

**SUSTAINABLE LIVELIHOOD ASSESSMENT THROUGH
SEAWEED CULTIVATION TO SUPPORT POVERTY
ALLEVIATION IN BANTAENG REGENCY**

Disusun dan diajukan oleh

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**PROGRAM STUDI PERENCANAAN DAN PENGEMBANGAN WILAYAH
SEKOLAH PASCASARJANA
UNIVERSITAS HASANUDDIN
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2021**

**SUSTAINABLE LIVELIHOOD ASSESSMENT THROUGH
SEAWEED CULTIVATION TO SUPPORT POVERTY
ALLEVIATION IN BANTAENG REGENCY**

THESIS

As a Requirement for Achieving Master's Degree

Written and Proposed by

FADHILAH

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LEMBAR PENGESAHAN TESIS**SUSTAINABLE LIVELIHOOD ASSESSMENT THROUGH SEAWEED
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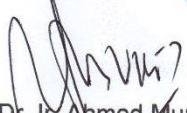
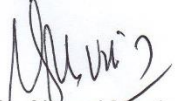

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A handwritten signature in black ink is written over a red rectangular stamp. The stamp contains the text 'METERA TEMPEL' and a serial number '06A.005756489'. The signature is stylized and appears to be 'Fadhilah'.

Fadhilah

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ABSTRAK

Fadhilah. Kajian Penghidupan Berkelanjutan Melalui Budidaya Rumput Laut untuk Mendukung Pengentasan Kemiskinan di Kabupaten Bantaeng (Dibimbing oleh Ahmad Munir dan Peter Davey)

Penelitian ini bertujuan untuk memberikan strategi pengembangan rumput laut yang berkelanjutan melalui penilaian mata pencaharian petani rumput laut untuk mendukung pengentasan kemiskinan di Kabupaten Bantaeng.

Penelitian ini menggunakan analisis spasial untuk melihat gambaran sebaran rumput laut saat ini dan Sustainable Livelihood Framework (SLF) untuk menilai kontribusi budidaya rumput laut terhadap penghidupan masyarakat pesisir. Selanjutnya, analisis Strength-Weakness-Opportunity-Threat (SWOT) digunakan untuk merumuskan strategi.

Hasil penelitian ini menemukan bahwa 78% kawasan potensi rumput laut telah dikonversi menjadi budidaya rumput laut, menyisakan 625 ha potensi kawasan yang belum dimanfaatkan. Pendapatan rumah tangga meningkat secara signifikan dengan budidaya rumput laut. Namun, menurut Sustainable Livelihood Framework (SLF), skor aset paling rendah yang dimiliki oleh petani rumput laut adalah aset modal manusia dan modal finansial. Hal ini mengakibatkan produksi rumput laut yang kurang memuaskan karena rendahnya kualitas sumber daya manusia terutama kurangnya bibit yang berkualitas dan kurangnya akses jaringan pemasaran. Oleh karena itu, kajian ini memaparkan beberapa strategi untuk mencapai rumput laut berkelanjutan antara lain pembenahan aspek pemasaran, penyediaan lembaga keuangan, dan pembangunan fasilitas pembibitan bibit unggul rumput laut.

Kata Kunci: budidaya rumput laut, pengentasan kemiskinan, analisis spasial, SLF, SWOT

ABSTRACT

Fadhilah. Sustainable Livelihood Assessment Through Seaweed Cultivation to Support Poverty Alleviation in Bantaeng Regency (Supervised by Ahmad Munir and Peter Davey)

This study aims to provide sustainable seaweed development strategies through assessing the livelihood of seaweed farmers to support poverty alleviation in Bantaeng Regency.

This study employed spatial analysis to depict the current distribution of seaweed and the Sustainable Livelihood Framework (SLF) to assess the contribution of seaweed cultivation to coastal communities' livelihoods. In addition, a Strength-Weakness-Opportunity-Threat (SWOT) analysis was used to develop strategies.

The study result found that 78% of the seaweed potential areas have been converted into seaweed farms, leaving 625 ha of potential areas unused. Household income is significantly increased by seaweed farming. However, according to the Sustainable Livelihood Framework (SLF), the least valuable assets held by seaweed farmers are human capital and financial capital assets. This results in unsatisfactory seaweed production due to low human resource quality, a lack of qualified farming technology, particularly qualified seedlings, and a lack of access to marketing networks. This study presented strategies for achieving sustainable seaweed including reforming marketing aspects, providing financial institutions, and constructing superior seaweed seedling facilities.

