

Towards Sustainable Food Security: Initiation of Adaptive Policies to the Climate Crisis in Baubau City, Southeast Sulawesi

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Keyword:
Climate change;
Food security;
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Abstract: This study aims to formulate adaptive policies to increase food security through analyzing the impacts of climate change and evaluating existing policies. This study maximizes qualitative methods through observation, documentation and interviews. The data that was successfully obtained was then transcribed and transferred into the NVivo 12 Plus analysis tool for data coding. Next, data visualization is carried out to assist analysis. This research found that climate change has significantly affected agricultural productivity and food availability in Baubau City through extreme rainfall fluctuations and increased temperatures. Declining crop yields and disrupted cropping patterns have led to local food shortages and increased food prices, especially for low-income families. To overcome these challenges, policies such as the Mother's Kitchen Garden Program and agricultural intensification need to be balanced with more comprehensive mitigation strategies, including the development of climate-resilient agricultural techniques, improved water management infrastructure, early warning systems, and farmer education. These findings emphasize the need for adaptive policies to improve food security and agricultural efficiency amidst the climate crisis.

Kata Kunci:
Perubahan iklim;
Ketahanan pangan;
Kebijakan adaptif;
produk pertanian;
kebijakan pertanian.

Abstrak: Studi ini bertujuan merumuskan kebijakan adaptif untuk meningkatkan ketahanan pangan melalui analisis dampak perubahan iklim dan evaluasi kebijakan yang ada. Studi ini memaksimalkan metode kualitatif melalui observasi, dokumentasi, dan wawancara. Data yang berhasil diperoleh kemudian ditranskrip dan dipindahkan ke dalam alat analisis NVivo 12 Plus untuk pengodean data. Selanjutnya, dilakukan visualisasi data untuk membantu analisis. Penelitian ini menemukan bahwa perubahan iklim telah secara signifikan mempengaruhi produktivitas pertanian dan ketersediaan pangan di Kota Baubau melalui fluktuasi curah hujan ekstrem dan peningkatan suhu. Penurunan hasil panen dan gangguan pola tanam telah menyebabkan kekurangan pangan lokal dan peningkatan harga pangan, terutama bagi keluarga berpendapatan rendah. Untuk mengatasi tantangan ini, kebijakan seperti Program Kebun Dapur Ibu dan intensifikasi pertanian perlu diimbangi dengan strategi mitigasi yang lebih komprehensif, termasuk pengembangan teknik pertanian tahan iklim, peningkatan infrastruktur pengelolaan air, sistem peringatan dini, dan edukasi petani. Temuan ini menekankan perlunya kebijakan adaptif untuk meningkatkan ketahanan pangan dan efisiensi pertanian di tengah krisis iklim.

INTRODUCTION

This study is rooted in the urgent need to address the complexity of challenges faced by Baubau City, Southeast Sulawesi, related to food security and the impacts of climate change. As a coastal city, Baubau City is vulnerable to the direct effects of climate change, including rising sea

levels and extreme weather (Harimudin & Salihin, 2017). The agricultural sector, which is the backbone of the economy and the main source of food for the population, generally experiences significant pressure due to increasingly unstable climate conditions (Huq et al., 2015; Lawrence & Vandecar, 2015; Safi et al., 2024; Syldon et al., 2024). Limited agricultural land, changes in rain patterns, and increasing temperatures are some of the main problems faced by farmers and the people of Baubau City in maintaining food security (Raufun et al., 2020). Thus, this research is urgent to provide concrete and responsive solutions in facing the climate crisis and increasing food security in Baubau City, especially in facing the challenge of drought in agricultural land such as rice fields.

