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Enhancing Poso Women and Youth's Climate Change Resilience and Adaptive Livelihood

Mas Davino Sayaza[1], Tjahjo Tri Hartono[2], Almyanti Ningrum[3], Usep Saripudin[4], Tarmizi Alba[5]
[1]University of British Columbia, Canada
[2345]Universitas Ibn Khaldun Bogor, Indonesia
Correspondent: masdvn21@student.ubc.ca[1]

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ABSTRACT: This exploratory study examines how climate change affects women and youth in Poso, using the Sustainable Livelihood Framework, Satellite Image Analysis, and Theory of Change. It aims to understand climate change's impacts on livelihoods and to develop strategies for improving community's livelihood resiliency and adaptiveness. Data were gathered from interviews, focus groups discussion, and literature review. Results highlight challenges such as agricultural productivity issues, limited healthcare access, and underutilized natural resources. To address these, the study suggests capacity building, enhancing post-harvest technology, promoting home gardening, and developing agrotourism are needed. To effectively implement the suggestion stakeholder collaboration and policy improvements are required. The study advocates for adaptive approaches to strengthen livelihood assets and calls for further research to design comprehensive programs for enhancing climate resilience and reducing vulnerability.

Keywords: Poso, Women And Youth, Climate Change Resiliency, Adaptive Livelihood.

INTRODUCTION

The escalation of climate change and its repercussions has become increasingly evident. The surge in the frequency and intensity of natural disasters, including floods, forest fires, storms, and droughts, has not only disrupted ecosystems but also profoundly impacted human communities, particularly in terms of their economic activities and means of subsistence.

However, amidst these challenges, it is the marginalized communities, particularly women and youth, who bear the brunt of these calamities, facing heightened vulnerabilities and limited resources to cope with and recover from such adversities (Awiti, 2022; Onyango et al., 2023). Addressing the multifaceted livelihood difficulties stemming from climate change and its

disproportionate impacts on women and youth requires a comprehensive and inclusive approach, one that goes beyond short-term fixes to promote enduring and sustainable solutions (Niemann et al., 2024).

Besides that, climate change has also worsened the social conflict in the world. (Cappelli et al., 2023; Ide et al., 2020). In the context of Indonesia, climate-induced social conflicts have also emerged (Tas et al., 2023). Poso Regency in Central Sulawesi exemplifies the convergence of climate change impacts and intricate social dynamics, yet it remains insufficiently researched. The region has already experienced tangible impacts of climate change, such as alterations in the Kodina watershed (Herman et al., 2017) and a decline in the population of endemic fish due to overfishing (Serdiati et al., 2021). Moreover, the region has faced prolonged social conflict, further exacerbating the community's vulnerability to climate change.

Considering the current environmental challenges in Poso Regency and the lack of specific studies, this research explores the question: "How does climate change affect the lives women and youth in Poso?" The study aims to achieve two main goals: first, to understand how climate change impacts these communities' livelihoods; and second, to develop effective strategies to help them become more resilient and adaptable.

METHOD

The study was conducted in Masani Village and Lape Village, both in Poso Regency, Central Sulawesi. These villages have a history of social conflict, making it especially insightful to examine their current livelihoods, resilience, and adaptability to climate change. The research was carried out from March to May 2024.

The study conducted is an exploratory study as the research is meant to profiling the community's livelihood and exploring possible livelihoods strategies based on the profile. This approach is often adopted for exploring topics related to climate change resilience (Amer, 2021; Sanson & Masten, 2024) and marginal communities (Asaolu et al., 2018; Leul et al., 2023).

This study utilizes both primary and secondary data. Primary data, related to the sustainable livelihood assets of the communities, was gathered through interviews and focus group discussions. Purposive sampling was employed to collect this data by interviewing and conducting focus group discussions with key informants from men, women, and youth groups. Within the men's and women's groups, participants were further divided into those working in agricultural and non-agricultural sectors. Secondary data, encompassing information on the communities' livelihoods, was obtained through a comprehensive literature review, including journals, government reports, and books.