Keywords: seaweed cultivation, poverty alleviation, spatial analysis, SLF, SWOT

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CHAPTER I

INTRODUCTION

1.1. Introduction

This introductory chapter discusses the research background, the research problem, the aim, the objectives, the research questions, and the scope of the study. The chapter discusses the potential for seaweed cultivation development in Bantaeng Regency followed by the rationale for conducting the study. This chapter also clarify the outline of the thesis. Lastly, the chapter closes with a layout of the study timeframe.

1.2. Background

Indonesia is an archipelagic country, enriched with abundant marine resources. The fishing industry is a major contributor to the local economy and income for residents in the coastal regions. In the past, fishing was the main source of income for coastal communities in Bantaeng Regency. However, environmentally destructive fishing practices, carried out by traditional fishers, such as bomb and poison activity are still rampant (Raycraft, 2019). Consequently, these environmentally degrading practices have resulted increased overfishing. This has resulted in a decline in fish catch in the coastal area (Katikiro & Mahenge, 2016; Raycraft, 2019). Most of the locals that depend on fishing activities to support their livelihood live in poverty (Cahaya, 2015; Gurning & Cahyagi, 2018). Therefore, it is

imperative that the government develop and implement alternative ways to overcome this serious problem.

Irmayani, Yusuf, and Arsyad (2015) has found that increasing the production of seaweed in the rural coastal area is an effective alternative activity for income and reduce poverty. Bantaeng Regency is one of the coastal areas in South Sulawesi where many of the coastal communities have become seaweed farmers. Azis (2011), stated that seaweed cultivation in the coastal area of Bantaeng Regency has become a new industry to improve economic conditions and welfare of coastal communities, who typically live-in poverty. Seaweed farming is an attractive alternative means of income for locals as the seaweed cultivation process is low cost and uses minimal technology and technical expertise (Irmayani et al., 2015; Zamroni, 2021)

Seaweed cultivation began on the coasts of Bantaeng Regency in 1989 and is still prevalent currently. Seaweed cultivation has increasingly become a vital source of income for coastal villagers. Seaweed is a leading export commodity, and its production is the priority of the Republic of Indonesia based on Presidential Regulation Number 33 of 2019 concerning the Road Map for National Seaweed Industrialization. This regulation has resulted in a significant increase in the amount of seaweed cultivation in the last twenty years. In 2001, the cultivation area utilized was 505.2 ha with a total production of 120.1 tons of seaweed. By 2019, the cultivation area had

significantly increased to 3,824 ha, producing 84,805 tons of seaweed (Fisheries and Marine Department of Bantaeng Regency, 2019).

Seaweed is an economically valuable resource, and extraction is widely used in major industries such as food, pharmaceuticals, cosmetics, textiles, paper, and paints. Seaweed cultivation has also altered some socio-cultural aspects of society (Buchholz, Krause, & Buck, 2012; Ferdouse, Holdt, Smith, Murúa, & Yang, 2018). Recently, the seaweed industry has provided a new source of income for women and the elderly who have previously been marginalized from fishing activities (Bjerregaard et al., 2016). The role of women in seaweed industry is complex. Women are directly involved in farming activities, as well as small-scale processing to produce seaweed-based products, such as cakes and snacks, and seaweed juice. These unique opportunities from processing and production of seaweed-based products provide women with direct benefits from seaweed cultivation (Mane & Menne, 2017; Msuya & Hurtado, 2017).

However, the sustainability of seaweed industry development presents and faces many challenges. The first challenge is that seaweed farming may cause environmental degradation. Seaweed farming uses traditional methods such as removing natural seagrasses and digging up coral reefs, which may cause environmental degradation (Waters, 2018). Moreover, pollutant waste produced by the smelter industry, in the area, reduces the productivity and quality of seaweed (Yaqin, Fachruddin, Suwarni, Umar, & Kadir, 2014).

Another problem is an economic cost-benefit balance, where the production of seaweed continues to increase, and at times, processing production costs are greater than the income from sales made. Seaweed is produced in raw form and sold at low prices, which has been a problem for farmers so far (Nor, Gray, Caldwell, & Stead, 2020). Consequently, it has little impact on the financial situation of seaweed farmers because the benefits are insignificant. Furthermore, poor seaweed quality, volatile seaweed prices, unstable production results, insufficient or inadequate skills and human resources, simple cultivation technology, and difficulty obtaining capital make seaweed cultivation vulnerable as a primary source of income (Nor et al., 2020; Rahim et al., 2019; Zamroni, 2021).

