried out is the province of North Kalimantan. It can be seen from the results of the latest table of ranking in 2022 that North Kalimantan is at the bottom of the rankings which previously also ranked in the bottom five provinces. This condition is also quite in line with the position of North Kalimantan's IKP which is close to the low position, namely rank 21 with 71.04. The main cause of this condition is the many criteria that weaken the province such as temperature changes, drought & land fires, irrigated rice fields, the number of farmers, agricultural GRDP, and the number of markets. Thus, it can be concluded that these alternative provinces or regions are not able to adapt to climate change to achieve food security.

Overall, provinces that have high rankings on the IKP are not necessarily able to achieve food security, this can occur due to considerations of livable needs and economic growth in each province. Geographical conditions and people's lifestyles also cause this to happen.

Acknowledgement

Praise and gratitude to the Lord Jesus Christ, for His guidance and grace that have given the researcher strength and smoothness in completing this research as part of fulfilling the requirements to obtain a Bachelor of Development Economics degree. With great respect, the researcher would like to express sincere appreciation to all parties who have contributed to the completion of this work. Special thanks are extended to Mrs. Indri Arrafi Juliannisa, SE, M.E, Head of the Department of Economics and Head of the S1 Development Economics Study Program, who has provided guidance, valuable knowledge, and mentorship both in this research and throughout the 3.5 years of study. Deep gratitude also goes to Mrs. Dr. Nani Ariani, SE, MM as the chief examiner, and Mr. Achmad Nur Hidayat, MPP as the first examiner, for their time, direction, and constructive input during the preparation of this research. The researcher is profoundly grateful to his beloved

family—Mami, Tulang Andrew, Tulang Grace, and all other relatives—for their unwavering prayers, support, and motivation. To his beloved partner, Felicia Candy, heartfelt thanks for the encouragement, companionship, and strength in difficult moments. Appreciation is also extended to close friends who have shared the academic journey since the first day at UPNVJ Development Economics—Michael, Rayhan, Iqbal, and Putera—as well as church friends Marbun, Famelo, Teofilus, Ayu, Tia, and Maudy, whose presence has always brought joy. Gratitude is also given to all friends from Development Economics 2021, who have been companions throughout the 3.5 years of lectures and learning. Finally, the researcher acknowledges that this research still has limitations; therefore, constructive criticism and suggestions will be highly valuable for its improvement. It is the researcher's hope that this work may provide benefits for readers and future researchers.

References

Adhiem, M. A. (2024). Perubahan Iklim Dan Faktor-Faktor Yang Mengancam Stabilitas Produksi Pangan Nasional. Info Singkat : Kajian Singkat Terhadap Isu Aktual Dan Strategis, 1-5.

Adhiguna, C. (2022). Identifikasi Perubahan Suhu Permukaan Di Kota Bandar Lampung Dengan Citra Landsat 8 Sebagai Pertimbangan Penataan Penggunaan Tanah. Repository Universitas Lampung, 1-39.

Adhiguna, R. T., & Rejo, A. (2018). Teknologi Irigasi Tetes Dalam Mengoptimalkan Efisiensi Penggunaan Air Di Lahan Pertanian. Seminar Nasional Hari Air Sedunia, 1-10.

Adiyoga, W., & Basuki, R. S. (2018). Persepsi Petani Sayuran Tentang Dampak Perubahan Iklim Di Sulawesi Selatan. Google Scholar, 1-14.

Afriansyah, Kembauw, E., Munajat, Marni, S., Permata Sari, F., Fitri, A., . . . Besse Dahliana, A. (2022). Prinsip Dasar Ekonomi Pertanian. Eureka, 1-36.

Aini, Y. N., & Kurniawan, F. E. (2019). Analisis Faktor Dan Pemetaan Ketahanan Pangan Provinsi Papua Dalam Upaya Mendukung Sustainable Development Goal's Di Indonesia. 101-110.