The data obtained shows that dozens of hectares of rice fields were damaged as a result of the drought in Bungi District, Baubau City, Southeast Sulawesi. Of the total rice planting of around 1,000 hectares, 12.75 hectares were damaged. This is a concrete illustration of the complexity of the challenges faced in the context of food security and climate change. Data presented by the Baubau City Department of Agriculture and Food Security (Dipertan) shows that drought conditions have resulted in significant losses for the agricultural sector, which is the backbone of the economy and the main source of food for local communities (Putra, 2023). The existence of agricultural land damaged by drought, as well as large areas of land that cannot be harvested, is a clear warning of the need for responsive and targeted solutions in dealing with the impact of climate change on food security in Baubau City. Therefore, this research urges the development of concrete and sustainable policy strategies to overcome this challenge, so that the people of Baubau City can face a more sustainable and productive future.

The general policies implemented by governments in many countries in following up cases such as what happened in Baubau, Southeast Sulawesi, tend to include several strategic approaches. First, the government usually carries out an in-depth evaluation of the impacts of climate change and food security as a whole, including identifying the most vulnerable and affected areas (Abbas et al., 2023; Behera et al., 2023; Rahman et al., 2024). Furthermore, various programs and policies are designed to strengthen infrastructure, increase water access, and introduce agricultural technologies that are more resilient to climate change (Abdi et al., 2024; Masipa, 2017; Pickson et al., 2023). In addition, the government also tends to strengthen early warning systems and emergency response plans to overcome crisis situations, such as droughts that threaten food security (McMahon, 2016; Pickson et al., 2023; Shisanya & Mafongoya, 2016). Education and training programs are also important to increase community food security against climate change and adapt agricultural practices to increasingly unstable environmental conditions (Gebre et al., 2023).

More specifically, food security refers to the ability of a community, country, or food system to meet current food needs without compromising the ability of future generations to meet their own needs (Kopittke et al., 2019). This involves not only sufficient food production, but also equitable access to quality food (Bai et al., 2024), efficient distribution systems (Maity, 2020), and environmentally friendly agricultural practices (Lan et al., 2023). The concept of sustainable food security includes economic, social and environmental aspects, and takes into account food sovereignty, environmental sustainability and social justice (Garba, 2024). With a focus on sustainability, sustainable food security aims to create a food system that can survive in the long term without destroying the natural environment or compromising social welfare.

Even though there is a lot of research currently examining similar problems, the lack of specific studies that analyze the case in Baubau City, especially studies that show the initiation of responsive policies by the local government, is still a deficiency that needs to be addressed to gain a deeper understanding of the challenges and potential solutions. in a more local and concrete context. The advantage of the problem solving offered by the proposer compared to previous research or other researchers in the context of the same problem is the focus on a holistic and inclusive approach in overcoming the challenges of food security and the climate crisis in Baubau City, Southeast Sulawesi. In contrast to previous research which tends to focus on certain aspects,

this research proposes a comprehensive approach, including analysis of the impacts of climate change, active stakeholder participation, and the formulation of responsive adaptive policies. The novelty of this proposal lies in the integration of policy analysis, community participation, and implementation of integrated action focused on adaptation to climate change at the local level. Thus, it is hoped that this research can make a significant contribution to the development of sustainable solutions to increase food security in Baubau City.

This research aims to explore the impact of climate change on food security in Baubau City, Southeast Sulawesi, especially in the context of drought which causes damage to agricultural land. The main problem formulation to be answered is how climate change affects agricultural productivity and food availability in Baubau City. Apart from that, this research also aims to evaluate existing policies and strategies and formulate new policy initiatives that are responsive and adaptive to the climate crisis. The main focus is how policies can be improved to strengthen food security in a sustainable manner and address increasingly complex challenges resulting from climate change. With an in-depth understanding of the impacts of climate change, it is hoped that this research can provide effective guidance in developing policies that are able to face the climate crisis and ensure food availability in Baubau City. Fast and responsive action efforts are crucial in overcoming damage to agricultural land due to drought and increasing food security in Baubau City, especially in the midst of increasingly complex challenges due to global climate change.