Additionally, the massive growth in seaweed farming has created some social issues in Bantaeng Regency. The local communities have started to claim ownership of seaweed cultivation areas as these areas have become a valuable resource. There are no official legal documents providing sole ownership of cultivation areas; these claims have only been verbally made by individuals. The ownership controversy has caused conflicts, not only between the seaweed farmers, but also with the farmers who use the area as transportation routes (Qalbi, 2008). To add further complexity, the land used for seaweed cultivation has significant economic and social value as it can be inherited, traded, and can also be used as a marriage dowry (Nur & Saleng, 2013). In contrast, coastal and marine resources are common property or open access. The term 'common

property' means that the ownership is under government control and resources cannot be owned privately (Ciriacy-Wantrup & Bishop, 1975; Platteau, 2016). Regarding seaweed cultivation land, there is currently no regulations regarding spatial planning for seaweed cultivation boundaries. Consequently, this lack of government control and identification of ownership has led to many claims of ownership of areas under seaweed cultivation.

Although there is support from the central and local governments, various challenges such as regional conflicts and the threat of environmental degradation, can hinder the sustainability of seaweed cultivation as the main income support for livelihoods. Moreover, even with positive trends in seaweed demand, it cannot be predicted that in the future seaweed will be able to meet the growing demand. Therefore, sustainable strategies for seaweed farming development is required, particularly in terms of promoting the economy of coastal villages. The development strategies need to take into consideration the maintenance of competition and overcoming issues presented and faced by the seaweed farming industry.

1.3. Research Questions

Poverty is a multidimensional problem in coastal communities. Solving this problem requires a comprehensive sustainable solution (as opposed to a temporary partial solution) (Cahaya, 2015). To achieve this,

the development of seaweed cultivation for poverty alleviation must consider the potential of human resources, the natural condition of cultivation, farmer access to existing and future facilities and infrastructure, the socio-cultural conditions, as well as access by farmers to financial capital to support the livelihood of coastal communities. To support poverty alleviation efforts for the coastal locals in Bantaeng Regency, strategies that support the sustainability of seaweed cultivation as the main livelihood of the coastal communities need to be developed and implemented. The research questions to investigate the best approach in strategy development and implementation are as follows:

1. What is the existing condition of seaweed farming in Bantaeng Regency?
2. How does seaweed cultivation contribute to sustainable livelihoods of coastal communities?
3. What are sustainable seaweed farming strategies that support the effort to alleviate the poverty of coastal communities in Bantaeng Regency?

1.4. Research Aims and Objectives

This study aims to assess the livelihood of seaweed farmers in Bantaeng Regency; to ensure the security of seaweed cultivation as a main livelihood to support poverty alleviation. The specific objectives of the research are:

1. To assess the existing condition of seaweed cultivation in Bantaeng Regency.
2. To assess the contribution of seaweed cultivation to sustainable livelihood based on sustainable livelihood framework.
3. To develop strategies to alleviate poverty through the development of a sustainable seaweed industry in Bantaeng Regency.

1.5. Aims and Objectives of Research

The purpose of this research is to generate new knowledge and provide additional literature based on the formulation of strategies to benefit all stakeholders including: the seaweed farmers, local government, wholesalers, and public and private industries dealing with seaweed development. This research will also provide information to the local government and highlight the importance of seaweed as a resource to support the welfare of coastal residents. It is important that this research will encourage the government to adopt policies that enhance seaweed cultivation for poverty alleviation in Bantaeng Regency. Furthermore, the findings of this research will assist in educating seaweed farmers through the support of government, to optimize the productivity of seaweed industry and effectively overcome current and potential challenges. This can include improved cultivation methods, more advanced technologies, and efficient pricing and marketing. Lastly, fellow researchers and academics conducting similar studies can use this paper as a reliable reference.

1.6. Scope of the Study

The scope of the research covers the Pajukukang Sub District. This area includes five coastal villages within the sub district namely: Nipa-Nipa Village, Pajukukang Village, Borongloe Village, Papanloe Village and Baruga Village. This region was selected due to the large of number of people in these villages engaging in seaweed cultivation and a high poverty rate. The study assessed the development of the seaweed industry by assessing the internal and external factors of seaweed farmers' livelihood, mapping the existing conditions of cultivation, followed by formulation of strategies.

1.7. Study Outline

This thesis contains of six chapters as follows:

Chapter 1, consists of a general introduction to the dissertation research, including the research background, research questions, research aims and objectives, research significance, research scope, definitions, and the structure of the research proposal.

