

ADAPTIVE HUMAN RESOURCE DEVELOPMENT IN SUPPORTING SUSTAINABLE DEVELOPMENT BASED ON GEO-TOURISM IN THE LAKE TOBA CALDERA AREA

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Abstract

This study aims to analyze how the Adaptive Human Resource Development (AHRD) approach can be a strategic framework in developing local human resource capacity to support sustainable development based on geotourism in the Toba Caldera Area in Samosir Regency, and uses a qualitative approach. The results of the study indicate that the implementation of AHRD integrated with local wisdom values, mastery of digital technology, and strengthening community institutions can be an important foundation in improving the quality of local human resources that are responsive to change and able to play an active role in environmental conservation, sustainable tourism management, and improving community welfare.

Keywords: Adaptive Human Resource Development, Geotourism, Sustainable Development, Lake Toba Caldera

I. INTRODUCTION AND RESEARCH PROBLEM

The Lake Toba Caldera area is one of UNESCO's Global Geoparks with unique geological, ecosystem, and cultural richness. The Lake Toba Caldera area, located in North Sumatra Province, Indonesia, is one of the geological wonders of the world. Formed from a supervolcano eruption around 74,000 years ago, this caldera is now the largest volcanic lake in the world with a length of around 100 km and a width of 30 km. This area not only holds high scientific values, but is also a mainstay of hope for sustainable geotourism-based economic development in North Sumatra. In the middle of this lake is Samosir Island, which not only has geological value, but is also rich in the culture and history of the Batak people. Samosir Regency, which is in the heart of the Toba Caldera, has a strategic role in the development of this area, considering its location on Samosir Island and the cultural richness of the Batak people which is an integral part of the tourist attraction. Samosir Regency, as an integral part of the Toba Caldera area, has a strategic role in the development of geotourism. The Samosir Regency Government has set a tourism development program in the 2021–2026 Regional Medium-Term Development Plan (RPJMD), which includes increasing human resource capacity, community empowerment, and cultural preservation. In addition, the recognition of the Toba Caldera as a UNESCO Global Geopark in 2020 marks the importance of this area in a global context. This status provides great

opportunities for the development of sustainable geotourism, which integrates nature conservation, cultural preservation, and local community empowerment in Samosir Regency. However, to realize this potential, adaptive and competent human resources (HR) are needed in managing and developing sustainable tourism. This is the main reason that the Adaptive Human Resource Development (AHRD) approach is very relevant in this study.

A serious challenge faced in the development of the Lake Toba Caldera Area, especially in Samosir Regency, is preparing local human resources (HR), because many local communities have not been fully involved in optimizing Toba Caldera tourism. This is due to low digital literacy, limited training based on local needs and suboptimal synergy between actors being the main obstacles in realizing sustainable development. As stated by (Tobing, 2025), that in facing the problems of sustainable development in increasingly complex global dynamics, especially in the demands of sustainable tourism, the HR development approach is not only technical, but also adaptive to the local socio-ecological context. Thus, the adaptive human resource development (AHRD) approach emphasizes the development of individual and organizational capacities that are responsive to changes in the environment, technology and market needs. (B.Sh, Usmonov; Z.A, Babakhanova; Kh.L, 2019; Hasselman, 2017) stated that this approach does not only focus on improving technical skills, but also on developing attitudes, values, and knowledge that support sustainability. The implementation of AHRD in Samosir Regency can include local needs-based training, integration of local wisdom into the training curriculum, and strengthening community institutions. Thus, AHRD can be used as a strategic framework in mainstreaming local community empowerment through education, training, lifelong learning, and strengthening local institutions based on participatory. Adaptive human resource development is also in line with Indonesia's national development vision as stated in Asta Cita, especially Cita 4 which emphasizes improving the quality of life of Indonesian people through education and training. Human resource development in the Toba Caldera area will not only support local development but also contribute to the achievement of national development goals. In addition, adaptive human resource development is also important in facing global challenges such as climate change and pandemics. (Sibarani et al., 2025) explained that the Toba Caldera area, with its high biodiversity and culture, is vulnerable to the impacts of climate change. Adaptive human resources can play a role in mitigating and adapting to these changes through sustainable natural resource management and environmentally friendly tourism development. Thus, adaptive human resource development is key in building tourism sector resilience to crisis and change and is a strategic step in supporting sustainable development based on geotourism in the Lake Toba Caldera area. This approach will not only increase the capacity of local communities, but also strengthen the competitiveness of the area as a leading sustainable tourist destination.

