Climate change adaptation based on local wisdom: Transforming home industries towards a sustainable circular economy in Magetan Regency

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Abstract. This research aims to explore climate change adaptation strategies based on local wisdom to drive the transformation of home industries towards a sustainable circular economy in Magetan Regency. In the context of the global climate crisis, home industries actors in this area face challenges in maintaining productivity and business sustainability. However, the local wisdom passed down through generations—such as energy-saving practices, the utilization of organic waste, and community-based production systems—becomes a potential social and cultural capital to shape a circular economy model. This research uses a qualitative approach with case study methods, in-depth interviews, participatory observation, and documentation studies involving home industries actors, community leaders, and relevant institutions. The research results show that the integration of local wisdom with the principles of a circular economy, such as waste reduction, raw material recycling, and the innovation of environmentally friendly products, can enhance the socio-economic resilience of the community and reduce environmental impact. This research recommends strengthening local capacity through appropriate technology training, the development of networks among business actors, and local government policy support favoring a locally-based green economy model. Thus, the transformation of the home industries in Magetan can serve as a good practice example in building a circular economy that is adaptive to climate change and rooted in local culture.

1 Introduction

Climate change has a significant impact on home industries, which serve as the backbone of local economies, through decreased productivity, rising costs, and limited market access [1–3]. Adaptation based on local wisdom has become an essential and sustainable strategy [4,5]. Magetan Regency, with its strong traditions and agrarian foundation, illustrates how communities respond to climate challenges through home industries such as Sidomukti batik, leather crafts, bamboo weaving, and traditional food processing. These products are not only cultural identifiers but also economic assets with the potential to transition toward a

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sustainable circular economy. The local wisdom of the Magetan community—such as gotong royong (mutual cooperation), frugality, and the prudent use of natural resources—serves as crucial social capital for climate adaptation. Traditional practices, including the use of agricultural waste, environmentally friendly local materials, and collective labor, support the principles of a circular economy. Inherited knowledge, such as pranata mangsa (traditional seasonal calendar), customary spatial planning, and culture-based conservation, forms the foundation for adaptation efforts that maintain ecological sustainability while strengthening identity and social solidarity amid climate change.

The circular economy emphasizes the importance of reducing waste, recycling materials, and creating new added value from limited resources [6–8]. The integration of local wisdom with the concept of a circular economy not only strengthens the resilience of home industries in facing climate change but also promotes the development of an inclusive, sustainable, and regionally grounded development model [9,10]. Therefore, this study aims to examine how local wisdom can serve as the foundation for transforming home industries toward a sustainable circular economy as a climate change adaptation strategy in Magetan Regency. This research is expected to contribute theoretically to the development of culturally based adaptation models and to offer practical recommendations for local governments, MSME actors, and the wider community in building an economic system that is resilient, sustainable, and responsive to global climate challenges.

2 Research Method

This study was conducted in Magetan Regency, East Java Province, Indonesia. Geographically, Magetan is located on the slopes of Mount Lawu and features a combination of mountainous, hilly, and lowland landscapes, which contribute to the diversity of its ecosystems and the community's economic activities. The primary districts (sub-regencies) focused on in this study include: Plaosan District (due to its proximity to the Sarangan Lake tourism area), Panekan and Ngariboyo Districts, which are active in home industries utilizing natural materials—such as traditional food processing and bamboo or wood crafts—and Bendo and Takeran Districts, known for their agricultural traditions and household-based agro-processing activities. The selection of Magetan Regency as the research site is based on several strategic considerations: the presence of active home industries (such as leather crafts, food processing, and agricultural products); the existence of local wisdom in natural resource management; vulnerability to the impacts of climate change that encourages adaptation and business innovation; and strong support from both the government and local communities through development programs grounded in local potential and environmental sustainability.

This study adopts a constructivist paradigm, which posits that social reality is shaped by the experiences, values, and perceptions of individuals or groups within specific social and cultural contexts [11,12]. In this framework, climate change is understood not merely as a physical-scientific phenomenon but also as a social reality that communities respond to based on their local and cultural understandings. Accordingly, the constructivist paradigm enables researchers to explore how local communities in Magetan Regency perceive climate change and develop local wisdom–based adaptation strategies to sustain their home industries. This paradigm emphasizes the importance of interaction between researchers and participants, as well as the understanding of socially constructed meanings embedded in community adaptive actions [13]. Thus, the study does not aim to generalize its findings but rather to achieve an in-depth understanding of the local context.