Aldin, A., Basri, H., & Syahrul. (2021). Analisis Indeks Kekeringan Hidrologi Das Krueng Aceh (Studi Kasus Sub Das Krueng Khee). Jurnal Rona Teknik Pertanian, 1-20.

Aldrianto, D. (2023). Teori Ekonomi Ketahanan Pangan. Repository Universitas Nasional, 1-22.

Alfi, K. M., Budiasih, Rohmah, A. N., Azizah, S. M., Rahmi, M., & Nafiis, F. A. (2023). Mampukah Sulawesi Selatan Mendukung Ketahanan Pangan Di Kawasan Timur Indonesia? Seminar Nasional Official Statistik, 1-10.

Aminah, S. (2015). Pengembangan Kapasitas Petani Kecil Lahan Kering Untuk Mewujudkan Ketahanan Pangan. Jurnal Kementerian Dalam Negeri, 1-14.

Anggraeni, M., Ratih, A., Suparta, I. W., Husaini, M., Emalia, Z., Usman, M., . . . Ciptawaty, U. (2023). Analisis Pengaruh Sektor Pertanian Terhadap Pdrb Sektor Pertanian Di. Journal On Education, 1-19.

Anggraeni, N. M., Sudarti, & Yushardi. (2023). Analisis Dampak Perubahan Iklim Dan Pola Angin Pada Lingkungan Global. Jurnal Pendidikan Dan Teknologi, 1-7.

Arsyad, K. A., & Priyana, Y. (2023). Studi Kausalitas Antara Polusi Udara Dan Kejadian Penyakit Saluran Pernapasan Pada Penduduk Kota Bogor, Jawa Barat, Indonesia. Jurnal Multidisiplin West Sciene, 1-15.

Asrofi, A., Ritohardoyo, S., & Hadmoko, D. S. (T.Thn.). Strategi Adaptasi Masyarakat Pesisir Dalam Penanganan Bencana Banjir Rob Dan Implikasinya Terhadap Ketahanan Wilayah (Studi Di Desa Bedono Kecamatan Sayung Kabupaten Demak Jawa Tengah). Jurnal Ketahanan Nasional.

Badan Pangan Nasional. (2022). Indeks Ketahanan Pangan Tahun 2022. 1-70.

Badan Penanggulangan Bencana Daerah Kota Yogyakarta. (2022, September 27). Kajian Risiko Bencana. Diambil Kembali Dari Bpbd.Jogjakota.Go.Id: Https://Bpbd.Jogjakota.Go.Id/Assets/Instansi/Bpbd/Files/Dokmen-Kajian-Risiko-Bencana-Kota-Yogyakarta-2022-2026-13325.Pdf

Badan Pusat Statistik. (2021, July 14). Sebaran Pasar Dan Pusat Perdagangan Menurut Klasifikasi. Diambil Kembali Dari Bps.Go.Id: Https://Www.Bps.Go.Id/Id/Statistics-Table/2/Mtg3nsmy/Sebaran-Pasar-Dan-Pusat-Perdagangan-Menurut-Klasifikasi.Html

Badan Pusat Statistik Kepulauan Riau. (2023, November 10). Luas Panen Padi Menurut Kabupaten/Kota (Ha), 2021-2023. Diambil Kembali Dari Kepri.Bps.Go.Id: Https://Kepri.Bps.Go.Id/Id/Statistics-Table/2/Ntmzizi=/Luas-Panen-Padi-Menurut-Kabupaten-Kota.Html

Barusman, M. S., Gultom, I. A., Cucus, A., & Redaputri, A. P. (2021). Program Peningkatan Kesejahteraan Petani Di Lampung. Jurnal Ekonomi Pertanian Dan Agribisnis (Jepa), 1-10.

Basuki, A. T. (2021). Pemetaan Polusi Udara Perkotaan Dl Propinsi Daerah Istimewa Yogyakarta. Jurnal Uii, 1-15.

Carpenter, S. R., & Brock, W. A. (2008). Adaptive Capacity And Traps. Jstor, 1-17.