Furthermore, in the sustainable development paradigm, (Kholik & Yusri, 2025) that human resource development is not only seen as an economic instrument, but as a key element in maintaining social and ecological sustainability. Local human resources in Samosir not only need to be skilled in providing tourism services, but also understand the philosophy of environmental conservation, regional governance, and the importance of maintaining cultural heritage and local wisdom. With this background, this article will discuss how the AHRD approach can be implemented to support sustainable geotourism development in the Lake Toba Caldera area, especially in Samosir Regency. Based on this explanation, there are several main problems that are the focus of this study:

1. Limited capacity of local human resources in supporting sustainable geotourism development.

Many local actors, including micro-entrepreneurs, youth groups, and indigenous communities in Samosir Regency, do not yet have adequate skills and knowledge to manage geotourism potential professionally and sustainably. Limited access to training, minimal mentoring, and lack of involvement in the planning process are crucial issues.

2. Lack of adaptive human resource development approaches to local characteristics.

Most human resource capacity building programs in the tourism sector are still generic and do not consider local dynamics, Batak cultural values, and the potential for local wisdom that should be social capital in the development of the Toba Caldera area. This results in low relevance of training and low community absorption of innovation.

3. There is no integration between human resource development policies and sustainable development strategies.

The fragmentation of sectoral policies between tourism, education, and community empowerment has resulted in suboptimal human resource development in supporting the grand vision of developing the Toba Caldera as a world geopark area. Synergy between stakeholders and multi-level governance collaboration are still not optimal.

4. Minimal use of digital technology in the process of empowering local human resources.

In the era of digitalization, the use of information technology should be able to expand access to training, tourism promotion, and strengthen local community networks. However, in reality, the digital divide in rural areas of Samosir is still high, thus limiting the process of transforming human resources towards the era of the creative economy and digital tourism.

5. The AHRD model based on local wisdom for sustainable development has not been established.

It is necessary to develop a conceptual and operational model for human resource development that is oriented towards local adaptation, based on community participation, and synergistic with the principles of geotourism. This model is expected to be able to answer the needs of the local context while supporting global agendas such as the Sustainable Development Goals (SDGs).

II. LITERATURE REVIEW AND PREVIOUS STUDY

Sustainable development is a global focus in order to improve the quality of life without damaging natural resources for future generations. One area that supports this concept is geotourism, which is a form of nature-based tourism that utilizes the unique geology of an area as its main attraction. In accordance with what was stated by (Álvarez, 2020; Sibarani et al., 2025) that the Lake Toba Caldera area, located in Samosir Regency, is one example of a geotourism area that has great potential in developing the tourism sector while supporting sustainable development. The Lake Toba Caldera area, especially Samosir Regency, has great potential for the development of sustainable geotourism. However, the main challenge faced is the limited capacity of local human resources in managing and developing sustainable tourism. Integration of AHRD in this context can help increase the capacity of local communities through local needs-based training, integration of local wisdom in the training curriculum, and strengthening community institutions. The development of sustainable tourism areas really needs the role of adaptive human resources, because they are not only able to adapt to the times

but can also innovate in maintaining a balance between economic growth, environmental preservation and social welfare. Therefore, adaptive human resource development is key to supporting the success of sustainable development based on geotourism in the Lake Toba Caldera area. The concept of Adaptive Human Resource Development (AHRD) emphasizes the importance of developing individual and organizational capacity that is responsive to changes in the environment, technology, and market needs. AHRD does not only focus on improving technical skills, but also on developing attitudes, values, and knowledge that support sustainability. This approach is relevant in the context of sustainable tourism, where human resources need to have the ability to adapt to the dynamics of the industry and the changing needs of tourists (Andrioni & Popp, 2012; Kusuma, 2022) also emphasized that this concept recognizes that the world of work and society continues to evolve, and therefore, human resources need to be trained to be more flexible, creative, and innovative. Meanwhile, the meaning of Geotourism is a form of tourism that emphasizes geological and landscape aspects as the main elements of the tourist experience. This concept aims to provide educational and sustainable experiences for visitors, as well as encourage the preservation of geological heritage.