RESEARCH METHODS

The research method used is qualitative with data sources from observation, documentation and interviews. Observations were carried out in Bungi District, where the total rice planting reached around 1,000 hectares, with 12.75 hectares recorded as experiencing damage. Official government documents include crop yield reports, land damage data, agricultural policies, and records of support programs for farmers that are relevant to this research. This official document provides valid and verified information regarding agricultural conditions in the research area, thereby supporting the accuracy of field data obtained through observation. This data also allows comparative analysis between actual agricultural output and targets set by the government. As such, the document provides an important basis for understanding the effectiveness of local agricultural policies and identifying areas requiring further intervention.

Interviews were conducted in depth with local governments, especially the Baubau City Agriculture and Food Security Service (Dipertan). This is done because they have direct data and insight regarding agricultural conditions and food security challenges in the region. In-depth interviews with the Department of Agriculture allowed the research to gain a deeper perspective regarding the policies, programs and challenges faced in maintaining food security in Baubau City. Direct data and insights from these agencies help understand factors that influence agricultural productivity and food security, such as climate change, cultivation techniques and support for farmers. This information also enriches the analysis with local context that may not be captured in written documents, such as operational constraints and community responses. Thus, this interview provides a strong basis for evaluating the efforts that have been made as well as the need for new strategies to face food security challenges in the region. The data that was successfully obtained was then transcribed and transferred into the NVivo 12 Plus analysis tool for data coding. Next, data visualization is carried out to assist analysis.

In carrying out the research, the research team will be divided into several stages. The observation process will be carried out by team members who are responsible for documenting field conditions directly. Interviews with local governments, especially the Baubau City Agriculture Department, will be led by team members who have expertise and experience in interacting with related parties. Furthermore, the data transcription and coding process will be handled by a team skilled in qualitative analysis and the use of NVivo 12 Plus software. NVivo 12 Plus was used in this research because of its ability to facilitate complex data transcription,

coding, and visualization processes, thereby facilitating in-depth qualitative analysis (Lestaluhu et al., 2023). Each stage will be monitored and evaluated by the responsible team member, and in accordance with the predetermined budget plan.

Using qualitative methods and utilizing data sources from observation, documentation and interviews, it is hoped that this research can produce an in-depth understanding of the challenges of food security and the impact of climate change in Baubau City. Thus, the proposed responsive policy initiation will be supported by analysis that is comprehensive and relevant to local conditions, so that it can make a significant contribution to efforts to increase food security in the region. The research data that has been processed is then validated by triangulating the research data. The research results that have been processed are then analyzed to answer research questions. The research results obtained are then compiled to be reported to inform the progress of the research results.

RESULTS AND DISCUSSION

Climate change: Agricultural Productivity and Food Availability in Baubau City

Climate change is one of the biggest challenges facing the global agricultural sector today (Jost et al., 2025; Karinda & Baharuddin, 2024; Khan et al., 2020; Malik et al., 2023). The impacts of climate change on the agricultural sector include changes in rainfall patterns, an increase in the frequency of natural disasters, and rising global temperatures, all of which affect crop productivity and the quality of harvests. This condition causes uncertainty in planting and harvest times, and increases the risk of crop failure in various regions, especially those vulnerable to drought and floods. Adaptation to climate change is now a priority for farmers and governments around the world, through the use of more resistant plant varieties, more effective management of water resources, and the application of environmentally friendly technologies. However, without greater collective effort, climate change is expected to continue to threaten global food security and the economic prosperity of many countries.

In Baubau City, the impact of climate change is increasingly being felt with changes in temperature, rainfall patterns and extreme weather events which have a significant impact on agricultural productivity and food availability. This research explores how climate change affects agricultural productivity in Baubau City and how this impacts food availability for the community. Figure 1 will show the various impacts of climate change such as reduced crop yields, changes in cropping patterns, and the impact on local food supplies.