Cheba, K., Kiba-Jainak, M., Baraniecka, A., & Kolakowski, T. (2021). Impact Of External Factors On E-Commerce Market In Cities And Its Implications On Environment. Elsvier, 1-9.

Christiyanto, M., & Mayulu, H. (2021). Pentingnya Pembangunan Pertanian Dan Pemberdayaan Petani Wilayah Perbatasan Dalam Upaya Mendukung Ketahanan Pangan Nasional: Studi Kasus Di Wilayah Perbatasan Kalimantan. Journal Of Tropical Agrifood 2021, 1-14.

Chun, A., Saputra, W., & Qurniawan, H. (2021). Penerapan Metode Promethee Pada Rekomendasi Prasarana Aset Irigasi. Journal Of Information System Research (Josh), 1-5.

Cun, A., Saputra, W., & Qurniawan, H. (2021). Penerapan Metode Prometheepada Rekomendasi Prasaranaaset Irigasi. Journal Of Information System Research, 1-5.

Dlhk Provinsi Banten. (2021). Pencemaran Lingkungan Dan Solusinya. 1-6.

Eliezer, W. R. (2024). Pengaruh Aksesibilitas Dan Kesehatan Masyarakat Terhadap Ketahanan Pangan Di Papua Dan Papua Barat Tahun 2022. Seminar Nasional Official Statistik, 1-8.

Environmental Protection Agency. (2017, January 19). Perubahan Iklim: Informasi Dasar. Diambil Kembali Dari Environmental Protection Agency: Https://19january2017snapshot.Epa.Gov/Climatechange/Climate-Change-Basic-Information_.Html

Fakultas Pertanian Universitas Sriwijaya. (2005). Master Plan Lumbung Pangan Provinsi Sumatera Selatan. 1-321.

Farosa, M. A., Kasih, P., & Irawan, R. H. (2022). Pemodelan Algoritma Roc Dalam Pembobotan Kriteria Seleksi Penerima Bantuan Sosial Pendidikan Menggunakan Algoritma Cpi. Repository Unp Kediri, 1-6.

Fau, S. W., Ihwan, A., & Adriat, R. (2021). Analisis Kekeringan Lahan Di Kayong Utara Pada Saat El-Niño Tahun 2019. Urnal Sains & Teknologi Modifikasi Cuaca, 1-8.

Fauzi, A. (2019). Teknik Analisis Keberlanjutan. Jakarta: Gramedia Pustaka Utama.

Fazri, H. S., Widodo, B., Ismawati, N., & Irawan, P. (2024). Laporan Utama Ketahanan Pangan Jakarta. Dki Jakarta: Jakita.

Fratama, D. P., Yulianti, V., Sadewa, N. Y., & Pinem, A. P. (2024). Analisis Prioritas Penanggulangan Bencana Di Kota Semarang Tahun 2022 Dengan Metode Promethee Dan Roc. Jurnal Tekno Kompak, 1-12.

Gandhi, P., Nidyantoro, Darmawan, I., & Rachmat. (2022). Persepsi Kelompok Tani Terhadap Multifungsi Sawah Dan Strategi Keberlanjutan Kebijakan Plp2b Di Kota Bogor. Jurnal Institut Pertanian Bogor, 1-19\.

Grace, A., Yudianto, D., & Fitriana, F. (2022). Optimasi Perencanaan Sistem Drainase Kawasan Industri Di Cikarang, Kabupaten Bekasi, Jawa Barat. Jurnal Teknik Hidraulik, 1-23.

Hanani, N., Syafrial, Suhartini, Toiba, H., Asmara, R., Sujarwo, . . . Andrianto, B. (2023). Pengantar Ekonomi Pertanian. Malang: Ub Press.

Harini, R., Ariani, R. D., Yulianda, Y., & Widyantari, R. (2022). Strategi Adaptasi Ketahanan Pangan Terhadap Perubahan Iklim Di Pinggiran Kota Yogyakarta. Majalah Geografi Indonesia, 1-9.