This study employs a descriptive qualitative approach, which is used to gain an in-depth understanding of how home industry actors in Magetan Regency adapt to climate change through practices rooted in local wisdom [14]. Through this approach, the researcher aims to identify: community adaptation patterns to the impacts of climate change, local strategies

used to maintain the continuity of home industries, and the local cultural values that support economic and environmental resilience. Three primary data collection techniques were applied in this study. In-depth interviews were conducted with home industry practitioners, traditional leaders, village officials, academics, and NGOs to explore adaptation practices, the integration of local wisdom, and institutional support. Participant observation was carried out during production processes, community activities, and local traditions to directly observe ecological adaptation patterns and social interactions. Documentation—including village archives, local policies, cultural records, photographs, and NGO reports—was used to reinforce findings from interviews and observations. In this qualitative study, data were analyzed using the interactive analysis model of Miles and Huberman [15], which consists of three main stages: data reduction, data display, and conclusion drawing/verification. These stages were conducted cyclically and continuously throughout the research process.

Data Reduction involves selecting data relevant to the research focus, namely: (1) local wisdom practices in responding to climate change, (2) the transformation of production strategies in home industries, and (3) the concept of a locally based sustainable economy. The second stage, Data Display, presents the data in descriptive narratives, matrices, or tables to systematically illustrate the findings. This process enables the researcher to: (1) identify patterns, relationships, and trends among the data; (2) compare practices across different home industry actors; and (3) determine the influence of local wisdom on climate adaptation and economic transformation.

The third stage, conclusion drawing and verification, involves formulating preliminary conclusions from the organized data, followed by verification through: (1) data triangulation (sources, methods, and theories), (2) reconfirmation with key informants, and (3) critical reflection on potential biases. As part of data validity, triangulation techniques were employed: Source triangulation, comparing data from home industry actors, traditional leaders, and local government representatives. Method triangulation, combining in-depth interviews, participant observation, and documentation. Theoretical triangulation, analyzing data through the frameworks of climate change adaptation, local wisdom, and sustainable economy theories.

3 Research Results and Discussion

Magetan Regency, located on the slopes of Mount Lawu, possesses rich natural and cultural resources that have fostered the growth of home industries as a pillar of the local economy. Rooted in tradition, mutual cooperation (gotong royong), and the utilization of local resources, these enterprises hold not only economic value but also embody the region's cultural identity. Their leading products include leather crafts, hand-drawn batik, traditional food processing, and agricultural produce.

A comprehensive description of the characteristics of home industries is essential to fully understand their role within the local economy. These characteristics encompass their historical background, production structure, labor patterns, social capital, and the challenges they face amid modernization and globalization. The historical development of home industries in Magetan is closely linked to the region's geographical and cultural conditions. As an agrarian area, the people of Magetan have long been accustomed to utilizing natural resources for daily needs, including as raw materials for handicrafts and processed food products. One of the most prominent examples is the leather craft industry in Magetan District, particularly in Selosari Village and its surroundings. The tradition of producing sandals, shoes, and leather jackets has existed since the colonial era, when locals made use of cowhide from nearby livestock farms. Initially, production was carried out on a small scale to meet domestic needs, but over time, it evolved into a commercial trade commodity.

In addition to leather crafts, Magetan batik also has a long and rich history. The Pring Sedapur motif, which has become the hallmark of Magetan batik, symbolizes the philosophy of togetherness and environmental harmony. Batik production in Magetan initially developed among housewives as a side activity but eventually became a significant source of household income. In the food sector, various traditional delicacies—such as getuk lindri, keripik tempe, kerupuk lempeng, and cassava-based snacks—reflect the creativity of Magetan's people in processing agricultural products. These homemade food items were originally produced for family consumption but later became market commodities, sold in traditional markets and as souvenirs for tourists.

This long-standing history demonstrates that home industries in Magetan are not merely small-scale economic units but also living cultural heritage that continues to endure today. Home industries are spread across almost all districts in Magetan, with concentrations in certain areas based on local natural resource potential. Examples of these distributions include: Magetan District, center of leather crafts, including sandals, shoes, and jackets. Panekan and Plaosan Districts, producers of food products made from cassava, bananas, and corn. Lembeyan and Takeran Districts, centers for agricultural product processing, such as keripik, rengginang, and other traditional snacks. Kawedanan District, home of hand-drawn batik artisans featuring Magetan's distinctive motifs. Parang and Ngariboyo Districts, producers of bamboo weavings, traditional household tools, and handmade crafts.