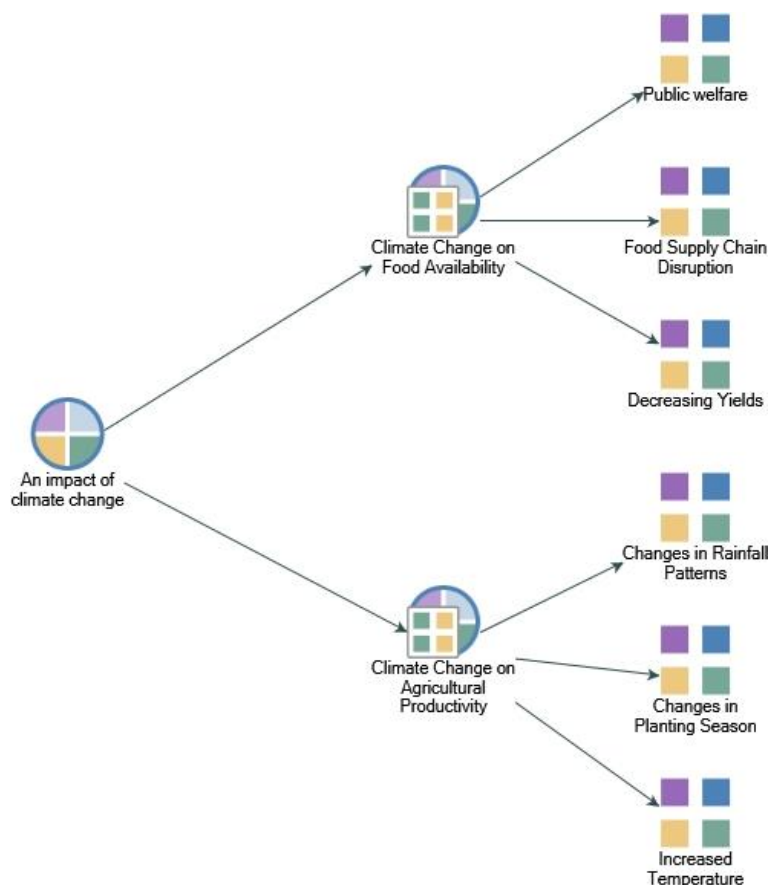


Figure. 1

The Effect of Climate Change on Agricultural Productivity and Food Availability in Baubau City

Source: Processed by researchers with Nvivo 12 Plus, 2024

Changes in rainfall patterns are one of the main impacts of climate change that affect agricultural productivity. Unexpected fluctuations in the amount and timing of rainfall can cause drought or flooding, negatively impacting plant growth and crop yields. Crops that require consistent and adequate rainfall conditions can experience reduced yields or crop failure if rainfall patterns are unstable, which ultimately affects food availability and farmer income. Increasing temperatures also play a significant role in reducing agricultural productivity. Higher temperatures can cause thermal stress in plants, reduce photosynthetic efficiency, and shorten the growing season. In addition, high temperatures can accelerate soil drying and increase water requirements for plants, posing additional challenges in water resource management. Changes in the growing season due to unstable temperatures force farmers to adjust their planting patterns, often with less than optimal results and a higher risk of crop failure.

The Betoambari Meteorological Station in Baubau City, which is located at position 01°37'00.5" South Latitude and 120°02'31.5" East Longitude with an elevation of 17 m, identifies Baubau City in season zone (ZOM) number 315, where the rainy season starts in December the first spring and the dry season in June the second spring, with annual rainfall ranging from 1,478 to 2,000 mm (Hapsah et al., 2020). However, climate change causes unpredictable fluctuations in rainfall patterns, such as droughts or floods, which affect agricultural productivity. This instability can lead to reduced yields and crop failure because crops require consistent rainfall. In addition, increasing temperatures play a role in reducing productivity by increasing thermal stress in plants, shortening the growing season, and accelerating soil drying, which makes water management difficult and leads to reduced crop yields and a higher risk of crop failure. The

empirical data that shows an event in the form of flooding which affected harvest yields in Baubau is seen in Figure 2.