Harun, A., Noh, J., & Muhammad, A. H. (2023). Penentuan Keputusan Penerimaan Bantuan Beras Raskin Bagi Warga Miskin Di Desa Bukit Tinggi Menggunakan Metode Promethee. Jurnal Teknologi Informatika, 1-9.

Hayong, B. S. (2024). Pertobatan Ekologis Menurut Ensiklik Laudato Sidalam Menanggapi Pelanggaran Martabat Alam Dinamis Dan Metaforis Di Kabupaten Nunukan, Kalimantan Utara. Repository Institut Filsafat Dan Teknologi Kreatif Ledalero, 1-21.

Ikhsani, I. I., Tasya, F. E., Inati, U., Sihidi, I. T., Roziqin, A., & Romadhan, A. (2020). Arah Kebijakan Sektor Pertanian Di Indonesia Untuk Menghadapi Era Revolusi Industri 4.0. Jurnal Administrasi Dan Kebijakan Publik, 1-21.

Indra, Sukmana, O., & Wahyudi. (2024). Strategi Ketahanan Pangan Provinsi Riau: Dampak Sosio-Ekonomi Terhadap Masyarakat. Jurnalsosial Dan Sains, 1-21.

Indriani, Y. (2022). Ketahanan Pangan Rumah Tangga Petani Padi, Petani Jagung Dan Nonpetani Di Kota Metro Provinsi Lampung. Jurnal Ilmu Ilmu Agribisnis: Journal Of Agribusiness Science, 1-14.

Institut Teknologi Nasional Bandung. (2019). Pengertian Irigasi. Itenas Repository, 1-9.

Ismiasih, Dinarti, S. I., & Adnanti, M. W. (2022). Peran Kelompok Tani Dan Anggota Pada Penerapan Inovasi Teknologi Pertanian Di Desa Trimulyo. Agritech, 1-10.

Kementerian Kesehatan Republik Indonesia. (2023, Oktober 29). Pusat Krisis Kesehatan Republik Indonesia. Diambil Kembali Dari Pusatkrisis.Kemkes.Go.Id: Https://Pusatkrisis.Kemkes.Go.Id/Kekeringan-Di-Bintan-Kepulauan-Riau-29-10-2023-38

Kementerian Kominfo. (2023, May 22). Keamanan Pangan: Prioritas Asean. Diambil Kembali Dari Asean Indonesia 2023: Https://Asean2023.Id/En/News/Food-Security-An-Aseans-Priority

Kementerian Lingkungan Hidup Dan Kehutanan. (2022). Laporan Kualitas Udara Jakarta. Dki Jakarta: Kementerian Lingkungan Hidup Dan Kehutanan.

Kubiak, J., Laks, I., Sroka, Z., & Sroka, Z. (2024). Application Of A Multi-Criteria Decision Support System For Assessing Development Potential In Flood Risk Areas - Case Study Of The Warta River. Elsevier, 1-17.

Kurniawan, B. (2016). Food Security And Entitlement: A Critical Analyses. Google Scholar, 1-5.

Kurniawan, E. (2018). Produk Domestik Regional Bruto Kabupaten Dharmasraya Menurut Oengeluaran Tahun 2013-2017. Dharmasraya: Badan Pusat Statistik Kabupaten Dharmasraya.

Lestari, H. (2022, Desember 2). Kearifan Lokal Dalam Peningkatan Ketahanan Pangan Di Provinsi Kepulauan Bangka Belitung. Hal. 1.

Liu, X., & Liu, Y. (2024). Sensitivity Analysis Of The Parameters For Preference Functions And Rank Reversal Analysis In The Promethee Ii Method. Elsevier, 1-17.

Liyanti, V. F. (2021). Dampak Limbah Pabrik Semen Terhada Perekonomian Masyarakat Di Pantai Pasir Putih Lampung Selatan (Studi Kasus Pt. Solusi Bangun Indonesia). Iain Metro, 1-103.