Geotourism, as a form of nature-based tourism, utilizes the geological wealth of an area, including landscapes, geological formations, and other natural resources, as the main attraction for tourists. The existence of Lake Toba and its Caldera Area offers enormous potential in the development of geotourism in Indonesia. According to (Rosado-González et al., 2023), the development of geotourism in the Lake Toba Caldera area can make a major contribution to the local economy, but also faces major challenges related to environmental sustainability. Sustainable development in geotourism requires a balance between economic exploitation and environmental preservation. This requires the active participation of local communities in the process of managing and preserving geotourism areas. Therefore, the development of adaptive human resources is very important. Human resources who are trained and have a high awareness of the importance of nature conservation will be agents of change that can direct geotourism areas towards sustainable management.

III. METHOD

This study uses a qualitative approach with discourse analysis as the main method in examining in depth the dynamics of adaptive human resource (HR) development in supporting sustainable development based on geotourism in the Lake Toba Caldera area. The qualitative approach was chosen because it allows researchers to contextually and interpretively explore various practices, policies, and narratives of local actors involved in the development of HR and geotourism holistically (Denzin & Lincoln, 2018). Discourse analysis is used as the main analytical method to reveal power relations, social construction, and representation of HR policies and strategies in the context of geotourism area management. This analysis not only pays attention to the linguistic structure of the text, but also the socio-political context behind the text, both in policy documents, stakeholder speeches, and local community narratives (Fairclough, 2013). Through a critical discourse analysis framework, this study seeks to trace how discourses on sustainable development and adaptive HR are constructed, disseminated, and implemented in policy spaces and field practices. The data analysis process was carried out in stages by following a critical discourse analysis model that includes three dimensions: (1) text analysis, (2) discourse practices (production, distribution, consumption of texts), and (3) broader

social practices. The data that has been collected was analyzed through a process of data reduction, thematic categorization, interpretation of meaning, and critical reflection on the socio-political context surrounding the discourse on HR and geotourism. In addition, triangulation was carried out to ensure the validity and credibility of the data through a comparison between the results of interviews, documents, and observations. Researchers also apply the principle of reflexivity, by recognizing the position and influence of subjectivity in the data interpretation process (Creswell & Poth, 2018). With this approach, the study is expected to be able to provide theoretical and practical contributions in formulating an adaptive and contextual HR development model, in order to support the achievement of sustainable development goals (Sustainable Development Goals) in the Lake Toba Caldera area which is part of the UNESCO Global Geopark.

IV. ANALIZED AND DISCUSSION

Sustainable development based on geotourism in the Lake Toba Caldera area requires an approach that not only emphasizes the physical aspects and tourism infrastructure, but also fundamentally places the development of human resource (HR) capacity as a strategic element. In this context, adaptive HR development becomes a very important and urgent issue, especially considering that this area not only holds geological potential and landscape beauty, but also unique and dynamic socio-cultural complexity. (Mihardja et al., 2023) that Adaptive Human Resource Development (AHRD) within the framework of geotourism requires integration between technical capabilities, local values, and flexibility to socio-economic and environmental changes. The adaptive human resource development discussed in this study not only includes increasing the technical capacity of HR, but also value transformation, strengthening local identity, and increasing social resilience to environmental changes and the tourism market. Adaptive human resource (HR) development in the Lake Toba Caldera area still faces complex structural and cultural challenges, but there are promising local initiatives in driving the direction of sustainable development based on geotourism. Based on the research results obtained, as follows:

1. The Toba Caldera Geopark Action Plan Document (2022-2026) mentions the importance of increasing the capacity of local tourism actors, but does not detail the mechanism for evaluating the achievement of sustainable HR adaptability. On the other hand, texts from local communities, such as documentation of training activities facilitated by NGOs, show more contextual and participatory language. Phrases such as "learning from nature", "eco-friendly tourism", and "village social capital" indicate the construction of rich local knowledge that is relevant to geotourism principles (Mihardja et al., 2023). This semantic difference confirms the gap between formal policy discourse and discursive practices at the community level.
2. The process of producing and distributing narratives about adaptive HR is still largely dominated by government actors and donor agencies. This is reflected in the dominance of top-down structures in the preparation of training curricula and community assistance programs. Training discourse is often positioned as a "transfer of knowledge", not as a collaborative or co-creation process between local communities and external parties. However, initiatives emerged from local communities such as the Batak Culture-Based Geological Tour Guide Training in Harian District,

Samosir Regency, which showed a more horizontal pattern of discourse distribution. In this context, local human resources are not only objects, but also active subjects in formulating the content and methods of capacity development. This phenomenon reflects the adaptive capacity building model as stated by (Sharma-Wallace et al., 2018), where social resilience arises from the ability of communities to collectively adapt to environmental and social changes.