The study conducted by following the Sustainable Livelihood Framework (SLF). SLF (Figure 1) is commonly used to better understand the current livelihood conditions within the communities (Allison & Horemans, 2006; Natarajan et al., 2022; Serrat, 2017). Additionally, this framework was

chosen due to its widespread applicability across diverse community settings (Li et al., 2023), ranging from coastal communities (Septanti et al., 2023; Tasnuva et al., 2023) to upland communities (Hartono et al., 2023; Mahdi et al., 2009; Rasul & Gurung, 2024).

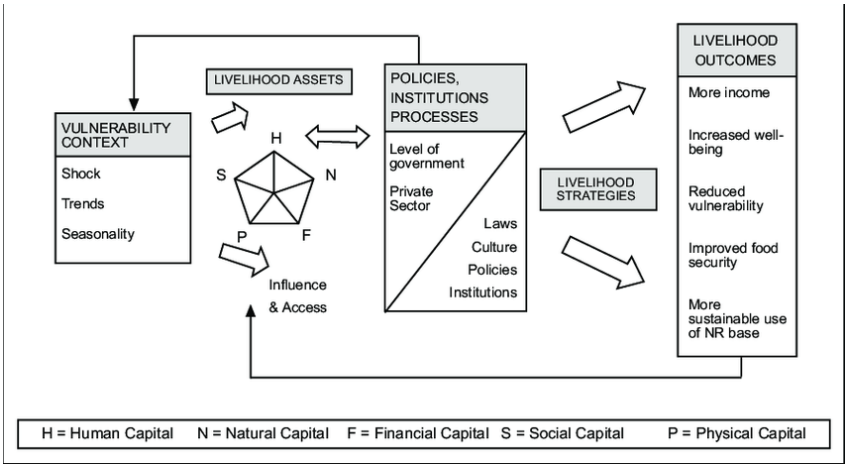

Figure 1 The DFID Sustainable Livelihoods Framework (SLF) (Source: DFID, 1999)

Based on the SLF diagram, the study is divided into four phases. The first phase involves mapping the community's vulnerability to identify the existing context, as these vulnerabilities affect the quantity and quality of livelihood assets. The second phase profiles the community's livelihood assets, which include human capital (skills, knowledge, health), social capital (networks, relationships), natural capital (land, water, forests), physical capital (infrastructure, tools), and financial capital (savings, credit). In the third phase, the study assesses the current livelihood conditions of the communities to comprehensively understand the relevant policies, institutions, and processes in place. Finally, in the fourth phase, a livelihood strategy is developed using the Theory of Change as a guide, based on the insights gained from the previous phases.

To conduct phase one to three, two frameworks are used. First, satellite image analysis compares land use/land cover dynamics between January 2024 and 2015 (Bey et al., 2016; D. A. L. A. Putri et al., 2024; Wei Zhudeng, 2024). This analysis helps observe interactions between natural and social systems to identify communities on the site. Next, livelihoods are profiled using the Sustainable Livelihoods Framework (SLF) to collect and categorize data. To analyse the data, content analysis is used. Content analysis is a research method used for systematically analysing textual data to identify patterns, themes, or concepts (Elo et al., 2014) and it is commonly used in studies on communities livelihood (Tohidimoghadam et al., 2023; Yamin et al., 2023; Zhai et al., 2024).