Maryani, S. (2020). Pengaruh Deforestasi Dan Tingkat Kebakaran Hutan Terhadap Tingkat Emisi Gas Rumah Kaca. Publikasi Penelitian Terapan Dan Kebijakan, 1-14.

Maulana, M. F., & Leki, Y. W. (2023). Analisis Prioritas Kebijakan Subsektor Pertanian Di Kabupaten Malang, Jawa Timur. Jurnal Green House, 1-11.

Metkono, D. I., Widiastuti, T., & Fanggiadae, A. (2023). Implementasi Sistem Pendukung Keputusan Dalam Penentuan Kesesuain Lahan Untuk Tanaman Jagung Menggunakan Metode Promethee. Jurnal Dialektika Informatika, 1-7.

Mir, S., Shah, S. A., Bhat, M. S., Akhter, S., Ahad, F., & Jelani, P. (2024). Disaster Risk Assessment Of Educational Infrastructure In Mountain Geographies Using Promethee-Ii. Elsevier, 1-24.

Muhamad, W. (2021). Analisis Kebijakan Pencegahan Dan Penanganan Kebakaran Hutan Dan Lahan Dikalimantan Tengah. Anterior Jurnal, 1-7.

Mulyani, A. (2022). Analisis Kapasitas Produksi Lahan Sawah Untuk Ketahanan Pangan Nasional Menjelang Tahun 2045. Jurnal Sumberdaya Lahan, 1-16.

Mulyani, S., Putri, F. M., Andoko, B. W., Akbar, F., & Novalia, S. (2020). Dampak Pembangunan Infrastruktur Terhadap Kondisi Ketahanan Di Indonesia (Studi Kasus Provinsi Bali). Jurnal Ketahanan Nasional, 1-18.

Musyaqaat, S. R. (2021). Jaringan Perdagangan Beras Dan Dinamika Pelabuhan Ekspor Di Sulawesi Selatan Pada 1930-An. Handep, 1-32.

Nasrudin, A., & Runturambi, A. S. (2022). Strategi Ketahanan Pangan Di Dki Jakarta Menunjang Ketahanan Nasional Melalui Strategi Kebijakan Perumda Pasar Jaya. Jurnal Pendidikan Konseling, 2-10.

Noerhayati, E., & Suprapto, B. (2018). Perencanaan Jaringan Irigasi Saluran Terbuka. Malang: Inteligensia Media.

Nugraha, N. R., & Ananda, A. T. (2023). Peluang Pasar Pada Tourism Metaverse Di Dki Jakarta. Jurnal Ilmiah Wahana Pendidikan, 1-7.

Nugroho, R. J., & Habibilloh, A. A. (2023). Studi Climate Smart Agricultur (Csa) Perubahan Iklim Terhadap Ketahanan Pangan. Jurnal Pendidikan Tambusai, 1-9.

Nur, A. A., & Wiryawan, D. (2022). Potensi Ekonomi Berdasarkan Produk Domestik Regional Bruto (Pdrb) Di Kalimantan Utara Dengan Menggunakan Metode Shift-Share. Ekonis, 1-12.

Nur, I., & Rakhman, M. T. (2019). Analisis Pdrb Sektor Ekonomi Unggulan Provinsi Dki Jakarta. Jurnal Perbendaharaan, Keuangan Negara Dan Kebijakan Publik.

Nurjasmi, R. (2021). Review: Potensi Pengembangan Pertanian Perkotaan Oleh Lanjut Usia Untuk Mendukung Ketahanan Pangan . Jurnal Ilmiah Respati , 1-18.

Pandiangan, Y. S., Zulaikha, S., Warto, & Yudo, S. (2023). Status Kualitas Air Sungai Ciliwung Berbasis Pemantauan Online Di Wilayah Dki Jakarta Ditinjau Dari Parameter Suhu, Ph, Tds, Do, Dhl, Dan Kekeruhan. Jurnal Teknologi Lingkungan, 1-7.