Figure. 2
Floods Affecting Harvest Yields in Baubau
Source: Author Documentation, 2024

This flooding was due to the high intensity of rain. The floods that hit Baubau City caused 40 hectares of rice fields in two sub-districts to fail to grow due to standing water which eliminated rice seeds in several locations. Head of the Baubau Agriculture and Food Security Service, Muhammad Rais, reported that the high intensity of rain had submerged rice fields in Ngkari-ngkari and Waliabuku Villages in Bungu District, as well as Kantalai Village in Lealea District, with losses especially for direct seed planted rice which was not able to survive. in flood conditions. The impact of these floods affects agricultural productivity with the potential for reduced crop yields and disruption to local food availability, requiring immediate action from the government to address losses and plan recovery measures.

Climate change which causes a decrease in crop yields in Baubau City has a significant impact on food availability. Extreme temperature and rainfall fluctuations can damage crops and reduce agricultural productivity, resulting in unstable crop yields. This decline in crop yields affects local food supplies and leads to increased food prices, which can burden household economies and increase the risk of food shortages, especially for families with low incomes. Apart from that, climate change is also causing disruption to the food supply chain. Weather instability can cause damage to agricultural and logistics infrastructure, such as roads and storage facilities, hampering food distribution from producers to consumers. As a result, dependence on food supplies from outside the region increases, which has the potential to cause food price inflation and reduce food accessibility for the community. This impact ultimately affects public welfare as a whole, threatening food security and public health in Baubau City.

The crop failure that occurred in dozens of hectares of rice fields in Bungu District, Baubau City, shows the real impact of climate change, especially drought caused by the El Niño phenomenon. Of the total 1,000 hectares of rice fields, 12.75 hectares experienced puso, which reflects a decrease in crop yields due to lack of water (Putra, 2023). The Head of the Baubau Agriculture Service explained that efforts to prevent more rice fields from experiencing puso were carried out by using water pump machines, but the number was still very limited compared to existing needs. A shortage of water pumps and drilled wells is exacerbating the situation, disrupting food supply chains and affecting local food availability. This has the potential to

increase food prices and reduce public welfare, in line with the impacts of climate change discussed previously.

Overall, climate change, which is demonstrated through fluctuations in rainfall patterns and increasing temperatures, has a major impact on agricultural productivity and food availability in Baubau City. Extreme fluctuations in rainfall, whether in the form of droughts or floods, as well as unstable temperatures, result in reduced crop yields and disruption to the food supply chain. Empirical data shows how floods and droughts result in significant losses in crop yields, ultimately contributing to rising food prices and threatening public welfare. Mitigation efforts such as the use of water pumping machines need to be increased to overcome this impact, but big challenges remain in maintaining food supply stability and supporting food security amidst increasingly uncertain climate change.

Policies and Strategies by the Regional Government in Baubau City

The Baubau City Government, through the Department of Agriculture and Food Security, has launched the Mother's Kitchen Garden (KEDAI) program as part of a strategy to increase food security in the area. The KEDAI program aims to utilize household yard land as an additional food source, focusing on planting vegetable seeds, providing equipment and the necessary fertilizer. Through this program, the government provides direct support to the community by handing over quality vegetable seeds, equipment for processing demonstration plots, and fertilizers needed to ensure the success of small-scale agricultural businesses in home gardens (Diskominfo, 2024).

Socialization regarding the KEDAI program was carried out to ensure that the community understands how to use their yard land effectively. Through this activity, the community is expected to be able to improve their farming skills, which will not only help meet daily food needs but also reduce dependence on external food supplies. In addition, the training and assistance provided aims to ensure that each family can manage their kitchen garden optimally, so as to increase harvest yields and support local food security. It is hoped that the KEDAI program can be a long-term solution in facing food security challenges in Baubau City, especially amidst climate change which affects agricultural productivity. By prioritizing community participation and utilizing homestead land effectively, this program not only helps improve food security but also empowers local communities to become more independent in meeting their food needs.

Although the Mother's Kitchen Garden Program (KEDAI) launched by the Baubau City Government aims to increase food security by utilizing garden land, this policy faces significant challenges due to climate change. Extreme fluctuations in rainfall, whether drought or flood, can affect the effectiveness of kitchen gardens in meeting daily food needs. Vegetable crops grown in home gardens may not survive unpredictable weather conditions, potentially reducing yields and hampering the program's food security goals.