Table 1 Instrument for collecting livelihood data on the communities

Types of assets	Subtheme of the assets
A. Natural Asset	1. Availability and Access to Land (e.g., what is the agricultural land ownership in the village and how they access it) 2. Main Products or Commodities (e.g., the primary commodities produced in the village) 3. Sufficient Clean Water for Families (e.g., source of clean water) 4. Environmental conditions (e.g., the primary environmental issue in the villages)
B. Human Asset	1. Education (e.g., level of education) 2. Livelihood related skills (e.g., livelihood skills and training ever attended) 3. Family Health (e.g., health facilities and traditional practices)
C. Social Asset	1. Family unit (e.g., division of household tasks) 2. Community (e.g., activities of village communities) 3. Supra-community (e.g., activities between the villagers and outside communities)
D. Physical Asset	1. Availability of Agricultural Production Facilities (e.g., the road access to their land) 2. Availability of Transportation Means (e.g., what vehicle is used and what it is for) 3. Availability of Sanitation Facilities (e.g., the condition of sanitation in each house) 4. Availability of Communication Tools (e.g., what tools do they use to communicate)
E. Financial Asset	1. Other Sources of Income (e.g., what are the alternative source of income asides from main job in agriculture or non-agriculture sector) 2. Savings (e.g., the purpose of saving) 3. Income (e.g., average monthly income) 4. Expenditure (e.g., types of expenditure)

To conduct the fourth phase, Theory of Change is utilized. Theory of Change is a strategic framework that delineates the process of achieving sustainable livelihoods by mapping out the necessary preconditions and pathways of influence. It ensures that the development of livelihood strategies is not only systematic and methodical but also participatory and inclusive, engaging all stakeholders in the process (Keahey, 2021; Maharjan & Issahaku, 2014; Morse & McNamara, 2013).

RESULT AND DISCUSSION

Vulnerability Context

From interviews and focus group discussions conducted, it is revealed that the community is currently facing pest disturbances and weather uncertainties. Farmers are dealing with pests such as rats, birds, and wild boars, which frequently disrupt rice yields by consuming field produce.

As for the weather, it is noted to be increasingly unpredictable in recent years, making it challenging to forecast rainy and dry seasons. Consequently, most of the population, predominantly agricultural laborers, experience family economic instability as they cannot have productive harvest season. This difficulty prompts them to seek loans from local cooperatives; however, some individuals are unable to do so due to outstanding previous loans.

From our satellite image analysis, it is found that there have been notable changes in land cover/use in the program area between 2015 and 2024, characterized by reductions in both coastal (mangrove) and terrestrial forest areas. These alterations have implications for disaster potential,

notably evidenced by declining water quality due to decreased terrestrial forest coverage, largely stemming from a shift to mixed dry land use. The reduction in coastal forest area is primarily attributed to conversion for shrimp ponds or aquaculture activities, predominantly conducted by outsiders from the village (Bega Village).

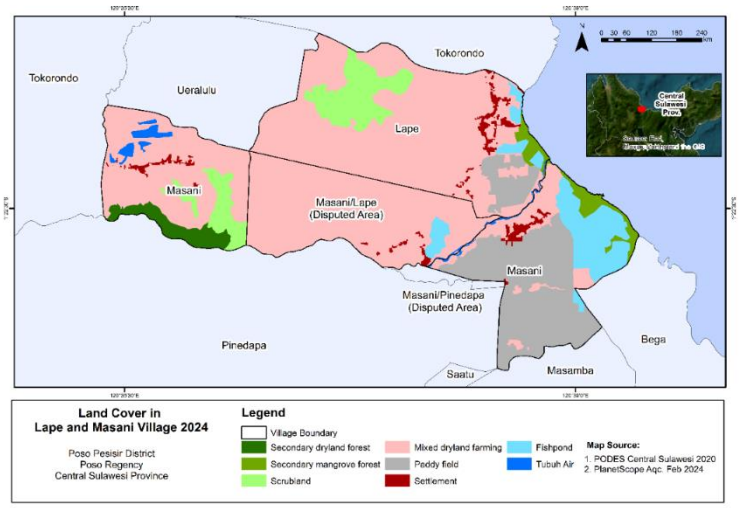

Figure 2 Land Cover in Lape and Masani Village, 2024. (Source: Processed data)