Pardosi, I., Damayanti, E., Devi, A., & Sumedi, P. (2020, April 22). Dampak Perubahan Iklim Berkaitan Dengan Produksi Pengolahan Pangan Lokal Dan Perempuan. Diambil Kembali Dari Pojok Iklim: Http://Pojokiklim.Menlhk.Go.Id/Read/Dampak-Perubahan-Iklim-Berkaitan-Dengan-Produksi-Pengolahan-Pangan-Lokal-Dan-Perempuan

Perdinan, Atmaja, T., & Adi, R. F. (2019). Adaptasi Perubahan Iklim Dan Ketahanan Pangan: Telaah Inisiatif Dan Kebijakan. 1-28.

Pieris, K. W. (2015). Ketahanan Dan Krisis Pangan Dalam Perspektif Malthus, Depedensi Dan Gender (Women In. Jurnal Hubungan Internasional, 1-13.

Poltekkes Jogja. (2021). Definisi Kekeringan. Repository Poltekkes Jogja, 1-24.

Pramudawati, M. A., Tanjung, M. I., & Ghafara, R. (2020). Penilaian Risiko Keamanan Bendungan Di Jawa Timurdam Safety Risk Assessment In East Java. Jurnal Teknik Hidraulik, 1-10.

Pujiati, S., Pertiwi, A., Silfia, C. C., Ibrahim, D. M., & Hafida, S. N. (2020). Analisis Ketersediaan, Keterjangkauan Dan Pemanfaatan Pangan Dalam Mendukung Tercapainya Ketahanan Pangan Masyarakat Di Provinsi Jawa Tengah. Jurnal Sosial Ekonomi Pertanian, 1-11.

Purifyningtyas, H. Q., & Wijaya, H. B. (2016). Kajian Kapasitas Adaptasi Masyarakat Pesisir Pekalongan Terhadap Kerentanan Banjir Rob. Jurnal Wilayah Dan Lingkungan, 1-14.

Rahayu, T. (2020). Analisis Pengaruh Tenaga Kerja, Luas Lahan, Dan Teknologi Sektor Pertanian Terhadap Produk Domestik Regional Bruto Sektor Pertanian Di Daerah Istimewa Yogyakarta Tahun 2010 -2017. Repository Upn Veteran Yogyakarta, 1-100.

Rahma, F. E. (2021). Ketahanan Pangan Di Indonesia Tahun 2014-2021. 1-62.

Rahman, F. N., & Wardhani, E. (2020). Badan Penanggulangan Bencana Daerah (Bpbd) Untuk Memberikan Respons Cepat Ketika Terjadi Banjir, Termasuk Evakuasi Warga, Distribusi Bantuan, Dan Perbaikan Infrastruktur Pascabencana. Edukasi Masyarakat Tentang Kesiapsiagaan Bencana Juga Menjadi Bagian Pe. Jurnal Serambi Engineering, 1-9.

Rizqullah, E. F., Feriska, Y., & Tolani, M. (2023). Analisis Tata Kelola Drainase Perkotaan Sigeleng Dalam Mengatasi Banjir Di Kecamatan Brebes. Jurnal Pendidikan Tambusai, 1-9.

Ronaldo, S., & Syefani, A. (2023). Determinan Ketahanan Pangan Rumah Tangga Provinsi Kalimantan Utara Tahun 2023. Jurnal Sosial Ekonomi Pertanian, 1-10.

Rosanty, M. A., Yudanegara, R. A., Sari, R. M., & Sihombing, T. M. (2024). Konsolidasi Tanah Pada Sistem Saluran Drainase Dalam Upaya Penanganan Banjir (Studi Kasus : Kelurahan Way Dadi, Kecamatan Sukarame, Kota Bandar Lampung). Jurnal Rekayasa Konstruksi Mekanika Sipil, 1-15.

Rosyada, K., & Rivai Ras, A. (2021). Potensi Blue Carbon Dalam Penanganan Perubahan Iklim Guna Menunjang Keamanan Maritim Indonesia. Jurnal Maritim Indonesia, 1-13.