Chapter 2 presents a Literature Review providing an outline of previous research surrounding the current knowledge of seaweed cultivation. This is followed by a discussion around the concept of Sustainable Livelihood Framework (SLF), a theoretical framework that has been developed presenting the core mechanisms, their indicators, and their underlying relations. Chapter 2 then discusses poverty in coastal communities; the

correlation between costal resources and poverty; and poverty alleviation strategies. This is followed by an analysis of the of Geographic Information systems (GIS), a SWOT analysis, previous research findings.

Chapter 3 presents the research design, research timeline and location, the research population and sample, data types and sources, data collection techniques, and data analysis techniques.

Chapter 4 presents research data results and discusses the research findings. Presenting the data collected from seaweed cultivation in Bantaeng Regency; the analysis of suitable land of seaweed cultivation; the contribution of seaweed cultivation to sustainable livelihood based on sustainable livelihood framework; and the SWOT analysis of sustainable seaweed cultivation.

Chapter 5 explores the considerations and processes required for developing strategies for seaweed cultivation as a sustainable livelihood for poverty alleviation in Bantaeng Regency.

Chapter 6 provides the conclusions of the study and recommendations for further research.

1.8. Study Timeframe

This study was conducted in Indonesia from August 2019 - June 2020, continued in July 2020 and concluded in June 2021 in Australia as presented in Table 1.

CHAPTER II

LITERATURE REVIEW

2.1. Introduction

This literature review explores the concepts used for the design and application of this research. Current relevant literature is analysed to guide the development of sustainable seaweed cultivation to alleviate poverty experienced by coastal inhabitants in Bantaeng Regency. The review discusses the correlation between seaweed cultivation and how this industry impacts the livelihood of coastal communities. The literature review explains seaweed farming and describes seaweed classifications. The concepts discussed in this literature review are the foundations for the recommendations for poverty alleviation strategies in coastal communities.

2.2. Seaweed Cultivation

Seaweed or macro-algae is classified into three phyla of marine brown (*Phaeophyta*), red algae (*Rhodophyta*) and green algae (*Chlorophyta*). The number of seaweed species is approximated between 8,000 and 10,500 species (Kim, Yarish, Hwang, Park, & Kim, 2017; McHugh, 2003; Radulovich et al., 2015). In Indonesia, the red algae species of *Euचेuma*, *Kappaphycus* and *Gracillia* are the most cultivated (over 83 % of global production, mostly *Euचेuma*) followed by the Philippines

(approx. 13% of global production, mostly *Kappaphycus*) (Kambey et al., 2020; Kim et al., 2017).

The main benefit of seaweed cultivation is that seaweed is easy and cost efficient to maintain and cultivate. Cultivation does not require elaborate setups or high capital investments. Additionally, seaweed cultivation causes minimal harm to ocean floors and fishery resources (FAO, 2018; Kim et al., 2017; A. Zamroni, Laoubi, & Yamao, 2011). Therefore, seaweed cultivation and production are strongly promoted for developing countries to grow the income of small-scale fishing communities, and in turn supports the national economy (Aslan et al., 2018; Béné, Hersoug, & Allison, 2010; FAO, 2018; A. Zamroni et al., 2011). For these reasons, the popularity of seaweed farming has grown significantly globally, particularly in the Asia Pacific region (including China, Indonesia, the Philippines, Malaysia) and the African region (including Ghana, Morocco, Zanzibar) (FAO, 2018).

Seaweed grows in sea-grass beds near the shoreline in coastal areas. Several physical external factors influence seaweed growth such as, water salinity and substrate, shallow water, water temperature between 25 - 30° C, sunlight, water current, nutrients, and maintenance (McHugh, 2003; Titlyanov & Titlyanova, 2010; Zamroni, 2021). Moreover, Herliany, Zamdial, and Meylia (2016) reported that seaweed farming success is also influenced by plant spacing and observation times. This study found that increased

plant spacing can increase the growth rate of seaweed, where the optimum spacing is approx. 30 cm apart (Herliany et al., 2016).

The general steps of cultivation include 1) site selection, 2) cultivation selection methodology, 3) nurturing process, and 4) harvesting and drying. Jana T. Anggadiredja and Purwoto (2006) reported that site selection for seaweed farming is the major contributing factor for successful seaweed farming. *Eucheuma* and *Kappaphycus* growth thrives on the upper side of the sublittoral areas where the water flow level ranges from slow to moderate. *Eucheuma* and *Kappaphycus* are cultivated using the same methods including the off-bottom method, the long line method, the floating raft method and basket method (Herliany et al., 2016; Kim et al., 2017). The off-bottom method is applied in sandy bottom or muddy sand sea water. The floating raft method is used in shallow water where its movement is affected by sea waves. The long-line method uses long ropes supported by plastic floats in the sea water as seen in Figure 1. *Gracilaria* species can be grown in cold and warm water. The cultivation methods for *Gracilaria* can be applied in open waters on the bottom of the bays, estuaries or reef flats, on lines, ropes or nets, in ponds or in tanks (McHugh, 2003). The methods of seaweed cultivation utilised by seaweed farmers in Indonesia differ depending on regional circumstances. For instance, in Bali, farmers prefer to use the off-bottom method to cultivate seaweed, while most of the farmers in South Sulawesi use the long-line method. Zamroni (2021) stated that the long line method is mostly preferred by farmers because the tools and