Changes in land cover, particularly the expansion of paddy fields, do not necessarily translate to increased community income, evident from declining paddy field productivity and rice harvest yields. The reduction in mixed dry land agricultural areas poses challenges, especially with declining cocoa land productivity (Managanta et al., 2018), whereas coconut remains the only consistently productive commodity. Factors contributing to decreased productivity include pest disturbances, inadequate irrigation supply, and unpredictable weather, despite a growing demand for cocoa, as indicated by increased demand for seedlings and typical harvests of 40-50 kg. Despite the diverse range of commodities produced, including coconut, cocoa, rice, cloves, and fruits, communities struggle to sustain their livelihoods, exacerbated by declining absorption of skilled labor into farming due to preferences for non-agricultural work. The desire of younger generations to continue farming, particularly observed in Lape Village, stems from farming legacies, relatively large land holdings (over 1 hectare), and familial livelihood responsibilities (Adittya et al., 2023; Wendy, 2010).

Furthermore, degradation of fishery resources, reported by local fishermen, is evident with fishing locations moving farther from the coastline compared to a decade ago, compounded by increasingly unpredictable weather conditions, deterring fishermen from venturing far out to sea. While direct information from the program villages is lacking, referencing common rural phenomena in other parts of Indonesia and other nations (Adeola et al., 2024; Rosen et al., 2021) suggests potential negative impacts on women and young people due to vulnerability to prolonged drought periods. Responsibilities such as water and fuel collection and seeking additional food often fall on women and girls, impacting various aspects of their lives, including education, health, and food security, indicative of increased workload and challenges faced by women and girls in rural areas (Latifa & Fitranita, 2016).

Livelihood Assets

a) Natural assets

Masani Village is situated along the coast of Tomini Bay, stretching from east to west, and is located in the Poso Pesisir District, Poso Regency. Geographically, Lape Village is one of the villages in the Poso Pesisir District, covering an area of 932.3 hectares divided into three hamlets. Lape Village has a population of 1,355 people and is situated at an elevation of approximately 22 meters above sea level, located to the north of Poso Pesisir District. Despite its modest size, Lape Village is one of the smallest villages administratively within the Poso Pesisir District.

Geographical location has endowed the communities of Masani and Lape Villages with natural assets such as land, coastline, and marine waters. On land, these resources are utilized for livelihoods in agriculture, particularly mixed dryland farming and rice cultivation. Land ownership currently remains predominantly private, with joint ownership by both men and women, averaging 0.5-2 hectares per household for mixed crops, though some farmers possess up to 6 hectares.

Despite the presence of cocoa plantations in Lape with potential yields, their productivity is notably low at only 0.3 hectares, constituting merely 42% of the national average productivity (0.7/ha) (Saleh et al., 2024). This low productivity is attributed to conflicts hindering optimal land use. Another critical natural asset essential for livelihoods is freshwater sources, obtained from two springs piped to households in both villages, managed by community-appointed individuals. However, the calcium-rich water poses long-term health risks, prompting locals to filter it through cloth before use, with vulnerability to contamination during rainy seasons necessitating pipeline maintenance.

Currently, agricultural activities focus on private plots with limited use of home gardens, often for drying crops. Despite extensive coastlines, both villages lack the skills for marine resource exploitation, leaving seaweed cultivation to neighboring communities like Tokorondo. Similarly, Masani Village's fishpond remains unused due to unfamiliarity with aquaculture, leading residents to lease it out and continue traditional rice farming. The tourism potential of their landscapes is underutilized, with sites like *Pantai Seribu Bintang* suffering from deteriorating infrastructure, impacting visitor experiences and local vendors' incomes. This underutilization is compounded by the predominantly agricultural economy lacking skills for sustainable tourism development.

b) Human assets

Gender ratio discrepancies show differing demographics between Lape Village (82 males per 100 females) and Masani Village (112 males per 100 females) (BPS Kabupaten Poso, 2020). Most residents in Lape Village have only primary education but are eager to join agricultural training programs offered by various stakeholders. However, challenges in training intensity and methodology, particularly for marginalized groups, impede effective skill transfer. While initiatives like VCO processing in Lape and bamboo plate production in Masani exist, knowledge acquisition often relies on individual efforts. Healthcare access remains a challenge, especially in remote areas like Dusun Tamanjeka, underscoring the need for community-specific healthcare programs.