This distribution indicates that home industries in Magetan are grounded in the unique local strengths of each region. The availability of raw materials, long-standing traditions, and inherited skills serve as key factors driving the growth of enterprises in every district. The study finds that home industries in Magetan Regency have developed across various sectors, including leather crafts (particularly in Magetan and Panekan Districts), agricultural product processing (such as emping melinjo, sale pisang, and jenang), and snack production based on locally sourced ingredients. Most home industry operators are family-based enterprises passed down through generations, which makes the elements of tradition, culture, and local values deeply embedded in their production processes. Typically, home industry actors employ local labor, utilize locally available raw materials, and apply semi-traditional production techniques. Despite their simplicity, these products maintain market competitiveness both locally and within broader regional distribution networks.

Table 1. The Impact of Climate Change on the Sustainability of Home Industries

Description of the Impacts	Example
Availability of Raw Materials	
Decreased productivity and product quality, so that raw material costs increase.	Defects in the product, such as imprecise stitching, leather color that fades quickly, or a shape that does not meet market standards.
The decline in the quality of animal feed affects the health of cattle, so that the availability of quality leather decreases.	Many cows experience suboptimal growth, their skin becomes thinner, drier, and they are even susceptible to skin diseases such as scabies.
The availability of natural dye plants is decreasing.	Leather crafts in Magetan were finally forced to switch to using chemical-based synthetic dyes.
Production process	
High temperatures can accelerate the deterioration of raw materials, while prolonged rain can hinder the drying process of emping or batik.	Melinjo or cassava that is exposed to excessive heat for too long will change its taste, becoming bitter or burnt, thus reducing the quality of the emping or chips.
The long dry season reduces water discharge, affecting businesses that use water-based energy.	Batik colors are uneven and fade easily, which reduces the product's selling value

Infrastructure Vulnerability: Small production houses are vulnerable to damage during heavy rain or flooding.	Raw materials such as cassava, soybeans, and batik cloth become damp, moldy, or even completely damaged.
Distribution and Market	
Distribution Disrupted: Heavy rain and landslides caused delays in order deliveries.	Rural-urban routes often block access, hindering the delivery of emping, chips and dairy products.
Increased Transportation Costs: Extreme weather increases transportation costs due to greater fuel requirements and higher travel risks.	Transportation costs rise and product prices become less competitive in markets outside the region.
Social and Labor Aspects	
Worker Vulnerability: Home industry workforce is decreasing as climate impacts on agriculture push them to move sectors.	When harvests decline due to extreme weather, they choose to work as construction workers or migrate to the city, so that the home industry lacks skilled labor.
Increasing Gender Burden: Women in Magetan's home industry face a double burden: their businesses are disrupted, and their families must remain food secure.	When the long rainy season disrupts production, they lose income. However, at the same time, they must still ensure their families' food needs are met.
Labor Migration: Younger generations are reluctant to continue home industries, triggering the loss of local skills.	Traditional skills such as batik making with natural dyes, processing leather manually, and making traditional emping are threatened with extinction due to a lack of regeneration.
Economic Sustainability	
Rising Production Costs: Fluctuations in raw materials, energy, and transportation are putting pressure on home industry profits.	Leather craftsmen in Kawedanan and garut chip producers in Panekan face rising costs
Risk of Losing Market: Home industry products are threatened with losing out to cheaper and more environmentally friendly substitutes.	Some consumers are starting to abandon Sidomukti hand-drawn batik because the price is relatively high and there are still craftsmen who use synthetic dyes.

Data source: Analysis of primary data through in-depth interviews 2025

Based on in-depth interviews with home industry practitioners, it was revealed that "prolonged dry seasons and extreme rainfall disrupt planting and harvesting patterns, thereby affecting the supply of raw materials" (Interview with Mr. Karso, June 31, 2025). In addition, changes in temperature and humidity have influenced the natural drying process of raw materials such as emping and keripik. Several entrepreneurs noted that a drying process that previously took two days can now take up to four days, and often requires additional drying equipment—further increasing production costs. Nevertheless, through adaptation grounded in local wisdom, the application of appropriate technological innovations, and the adoption of circular economy principles, home industry actors can strengthen their resilience and ensure the continuity of their enterprises in the face of climate-related challenges.