3. Observation results show that the development of geotourism in the Lake Toba Caldera has a dual impact. On the one hand, there has been an increase in the role of village youth as creative economic actors, tour guides, and homestay managers. For example, in Sigapiton Village, a 25% increase in community income in the last two years (Samosir Tourism Office Data, 2024) is associated with the active participation of youth in ecotourism training and digitalization of destination promotion. However, on the other hand, there is still an imbalance in access to training between villages located in the center of the geopark area and peripheral villages. This shows the importance of designing inclusive and local needs-based HR policies (needs-based approach), so that there is no development inequality between regions (Naswar et al., 2024). Furthermore, the social practice of adaptive HR development in this region is also influenced by local values such as mutual cooperation, dalihan na tolu, and respect for geological and cultural heritage. These values have great potential to become a social framework in strengthening collective awareness of the importance of sustainability. Therefore, HR development is not only interpreted as increasing technical capacity, but also as a process of internalizing values, norms, and ecological awareness (Hrynevych et al., 2023).

In accordance with the explanation, it can be emphasized that the development of adaptive human resources in the context of geotourism requires a transformative approach, namely combining structural, cultural, and ecological dimensions in one unit. This process is not enough with formal training or technical counseling, but requires a strategy based on social learning, strengthening local identity, and ongoing cross-actor dialogue. Thus, sustainable development based on geotourism in the Lake Toba Caldera can only be achieved through an adaptive, participatory, and contextual human resource development model, by placing local communities as the center of transformation, not just recipients of development benefits.

V. CONCLUSION, LIMITATION AND RECOMENDATION

1. Conclusion

Adaptive human resource development is a key pillar in realizing sustainable development based on geotourism in the Lake Toba Caldera area. Human resources that are able to adapt socially, culturally, ecologically, and digitally have proven to be a catalyst in optimizing the potential of geoparks as sustainable tourism destinations. Although there is policy support from the central and regional governments, human resource development at the local level still faces challenges in terms of access, relevance of training, and sustainability of empowerment programs. Human resource empowerment tends to be technocratic and top-down, while social practices in local communities show resistance as well as adaptive innovation based on local wisdom values such as dalihan na tolu, mutual cooperation,

and preservation of cultural heritage. This indicates the need for recontextualization of human resource training policies so that they are not only oriented towards improving skills, but also building critical awareness and adaptive capacity of the community towards the dynamics of changes in tourism, economy, and environment. Thus, adaptive human resource development in the context of the Lake Toba Caldera is not sufficiently understood as a linear process, but must be viewed as a dynamic, interactive, and contextual social process. This process will only be successful if it involves the active participation of local communities, recognition of traditional knowledge, and cross-sector integration between government, communities, academics, and geotourism industry players.

2. Limitation

This study has several limitations that need to be considered. First, the qualitative approach with discourse analysis has limitations in measuring the quantitative impact of human resource development interventions broadly. Second, the study area is focused on several points in the Lake Toba Caldera area that are considered representative, but do not yet cover the entire geopark area spread across seven districts. Third, data collection is highly dependent on the availability of key informants and policy documents, so there is potential for perspective bias or limited access to strategic data. In addition, social dynamics at the local level are very fluid and change rapidly along with tourism developments and government policies. Therefore, the findings in this study are contextual and cannot be fully generalized to other areas without considering specific local characteristics.

3. Recomendation

Based on the findings and critical reflection on the limitations of the research, there are several recommendations that can be put forward:

- a. Strengthening the design of adaptive HR policies, that local governments need to design training and community empowerment policies that are more flexible, contextual, and based on the real needs of the community. A top-down approach needs to be combined with a participatory approach so that the program really touches the root of the problem in the field.
- b. Integration of local values in the training curriculum, it is recommended to integrate local values, geological history, and traditional knowledge in the curriculum for developing geotourism HR so that the learning process is more contextual and meaningful.
- c. Multi-party collaboration and co-creation, active collaboration is needed between the government, universities, industry players, and local communities in designing, implementing, and evaluating HR development programs. The co-creation model allows the community to become the main subject in the sustainable development process.
- d. Strengthening digital adaptive capacity, by providing training to local HR, especially digital technology skills to support tourism promotion, online tourism business management, and involvement in a sustainable creative economy ecosystem.
- e. Mapping of regional-based competencies, namely mapping the capacity and competencies of HR per region in the Lake Toba caldera area to ensure even distribution of training and avoid inequality between tourism communities.

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