c) Social assets

Traditional family roles remain prevalent, with men typically seen as household heads responsible for economic management, while women handle household chores and financial matters. Despite these norms, social and economic changes are reshaping family dynamics. Interview data reveals that some women also contribute to the family's income, with professions ranging from midwives to farmers and fishers. In both villages, social cohesion is maintained through community leaders and collective activities. Figures such as the Village Chief, Community Elders, and Traditional Leaders mediate conflicts and facilitate social events, ensuring harmony. Communal work, or "gotong royong," serves as a vital informal communication channel, enhancing both village infrastructure and a collective sense of belonging.

Community networks, formed through organizations, facilitate information exchange and aspirations among members. Although there is no regular community forum for active decision-making and development planning, annual MUSREM meetings serve as the primary venue for villagers to influence development activities. Government programs, initiated through village RKPDes, district departments, and NGOs/CSOs, offer support for sustainable livelihoods. However, these programs, focusing primarily on production improvement, have not significantly increased income. Training in marketing and digital technology utilization remains lacking. A promising initiative is the trigona honey bee cultivation training by the Habibie Center in October 2023, involving women from Tamanjeka Hamlet, Masani Village.

Agricultural supply chains, particularly for cocoa, involve collecting harvests in the village before sending them to Poso, limiting the process to raw product sales. This situation is common as cocoa is a prominent provincial commodity (Marwahti et al., 2023). Seaweed, on the other hand, is sold directly to a neighboring district due to the lack of local buyers, raising its base price. Agricultural production in the two villages is generally limited, except for rice and a few SMEs like VCO, Red Ginger, and Durian, leading to scarce post-harvest facilities. Agrotourism potential remains underdeveloped due to neglected infrastructure, weak promotion, and lack of tourism business support (Tuwungkuya, 2021). In fact, in 2019, there had already been good development for its tourist attractions.

d) Physical assets

Farm Roads, developed by the village government using village funds (APBDes), provide critical access to agricultural lands. While these roads support both two-wheel and four-wheel vehicles, some hilly and steep areas remain challenging to reach, and road maintenance is reported to be irregular. In addition to infrastructure challenges, waste processing remains underdeveloped. Households either burn waste or dispose of it improperly, which can potentially pollute the mangrove ecosystem through ditches leading to the river and sea. Despite the absence of significant pollution sources nearby, this issue underscores the need for better waste management systems.

On a more positive note, the villages benefit from their strategic location on the Trans Sulawesi route, which supports business and agricultural distribution. Most roads are adequate for this purpose, except for those in Tamanjeka Hamlet. Rice mills and cocoa drying facilities are within

reasonable distances for farmers. However, the lack of public transportation means residents rely heavily on private vehicles, with taxis available to Palu and Poso, though trips to Palu often require advance reservations.

Lastly, internet usage has become integral to daily life in the villages, primarily for communication via WhatsApp and for accessing information on farming practices. While Facebook activity is minimal, the internet serves as a valuable tool for both social interactions and practical needs. This finding is aligned with previous research that argue that internet has become an important aspect of community's social interactions and practical needs, both in rural and urban settings in Indonesia (S et al., 2022). Thus, considering this finding is important when developing livelihoods strategies as this is indicating that the community has seen the benefits of internet. If develop further, not only this will improve the community's livelihood (Meng et al., 2024), but improve their subjective well-being (R. D. Putri et al., 2024) and promote better social inclusion (Ye & Yang, 2020).

e) Financial assets

Based on the available literature, the average income from rice farming in Masani Village is Rp. 15,278,035.02 per hectare per growing season, although productivity remains relatively low compared to other villages such as Saatu (Morante et al., 2023). Another study revealed that the annual cost of cocoa farming in Lape Village is Rp. 23,345,285, with farmers earning an annual income of Rp. 33,581,475 or Rp. 2,798,456 per month (Bakar, 2020). Cocoa farmers incur additional expenses, such as non-subsidized fertilizer at Rp. 250,000 per sack. During harvest, those with capital typically hire labor at Rp. 120,000 per day.