3.1 Adaptation Strategy Based on Local Wisdom

Tabel 2. Adaptation Strategy of Home Industry Actors Based on Local Wisdom to the Impact of Climate Change

Strategy form description	Impact
Adjustment of production time:	
Business owners adjust their production schedules to local weather patterns, observed over generations. They maintain a kind of unwritten local calendar to determine the best times to process and dry their products..	Home industry players are able to reduce the risk of raw material loss, making it more economical and environmentally friendly.
	This pattern is in line with the principles of a circular economy, as it emphasizes efficient use of resources and minimizing waste resulting from production failures.
	This wisdom shows how traditional knowledge can contribute to the resilience of small businesses in the face of climate change.
Product and Business Diversification:	
When primary raw materials are difficult to obtain due to climate change, businesses turn to other readily available products. For example, when melinjo (gnetum gnemon) is scarce, some businesses switch to producing cassava chips or local fermented foods like tape.	Adding value, because fermented products have a stable market and strong local cultural identity.
	Business actors do not lose the market completely even though they face commodity shortages.
	Strengthening tradition-based innovation, because people are already accustomed to processing this alternative food ingredient.
Utilization of Appropriate Energy and Technology:	
Several business groups have begun to utilize simple technologies such as solar-powered drying ovens or biomass furnaces to replace natural drying.	Home industries can continue to produce throughout the year without being too affected by extreme weather conditions.
	Utilizing sunlight and local biomass makes the business more cost-effective and environmentally friendly.
	Products dried using this simple technology are more consistent in terms of taste, color and shelf life..
Local Social and Institutional Collaboration:	
Magetan home industry players join BUMDES to share information, tools, raw materials, and marketing.	Business actors can make collective purchases to reduce prices
	Ensuring the availability of raw materials through a joint stock system.
	Reduce the risk of dependence on middlemen.

Data source: Analysis of primary data through in-depth interviews 2025

The formation of working groups and village-owned enterprises (BUMDes) serves not only as a practical solution to resource constraints but also as a form of sustainable social adaptation. These strategies are deeply rooted in the social capital values that have been passed down through generations, such as mutual cooperation (gotong royong), trust, and collective responsibility within the community.

3.2 Social capital and the development of home industries

Home industries in Magetan Regency rely not only on economic factors but also on the deeply rooted socio-cultural strengths embedded within the community's way of life. This strength takes the form of social capital—the networks, norms, and values that facilitate coordination and cooperation to achieve common goals (Putnam, 1993). Such social capital serves as a vital foundation for maintaining the sustainability of home industries, even in the face of various constraints such as limited financial resources, technology, and market access.

Table 3. Contribution of social capital to the development of home industry

Implementation of social capital	Contribution to the development of home industry
Mutual cooperation	
The value of mutual cooperation is evident in production and marketing practices. For example, when a large order arrives, families and neighbors will help each other.	Helping to complete work, both in the leather craft production process, batik making, and traditional food processing
Mutual cooperation is also seen in the form of sharing production equipment, lending small capital, and sharing marketing networks.	Able to overcome the limited resources owned by each business actor
Mutual respect	
The principle of mutual respect creates a harmonious business climate. Despite the presence of many businesses operating in similar fields, competition tends to be healthy.	Home industry players try to maintain good relations to create social balance.
This local business ethic makes it easier for people to collaborate, for example in forming groups.	Prevent conflicts that could harm business continuity.
Trust	
Building business relationships based on mutual trust, both between craftsmen, between families, and with consumers.	This trust reduces transaction costs.
Many transactions are conducted on a trust system without rigid written agreements.	Speed up the cooperation process, and facilitate product distribution.
Honesty	
The products sold reflect the true quality, thus creating consumer loyalty.	Make consumers and business partners feel safe
Home industry players maintain product quality according to standards and consumer demand.	Make consumers feel confident that every product made in Magetan truly lives up to the promised value.
Altruism	
When there are difficulties with capital, raw materials, or marketing, other members provide non-formal loan assistance.	Creating a social safety net that ensures no member of the community is marginalized and also strengthens collective economic resilience.
If a craftsman is short of raw materials, other business actors are willing to lend them or sell them at a cheaper price.	This practice demonstrates how social networks can serve as a buffer against production risks.
If one craftsman is unable to fulfill an order, he will involve other fellow craftsmen to work together.	Maintaining relations between business actors and also strengthening collective competitiveness in meeting market demand

Data source: Analysis of primary data through in-depth interviews 2025

Social capital serves as the primary foundation for the continuity of home industries in Magetan. Values such as gotong royong (mutual cooperation), tepo seliro (empathy and

respect), trust, honesty, and altruism not only support the local work ethic but also function as adaptive mechanisms to overcome limitations in capital and challenges in business sustainability. Climate change poses significant threats to the sustainability of Magetan's home industries through disruptions in raw material supply, production processes, distribution networks, and labor availability. However, by integrating local wisdom, circular economy principles, and leveraging government and community support, home industries have the potential to enhance their resilience while simultaneously advancing toward sustainable growth.