materials used for cultivation are easy to obtain and the cost of materials are lower compared to the other methods.

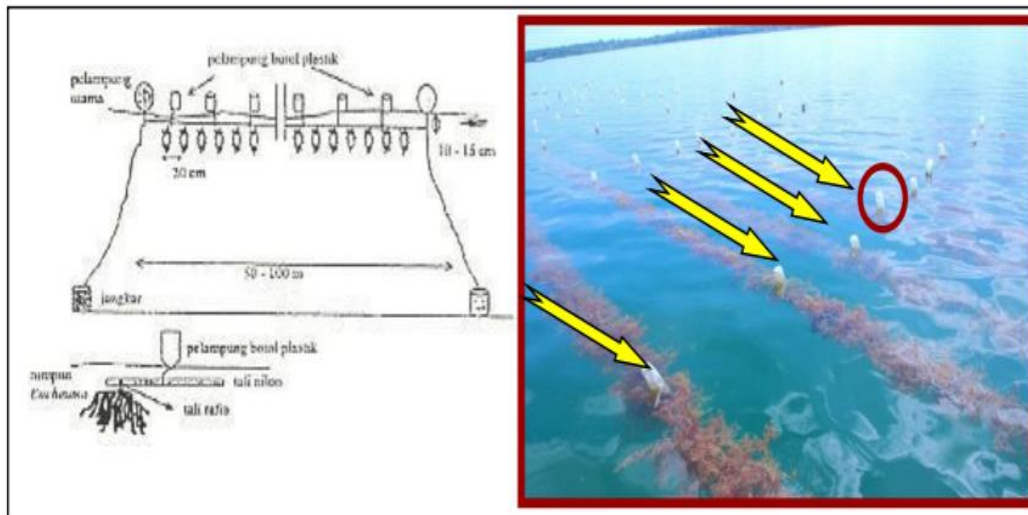


Figure 1: Seaweed cultivation with floating long-line method (Zamroni, 2021)

After 35 to 45 days of cultivation, the seaweed can be harvested. Seaweed farmers divide their harvest into new seedlings that will be preserved and used for the next planting, as well as a commodity that will be dried and sold. Seaweed can be dried in a variety of ways. The simplest method is to lay it on the beach or in other open fields with a tarpaulin or netting to protect it from sand or dirt. A drying platform or hanging rack is a more advanced method (*para para*). This technique is more expensive; however, this method provides the seaweed with extra protection from dirt and debris. The drying process typically takes 2-5 days depending on the

weather and technique used. The industry standard for dried seaweed is 35% moisture content. After the standard is achieved, the seaweed can be packed into sacks for sale (McHugh, 2003).

2.3. Demand for Indonesian Seaweed

In the mid-1990s, the global demand for raw seaweed grew significantly. During that period, seaweed farming throughout Indonesia started increasing. The Indonesian government at that time supported seaweed cultivation and products as an economic strategy to increase coastal communities' income from coastal resources (M. S. Islam, 2014). Salim and Ernawati (2015) and FAO (2018) stated that the existing data showed that Indonesia is the second largest producer of seaweed worldwide (after China); and the largest producer in South Asia Region. FAO (2018) reported that the output of seaweed increased from 1.2 million tons in 2006 to 11.3 million tons in 2015. Indonesian seaweed contributes more than 30 % of the total global production of seaweed compared to China which is nearly 50 %.

Indonesia is reported to be the world's largest producer of *Eucheuma*, *Kappaphycus* and *Gracillia*, contributing to more than 90 % of global demand for those species (Salim & Ernawati, 2015). The input of seaweed production in Indonesia comes from the farmers who are largely located in Sulawesi, Maluku, West and East Nusa Tenggara, Northern Kalimantan and East Java (FAO, 2018).