Some farmers also run alternative businesses, such as small shops, earning up to Rp. 1 million per month. Savings are generally invested in agricultural capital, household assets, or tangible items like land, vehicles, and household goods, with some saving in banks for children's education, pilgrimages, and economic reserves. Subjective estimates from interviews suggest an average maximum income of Rp. 3 million per month, with monthly expenses ranging from Rp. 2-4 million depending on the number and age of children and needs such as consumption, transportation, communication, health, education, and social activities.

However, similar trend that is happening in other places is also happened here, where farmers and SMEs often lack financial recording and projection, and are unaware of fixed capital or production costs in detail (Khanal & Omobitan, 2020; Mujuru et al., 2022; Wulandari et al., 2023). In some cases, wives make purchases or investments without consulting their husbands to avoid conflicts and arguments within the family. This finding can be also perceived that the wives' s input or opinion is undervalued by their husband, forcing them to choose independent financial decisions to avoid arguments (Su et al., 2008)

Policies, Institutions, and Process

Various local policies in Poso Regency can provide a foundation for stakeholders to address vulnerability and enhance community livelihood assets. However, these policies also pose certain challenges. In the agricultural sector, policies primarily focus on crop cultivation and livestock rearing, neglecting post-harvest aspects like product processing and marketing. Despite the formation of farmer groups, their participation remains low, and they are not actively involved in agricultural development. Decision-making is dominated by government directives and market demands, leaving little room for community participation in policy formulation that reflects local needs and conditions. These farmer groups mainly exist to facilitate access to farming tools and supplies rather than to identify and develop stable income-generating commodities. As a result, they focus solely on their own lands.

In the non-agricultural processing sector, there is no sustained support for small and medium enterprises (SMEs). The tourism sector faces similar issues, with a lack of tangible policy implementation. Youth empowerment for developing the creative economy has not been significantly pursued by local authorities. Necessary institutions for these initiatives are also lacking, and supporting processes for policy and institutional implementation are absent, as seen in the development of Seribu Bintang Beach in Masani Village.

Existing policies suggest various stakeholders should play a role in strengthening policy implementation in the program area as their involvement can help communities tackle vulnerabilities and develop their livelihood assets. Based on the collected information, it can be known that several stakeholders that have interacted with the community, which are:

Table 2 Existing Stakeholders

Government	Non-government
• **Poso Regency Cooperatives and UMKM Service** • **Poso Regency Women and Children Protection Service** • **Poso Regency Agriculture/Plantation Service** • **Poso Regency Fisheries Service**	• Sikola Mombine, • local cacao company • LPMS Poso • Institut Mosintuwu

The table reveals that some stakeholders, such as academics, NGOs, village governments, the Department of Industry, the Department of Tourism, and the Department of Community Development, have not yet interacted with the local community, whereas their important roles in enhancing community livelihood quality. Nonetheless, it is clear that cooperation between these stakeholders and the community is necessary for the development of both the agricultural and non-agricultural sectors.

Potential Climate Change Resilience and Adaptive Livelihood Strategies

The vulnerability context faced by the community, the available livelihood assets, and the policies and roles of stakeholders as policy implementers form the basis for developing sustainable

livelihood strategies for the communities, especially for women and youth. These strategies are formulated by using the Theory of Change, following these stages:

Stage 1: Creating Enabling Conditions

First, local champions are identified. These individuals, particularly women, youth, and persons with disabilities, who have a deep understanding of their community's needs and potentials, are encouraged to initiate group formation. These champions represent often-overlooked community aspirations, ensuring the proposed programs are inclusive and address diverse needs. Their involvement helps ensure that the programs do not cater to a single population segment but encompass various community layers, leading to broader and more sustainable impacts.