3.3 Circular Economy Development Strategy in Magetan

The development of a circular economy in Magetan is grounded in local potential, cultural values, and the application of appropriate technological innovations. Through the integration of local wisdom, resource efficiency, and multi-stakeholder collaboration, Magetan's home industries have the capacity to transform from mere family-based economic units into pillars of a sustainable economy that are resilient to climate change.

Table 4. Circular Economy Development Strategy in Magetan

Strategy Description	Impact on Circular Economy Development
Production Time Adjustment:	
Magetan business owners follow the local weather calendar, which has been passed down through generations, to determine the right time for production and drying.	Home industry players are able to reduce the risk of raw material loss, making it more economical and environmentally friendly.
	Efficient use of resources and minimizing waste due to production failure.
	Traditional knowledge can contribute to the resilience of small businesses in the face of climate change..
Product and Business Diversification:	
When raw materials are scarce due to the climate, Magetan business people turn to alternative products, for example from melinjo chips to cassava chips or tape.	This diversification provides added value, because fermented products have a stable market and a strong local cultural identity.
	Business actors do not lose their market completely even though they face commodity shortages.
	Local wisdom: strengthening tradition-based innovation, because people are accustomed to processing these alternative food ingredients.
Utilization of Appropriate Energy and Technology:	
Several business groups have begun to utilize simple technologies such as solar-powered drying ovens or biomass furnaces to replace natural drying.	Production Resilience: Home industries can continue production throughout the year without being overly affected by extreme weather conditions.
	Utilizing renewable energy (solar) and local biomass makes the business more cost-effective and environmentally friendly.
	Products dried using this simple technology are more consistent in terms of taste, color, and shelf life.
	With stable product quality, Magetan home industry can compete better in local and regional markets.
Local Social and Institutional Collaboration:	
Magetan home industry players form groups and associations to share information, production tools, raw materials, and joint marketing.	Business actors can: Make collective purchases to reduce prices
	Ensuring the availability of raw materials through a joint stock system.
	Reducing the risk of dependence on middlemen.

Data source: Analysis of primary data through in-depth interviews 2025

The implementation of this strategy will enable Magetan's home industries to become more resilient to the impacts of climate change, enhance their competitiveness, and remain grounded in local cultural values. Thus, the circular economy serves not only as an ecological solution but also as a sustainable development strategy aligned with the region's socio-cultural character. "If small enterprises in Magetan want to survive, we must adapt. For example, leftover leather or bamboo waste can be processed into other products instead of being discarded. Likewise, in food production, if the main ingredient becomes scarce, we switch to other locally available materials. That way, the business keeps running without abandoning our traditions." (Interview with Mrs. Sulastri, traditional food home industry owner, July 2, 2025). Therefore, climate adaptation strategies based on circular principles contribute to achieving inclusive and identity-based sustainable development.

4 Conclusion

Climate change adaptation based on local wisdom serves as a key driver in transforming home industries in Magetan Regency toward a sustainable circular economy. Local wisdom—embodied in the principles of frugality, gotong royong (mutual cooperation), and harmony with nature—has proven highly relevant in addressing climate challenges that affect raw material availability, production processes, and distribution systems. Through strategies such as product innovation, waste utilization, implementation of clean production systems, strengthening of cooperative institutions, and integration of local cultural values, Magetan's home industries have enhanced both their resilience and competitiveness. The transition toward a circular economy not only generates economic benefits—including cost efficiency and product diversification—but also produces social impacts through community empowerment and the reinforcement of social capital. Moreover, the environmental impact is equally significant, as waste materials are repurposed into new resources, reducing ecological pressure. Thus, the application of local wisdom–based adaptation and circular economy principles enables Magetan's home industries not only to survive amid the climate crisis but also to grow sustainably while preserving the region's cultural identity.

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