Due to the relatively low consumption of seaweed domestically, nearly 60 - 70% of total production is exported to the global market. The remainder consumed in the domestic market. Most Indonesian seaweed is traded as a dried raw material. Unprocessed seaweed is divided into two categories: edible seaweed (fit for human consumption) and non-edible seaweed (FAO, 2018; Kılınç, Cirik, Turan, Tekogul, & Koru, 2013). Indonesian exports of dried seaweed reached 207 million tons with a total value of USD \$170.3 million, in 2015. In more recent years, demands for semi-processed *Eucheuma*, *Kappaphycus*, and *Gracillia* products such as carrageenan and agar has increased significantly. In 2015, Indonesia exported 5,190 tons of carrageenan worth approximately USD 30 million. The European Union, Japan, and the United States of America are the top market regions for Indonesian carrageenan. However, agar is in lower demand than carrageenan; where only 750 tons of agar was exported in 2015, valued at nearly USD 10 million. However, future ratios are likely to vary due to rising domestic incomes and increased national and international demand for seaweed. (FAO, 2018).

2.4. Seaweed Cultivation for Livelihood: Potential and Challenges

Recently, the potential of Indonesian seaweed as a direct product has shown a positive trend in the domestic market. Seaweed is now processed into a variety of seaweed food products, such as noodles, drinks,

snacks, cookies, and sweets. These products are primarily manufactured by macro enterprises throughout Indonesia (FAO, 2018; Rahim et al., 2019).

The Indonesian seaweed export rate has increased significantly in the global market. However, as a new production paradigm with enormous potential, seaweed farming offers numerous opportunities, but it will be difficult to overcome the sector's expansion constraints (Kim et al., 2017; Rahim et al., 2019; Achmad Zamroni, Apriliani, Rosyidah, Muliawan, & Hatanaka, 2020). As indicated earlier, the driving force of this expansion in seaweed farming is market demand for the products and services. Evidently, in an iterative process between the decision to farm and the steps that lead to yield and marketing, more consolidated farming operations are needed to better respond demand increase. A supply-driven approach can be used to create demand, if costs, risks, and marketing strategies are properly considered. There is potential for national and international public sector investments to develop partnerships with the private sector (Rahim et al., 2019; Zamroni, 2021).

The amount of Indonesian seaweed exported in world trade has greatly increased. However, according to Kim et al., 2017, even though the large industry potential of seaweed farming brings bright prospects for the future, it will also create some difficulties which need to be considered in the development phase of strategies. Many seaweed-farming communities have traditionally been reliant on coastal fisheries and are currently being affected by overexploitation of these resources (Eggertsen & Halling, 2021;

Rahim et al., 2019). In Bantaeng Regency, many of the seaweed farmers now receive an attractive income from seaweed cultivation; this has encouraged many people of the coastal areas to start seaweed farming (Azis, 2011), and consequentially, the ecological condition of coastal areas has become vulnerable (Eggertsen & Halling, 2021).

Another problem of seaweed farming is the excessive volatility of prices (FAO, 2018). Seaweed farming is particularly prone to boom-and-bust cycles given the large number of small-scale price-takers in the industry. Volatility is further compounded by the absence of relevant, reliable, and timely production statistics and market intelligence. In contrast to agricultural commodities such as coffee, copra, or tea, there are no organized markets to provide benchmarking of international prices for seaweed. Seaweed farmers, traders, and processors frequently make decisions based on speculation or misinformation, resulting in market fluctuations (FAO, 2018; Achmad Zamroni et al., 2020).

2.5. Sustainable Livelihood Framework (SLF)

The Sustainable Livelihoods Framework (SLF) enhances the understanding of the livelihoods of the poor. It helps focus researchers on how to organize the factors that constrain or enhance livelihood opportunities, and shows how these factors interrelate (Serrat, 2017). This framework can help plan development activities and assess the contribution that existing activities have made to sustaining livelihoods (Azis, 2011).

A closer examination of livelihood components using the Sustainable Livelihood Framework (SLF) has proven to be extremely beneficial. It is used as an instrument to understand livelihoods of economically poorer populations. This strategy focuses on securing better livelihoods that improve people's lives by recognizing the need for increased incomes as and poorer households' ability to deal with risks and vulnerabilities. A livelihood is crucial improved quality of life and a vital tool for poverty reduction. The framework depicts all the basic elements that affect the livelihoods of the poor. This framework is widely used in planning new projects and assessing the progression of existing projects. The SLF offers a checklist of key issues and reveals how these issues are associated with each other, while drawing special attention to the principal influences and processes and their multiple interactions in association to livelihoods.