Second, the formation of groups led by local champions is a crucial initial step in building community solidarity and collaboration. Through these groups, the community can support each other, share knowledge and skills, and collaboratively design and implement programs tailored to their needs. This enhances community self-reliance and economic well-being while strengthening local social bonds. Thus, mapping local champions and facilitating group formation is a practical step in program mobilization and an effective strategy for ensuring inclusive and collaborative community participation. Involving women, youth, and persons with disabilities in planning and implementing the program aims to make the sustainable livelihood initiatives more relevant, impactful, and long-lasting.

Stage 2: Participatory Program Design

To create sustainable livelihoods for the community, four key programs are proposed based on current conditions, livelihood assets, and policies:

1. Capacity Building in Leadership and Organizational Management: This program aims to strengthen leadership and management skills to enhance resource management, decision-making, and organizational structures.
2. Post-Harvest Technology Capacity Building: Training in modern post-harvest technologies will improve agricultural efficiency, product quality, and market competitiveness.
3. Enhancing Household Economy through Home Gardening: Encouraging home gardening will reduce household costs and improve family nutrition.
4. Technical Capacity Building for Agrotourism Communities: Developing technical skills in agrotourism, such as managing chocolate cafes, beach camping areas, digital marketing, and marketing cocoa and coffee products, will boost local income and tourism attractiveness.

Stage 3: Developing Program Networks with Stakeholders

Effective collaboration among stakeholders is crucial for the success of the proposed programs. Engaging with identified stakeholders ensures comprehensive input, expertise, and resources, enhancing implementation and sustainability. Key stakeholders include:

1. Village Government: Involved in spatial planning for agrotourism development and institutional support.
2. Poso Regency Industry Department: Provides technical support and training for post-harvest agricultural practices.

3. Poso Regency Tourism Department: Develops agrotourism awareness and promotes community engagement.
4. Poso Regency Cooperatives and MSMEs Department: Supports business model development and enhances MSMEs' competitiveness.
5. Poso Regency Village Community Empowerment Department: Assists in establishing and managing Village-Owned Enterprises.
6. Job Training Center: Enhances workforce quality through certified training.
7. Poso Regency Women's Empowerment and Child Protection Department: Integrates gender and child interests into program strategies.

By adopting a participatory approach, these programs aim to include and empower women and youth, ensuring their specific needs and potentials are addressed. Furthermore, Social Return on Investment (SROI) approach can further refine the programs by evaluating their social, environmental, and economic impacts, leading to more responsive and sustainable outcomes.

Implementing the programs in stages will enhance existing livelihood assets, increasing the capacity of managers and business members, particularly women and youth. This inclusive approach will foster group-based economies and financial capital, resulting in sustainable agricultural and coastal resource productivity, community business development, and increased income for business group members.

CONCLUSION

In conclusion, the study shows that the climate change is affecting the livelihood of the community, especially the women and youth. This is showed by the vulnerabilities, that are exacerbates by climate change impact, that affecting the quality of their livelihood assets. The research suggests the need for inclusive and adaptive livelihood strategies to enhance community resilience and adaptability.

This study uses the Sustainable Livelihood Framework and Theory of Change to outline participative sustainable livelihood strategies and promote stakeholder collaborations, including government, NGOs, and educational institutions. Moreover, the proposed livelihood strategies, grounded in participatory approaches and stakeholder engagement, could empower communities, especially women, youth, and persons with disabilities, to build more resilient and prosperous futures amidst the changing climate landscape (Phiri et al., 2022).

The strategies furthermore should be developed by ensuring that supporting policies and institutions are realized. To effectively realize that enabling conditions, it is mandatory formulate and implement policies that are holistic, which are integrating social, economic, and environmental dimensions. The study has recommended ideal program designs, such as capacity building, and stakeholder engagement, in which can become the base for future studies on designing a thorough program to enhancing climate resilience and adaptive livelihoods to reduce their vulnerability.

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