Ruminta, D. (2021). Analisis Kinerja Ptpupuk Indonesia(Persero) Sebagaiholding Companysektor Pupukdi Indonesia. Jurnal Administrasi Bisnis, 1-10.

Saputra, I., Prasmatiwi, F. E., Abidin, Z., & Setiawan, A. (2023). Persepsi Petani Padi Sawah Irigasi Dan Tadah Hujan Terhadap Perubahan Iklim Di Kabupaten Lampung Selatan. Jurnal Ekonomi Pertanian Dan Agribisnis, 1-10.

Sari, J. (2018). Resiliensi. Repository Universitas Islam Indonesia, 1-9.

Siahaan, D., Manurung, A. I., Julianti, E., Elisabeth, J., Purba, E., & Sirait, B. (2021). Evaluasi Tandan Buah Segar Dan Hasil Minyak Sawit Rakyat Di Provinsi Sumatera Utara, Jambi, Kalimantan Utara Dan Sulawesi Tenggara. Jurnal Penelitian Bidang Ilmu Pertanian, 1-14.

Singal, R. Z. (2022). Mitigasi Bencana Banjir Kalimantan Utara. Repository Eureka, 1-18.

Siswadharma, A. B., & Burhanuddin, N. F. (2022). Analisis Subsektor Unggulan Pertanian Di Sulawesi Selatan. Jurnal Ekonomika Dan Dinamika Sosial, 1-23.

Suarsana, K. (2020). Ketahanan Pangan Berbasis Adat(Tantangan Penanganan Covid-19 Di Bali). Prosiding Seminar Nasional, 1-8.

Suciyati, A. (2019). Peningkatan Ekonomi Petani Rumput Laut Melalui Program Diversifikasi Produk Olahan Rumput Laut (Diporla) Di Kelurahan Pantai Amal Kecamatan Tarakan Timur Kota Tarakan Kalimantan Utara. Ethos, 1-10.

Sugianto, M. A. (2023, September 26). Badan Riset Dan Inovasi Daerah Kabupaten Badung. Diambil Kembali Dari Brida Badung: Https://Brida.Badungkab.Go.Id/Artikel/52693-Perubahan-Iklim-Mengancam-Ketahanan-Pangan

Sujarwo, B. (2023). Penyebab Terjadinya Pencemaran Udara Di Indonesia, Kaitkan Dengan Perubahan Iklim Dan Ketahanan Pangan. Lemhannas Ri, 1-94.

Sukmawati, A. M., & Utomo, P. (2021). Analisis Risiko Kekeringan Di Kabupaten Bantul Provinsi D.I. Yogyakarta. Jurnal Planologi, 1-21.

Sun, F., Yun, D., & Yu, X. (2017). Air Pollution, Food Production And Food Security: A Review From The Perspective Of Food System. Elsevier, 1-19.

Sunarja, Z. E., Triwandoyo, D., Zebua, V., & Tafanao, S. A. (2024). Analisis Kritis Studi Literatur Tentang Dampak Perubahan Iklim Terhadap Ketahanan Pangan. Jurnal Ilmu Pertanian Dan Perikanan, 1-5.

Suprapto, H., & Raden, I. (2022). Analisis Kesesuaian Kualitas Pasar Sni 8152 Pasar Rakyat Pada 3 Pasar Di Kutai Kartanegara. Jurnal Ekonomi Dan Manajemen Indonesia, 1-13.

Tavita, G. E., Ashari, A. M., Linda, R., Lestari, D., & Kurniadi, B. (2022). Sosialisasi Dan Edukasi Pencegahan Dini Resiko Kebakaran Lahan Gambut Di Musim Kemarau Kepada Masyarakat Desa Kapur. Jurnal Pengabdian Kepada Masyarakat, 1-6.