The SLF aims to evolve thinking about the how the poor and vulnerable live their lives and the importance of policies and institutions as presented in Figure 2. It helps formulate development activities that are:

- People-centred,
- Responsive and participatory,
- Multilevel,
- Conducted in partnership with the public and private sectors,
- Dynamic,
- Sustainable.

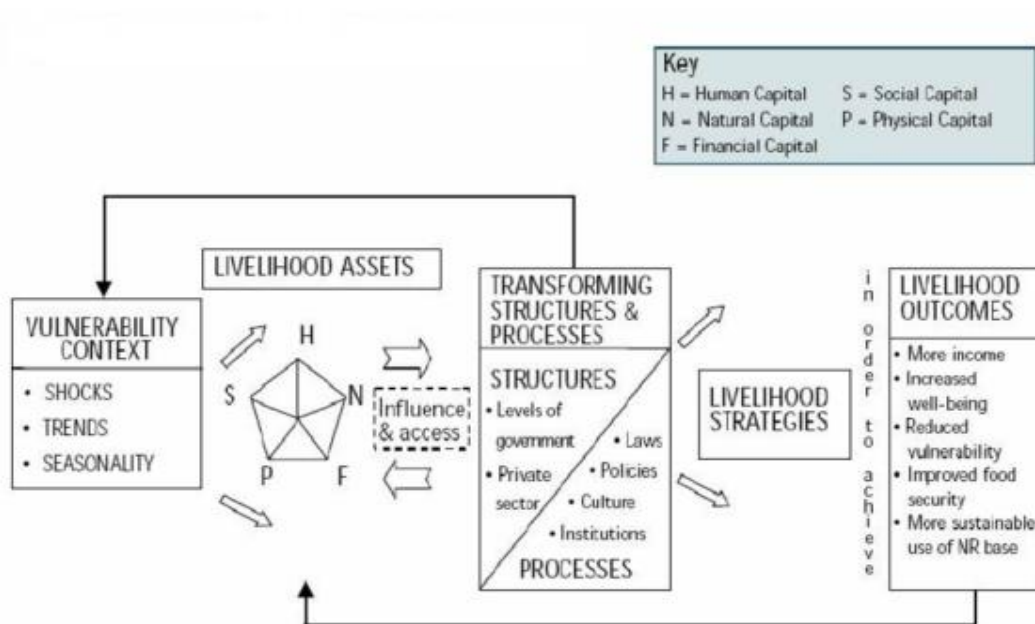


Figure 2: The Sustainable Livelihood Framework (SLF) (Scoones, 1998)

A central notion is that different households have different access to livelihood assets, and the SLF aims to expand this access. The livelihood assets with which the poor must often make trade-offs and choices about, comprise (Serrat, 2017):

- **Human capital:** skills, knowledge, the ability to work and good health. Good health is not simply a means to earning a livelihood; it is of course an end.
- **Social capital:** the social resources that people draw on to make a living, such as relationships with either more powerful people (vertical connections) or with others like themselves (horizontal connections), or membership of groups or organisations. Generally, relationships of trust, reciprocity, and exchange that the poor can draw on in times of

need, and that lower the costs of working productively together. Like human capital, social capital has an intrinsic value; good social relationships are not simply a means, they are an end in themselves.

- **Natural capital:** the natural resource stocks that people can draw on for their livelihoods, such as land, forests, water, and air.
- **Physical capital:** the basic infrastructure that people need to make a living, as well as the tools and equipment that they use. For example, transport and communication systems, shelter, water and sanitation systems, and energy.
- **Financial capital:** savings, in whichever form, access to financial services, and regular inflows of money.

The SLF offers a framework for analysing livelihoods and identifying entry points for development interventions by donors and governments. The framework provides a way of conceptualizing key influences on the livelihoods of poor people, including their vulnerabilities, their access to assets, and the various factors that influence what they can achieve with these assets (Patnaik & Prasad, 2014).

Livelihood strategies and outcomes are not just dependent on access to capital assets or constrained by the vulnerability context; they are also transformed by the environment of structures and processes. Structures are the public and private sector organizations that set and implement policy and legislation; deliver services; and purchase, trade, and perform all

manner of other functions that affect livelihoods. Processes embrace the laws, regulations, policies, operational arrangements, agreements, societal norms, and practices that, in turn, determine the way in which structures operate. Policy-determining structures cannot be effective in the absence of appropriate institutions and processes through which policies can be implemented. Processes are important to every aspect of livelihoods. They provide incentives that stimulate people to make better choices and grant or deny access to assets. Processes can enable people to transform one type of asset into another through markets and have a strong influence on interpersonal relations. One of the main problems that the poor and vulnerable face is that the processes which frame their livelihoods may systematically restrict them unless the government adopts pro-poor policies that, in turn, filter down through legislation and reduced formal processes.