In addition, increasing temperatures which cause thermal stress in plants and accelerate soil drying also add challenges to the success of the KEDAI program. While providing equipment and fertilizer is a positive step, reliance on stable weather conditions for small farm productivity may not be enough to address the wider impacts of climate change. Therefore, this program needs to be balanced with climate change mitigation strategies, such as developing agricultural techniques that are more resilient to climate change and better water management systems, to ensure the success and sustainability of food security efforts in Baubau City.

Apart from that, the Baubau City Government through the Department of Agriculture and Food Security (Dipertan) is also implementing an agricultural intensification policy to increase food production considering the limitations in expanding rice field areas. With a rice field area that has reached 1,290 hectares and is considered the maximum, the Agriculture Department is focused on optimizing existing land through the application of intensification techniques. This includes the use of new rice seeds from the same variety, namely the Cisantana variety, to increase yields from 3.7 tonnes per hectare to 4.3 tonnes per hectare (Putra). This policy aims to increase agricultural productivity without expanding land, considering the difficulties in expanding rice fields in dense urban areas. Through steps such as procuring more productive seeds and more

efficient land processing methods, the Agriculture Department hopes to overcome challenges in food production and support food security in Baubau City, although limited space for expansion is a major obstacle.

Responsive and Adaptive Policy Initiatives to the Climate Crisis

This study further maps several recommendations that can encourage responsive and adaptive policy initiatives in Baubau in overcoming the climate crisis and its impacts. This is seen in Figure 3.

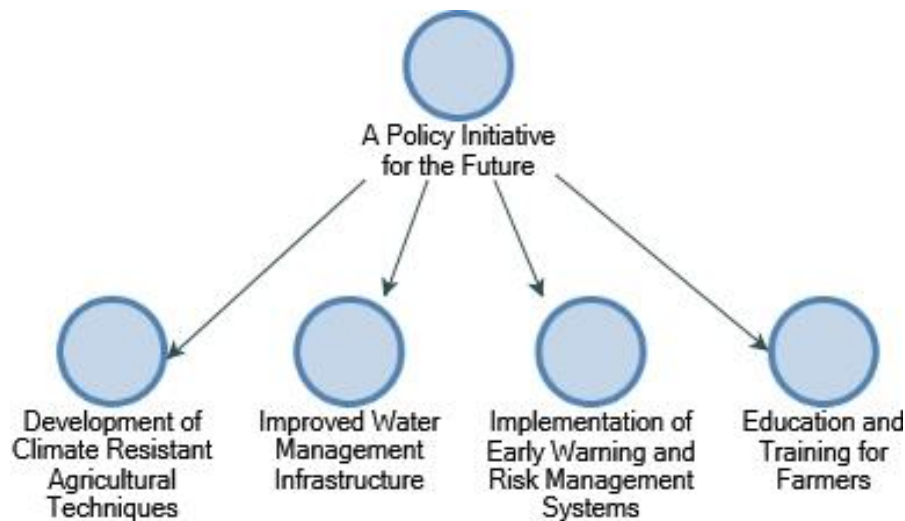


Figure. 3

Responsive and Adaptive Policy Initiatives to the Climate Crisis

Source: Processed by researchers with Nvivo 12 Plus, 2024

Developing climate-resilient agricultural techniques is an important step to deal with climate change. The Baubau City Government must integrate agricultural techniques designed to withstand extreme climate conditions. For example, developing crop varieties that are resistant to high temperatures and fluctuations in rainfall is an effective strategy. Rice varieties that are resistant to drought or flooding can help increase productivity amidst climate change. Additionally, implementing farming methods such as drip irrigation, which minimizes water use while ensuring crops get the right water requirements, can increase resource use efficiency. Good soil management methods, such as soil conservation and sustainable planting techniques, are also important for reducing erosion and maximizing water retention, which in turn supports food security. For example, in India, climate-resilient agricultural techniques have been implemented to deal with climate change. The Sustainable Intensification Program integrates drought-resistant crop varieties and uses efficient irrigation techniques to increase crop yields in areas that frequently experience drought (Yaqoob et al., 2023). In Kenya, the Climate-Smart Agriculture program also implements climate-friendly agricultural practices, including the use of crop varieties that are resistant to extreme weather and efficient water management (Ndung'u et al., 2023).