Tenriawaru, A. N., Arsyad, M., Amiruddin, A., Viantika, N. M., & Meilani, N. H. (2021). Analisis Dan Determinan Nilai Tukar Petani Tanaman Pangan (Ntpp) Di Provinsi Sulawesi Selatan. Journal Of Agricultural Extension, 1-6.

The Economist Impact. (2022). Country Report : Indonesia. Global Food Security Index 2022, 1-4.

Uin Suska Riau. (2018). Konsep Pasar. Repository Uin Suska Riau, 1-23.

Universitas Andalas. (2020). Definisi Banjir. Repository Universitas Andalas, 1-54.

Vioni Nurhaliza, D., Novianti, I., Rafina Rahman, K., Wijaya Abdul Rozak, R., Nurlela, T., Sugiarti, Y., & Trisno Setyani, Z. (2023). Dampak Perubahan Iklim Terhadap Ketahanan Pangan Dan Gizi Di Indonesia Demi Tercapainya Tujuan Sdgs. 1-7.

Wahyudi, I., Hermawan, L. H., & Ferdiansyah, M. (2023). Pertumbuhan Ekonomi Pertanian Di Kabupaten Lampung Selatan Dalam Perspektif Ekonomi Islam. Repository Universitas Lampung, 1-13.

Wakhid, M. U. (2018). Analisis Dampak Emisi Gas Buang Kendaraan Bermotor Co Di Uin Raden Intan Lampung. Repository Uin Raden Intan Lampung , 1-124.

Wanimbo, E. (2019). Kehidupan Sosial Ekonomi Keluarga Petani Dalam Meningkatkan Taraf Hidup (Studi Di Desa Bapa Distrik Bogonuk Kabupaten Tolikara Propinsi Papua). Wanimbo, Eunes, 1-18.

Warsari, D., & Iswan, J. (2023). Kesadaran Masyarakat Dalam Mengurangi Bencana Banjir Dilihat Dari Aspek Hukum Di Sumatera Selatan. Environmental Science Journal (Esjo) : Jurnal Ilmu Lingkungan, 1-7.

Wati, R. I., Subejo, Maulida, Y. F., Gagaria, E. A., Ramdhani, R. A., Izroil, K., . . . Putri, L. A. (2021). Problematika, Pola, Dan Strategi Petani Dalam Mempersiapkan Regenerasi Di Daerah Istimewa Yogyakarta. Jurnal Ketahanan Nasional, 1-21.

Wicaksana, B. (2023). Resiliensi Ekonomi. E-Journal Universitas Atma Jaya Yogyakarta, 1-5.

Widati, A. W. (2021). Ketersediaan Pangan Di Provinsi Papua Barat. Seminar Nasional & Call For Paper Dies Natalis Xxxiii Universitas Islam Batik Surakarta, 1-16.

Wijaya, R. F., Utomo, R. B., Niska, D. Y., & Khairul. (2019). Aplikasi Petani Pintar Dalam Monitoring Dan Pembelajaran Budidaya Padi Berbasis Android. Rang Teknik Jurnal, 1-4.

World Health Organization. (2024, 9 26). World Health Organization. Diambil Kembali Dari World Health Organization: Https://Www.Who.Int/Health-Topics/Air-Pollution#Tab=Tab_1

Yuliyani, N., & Khoirudin, R. (2021). Analisis Efektifitas Investasi Revitalisasi Pasar Prambanan Di Sleman Yogyakarta. Jurnal Sekuritas (Saham, Ekonomi, Keuangan, Dan Investasi, 1-13.

Yusuf, A., Hapsoh, Siregar, S. H., & Nurrochmat, D. R. (2019). Analisis Kebakaran Hutan Dan Lahan Di Provinsi Riau. Dinamika Lingkungan, 1-18.

Zobeidi, T., Yazdanpanah, M., Komendantova, N., Lohr, K., & Sieber, S. (2024). Evaluating Climate Change Adaptation Options In The Agriculture Sector: A Promethee-Gaia Analysis. Elsevier, 1-13.