Improving water management infrastructure is a crucial step in overcoming the impacts of climate change, such as drought and floods. Investments in improving irrigation systems, building small dams, and providing additional water pumps are urgently needed to address water shortages and prevent flood damage. Infrastructure designed to accommodate erratic weather fluctuations can help farmers better manage water resources and maintain the stability of food production. For example, in Bangladesh, the development of weather-based irrigation systems, which allow farmers to monitor and adjust water use according to changing weather conditions,

has helped improve food security (Jamal et al., 2023). In Ethiopia, the Smallholder Irrigation Development Program project has succeeded in building small irrigation systems that help farmers face the challenges of drought and increase crop yields (Berhanu Desalegn et al., 2024).

Developing an early warning system for weather-related disasters is an important step in climate change risk management. This system can include information technology to monitor real-time weather and provide information and advice to farmers regarding appropriate planting times and mitigation measures. With an early warning system, farmers can prepare for and deal with the impacts of extreme weather before it occurs, reducing losses and ensuring food security. For example, in Papua New Guinea, a satellite-based early warning system that monitors flood and tropical storm risks has been implemented to provide information to farmers and communities (Isaev et al., 2024). In Vietnam, the Flood Early Warning System program has helped farmers anticipate floods and reduce crop losses by providing accurate warning information (Cao et al., 2023).

Education and training for farmers is key to adapting to climate change. Training programs should cover climate-friendly farming techniques, risk management, and ways to use land efficiently. With the right knowledge, farmers can adapt their practices and reduce the negative impacts of climate change on food production. In Southern Ethiopia, the Climate Smart Agriculture Training program provides training to farmers on agricultural techniques that are sustainable and adaptive to climate change (Masha et al., 2024). In Northern Ghana, the Farmer Field Schools program provides education for farmers on climate-friendly agricultural practices and risk management to improve food security (Pienaa et al., 2024). The above programs have been proven to help farmers adapt their practices to climate change and increase crop yields. Through these initiatives, Baubau City can develop policies that are responsive and adaptive to the climate crisis, increase food security, and support community welfare amidst increasingly uncertain climate change.

CONCLUSION

Climate change has had a significant impact on agricultural productivity and food availability in Baubau City. Extreme fluctuations in rainfall, both in the form of droughts and floods, as well as increasing temperatures, have disrupted plant growth, reduced crop yields and changed cropping patterns. Falling crop yields impact local food supplies, increasing food prices and exacerbating the risk of food shortages, especially for families with low incomes. This shows an urgent need for policies that can address these challenges, such as the development of climate-resilient agricultural techniques and better water management systems. In response to this challenge, the Baubau City Government has launched the Mother's Kitchen Garden Program (KEDAI) and an agricultural intensification policy to increase food security and agricultural productivity.

However, to achieve optimal results, these programs must be balanced with more comprehensive climate change mitigation strategies. First, the development of climate-resistant agricultural techniques must be carried out, such as plant varieties that can withstand extreme temperatures and efficient irrigation methods such as drip irrigation, as well as good soil management to increase plant resilience and efficient use of resources. Second, improving water management infrastructure through improving irrigation systems, building small dams, and providing additional water pumps is very important to overcome droughts and floods. Third, an early warning system for weather-related disasters should be developed to provide real-time information to farmers about extreme weather and mitigation measures. Fourth, education and training for farmers on climate-friendly agricultural techniques and risk management needs to be improved to ensure they can adapt practices effectively and increase food security

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