2.6. The Correlation between Poverty and Coastal Resources

Poverty is described as a person's or community's circumstances when insufficient available funds and resources are available to meet their basic needs (Chen, De Bruyne, & Bollempalli, 2020). The World Bank (2018) defined that poverty means the hardship in achieving prosperity which includes several indicators. It involves a lack of money, inability to fulfil the basic needs such as proper housing, clean water, nutritious food, and healthcare. Poverty not only impacts economic aspects but also social and political elements (Rupasingha & Goetz, 2007). Poverty is caused by

the inability of a person or society to get access on economic activities. However, measuring poverty is challenging, where every nation uses varying indicators with a different approach and standards to establish the extent of poverty and the number of people living in poverty.

Furthermore, the data from the World Bank (2018) and the United Nations (2019) shows that majority of those in poverty live in rural areas (17.2 % of rural population). This statistic is approximately three times higher than those who live in urban areas (5.3 % of urban population). Those in poverty living in rural areas are reported to make up approximately 79 % from the total population in poverty. Many of poverty population in rural areas have low levels of human capital, which in turn traps them into income poverty. They depend on agricultural activities for their livelihoods and have limited access to non-agricultural activities to support their basic needs. To add further stressors, many of the poverty population have dependent children, poor educational background, poor health and vulnerability to malnutrition.

As an archipelagic nation with around 17,508 islands, and a coastline of approximately 81,000 km, Indonesia has an abundance of coastal and marine resources. The vast coastal areas of Indonesia are home for more than two million fishers and farmers (Wekke & Cahaya, 2015). Hence, the richness of the coastal and marine resources of Indonesia have made the nation the second-largest marine food producer worldwide (Ministry of

Marine Affairs and Fisheries (MMAF) Republic of Indonesia and USAID Sustainable Ecosystems Advanced (SEA) Project, 2018).

However, Orsini, Kahane, Nono-Womdim, and Gianquinto (2013) found that more than 60 % of fishers who live in rural coastal areas still receive an income below the minimum living standards. The data from Central the Bureau of Statistics (BPS) in 2017 revealed that the poverty rate in Indonesia was 26.58 million people. Most of the population in poverty (61.36 %) in Indonesia live in coastal and rural areas. This reality is paradoxical to the abundant potential of Indonesian coastal resources.

For fishers, food is the only essential need in their life (Wekke & Cahaya, 2015). Most of them are poor due to their hardship not only in receiving a proper wage, but also in purchasing the fuel, bait and fishing gear. Fishers tend to misuse the coastal resources when they need to fulfil their needs without thinking of the sustainability of the coastal resources. This human behaviour and activity depletes the coastal and marine resources and further adds to the degradation of marine. (Cahyagi & Gurning, 2018; Ministry of Marine Affairs and Fisheries (MMAF) Republic of Indonesia and USAID Sustainable Ecosystems Advanced (SEA) Project, 2018).

Illegal fishing practices, including blast fishing, beach seine netting and use of poison, are harmful for the marine environment. The overfishing practices can quickly deplete the marine resource stocks. Consequently, the fish catch has reduced significantly in a short period of time. Moreover,

the uncertainties in weather phenomena and forecasts, due to global warming, have also threatened the fishery harvest (Raja, 2012). Overfishing, environmental degradation and climate change conditions directly impact the income of fishers. The result of this is that many of them are unable to meet their other basic needs including proper housing, clean water, good education, and healthcare (Orsini et al., 2013; Rupasingha & Goetz, 2007; Wekke & Cahaya, 2015).

2.7. Poverty Alleviation Strategies

The United Nations Development Program (UNDP) has declared that “Ending poverty in all its forms everywhere” is the first of the 17 sustainable development goals set by the UN, with the commitment that “no one will be left behind” (Gill, Caven, & Hussain, 2021). Economic growth is a key tool for poverty alleviation and lifting the poor out of poverty through productive employment (Sud & VanSandt, 2015). Economic growth provides the resources to expand the program of poverty reduction while allowing governments to spend on the basic needs of the poor, for example healthcare, education, and housing (United et al., 2014).

In order to improve life conditions, the improvement of the capacity of the poor is essential. Improving individual capacity also helps to pool resources and allows the poor to engage in economically advantageous activities. Therefore, access to natural resources need to be secured by the local communities in order to maintain their livelihood activities (Daw,

Brown, Rosendo, & Pomeroy, 2011). However, most developing countries have difficulties in land tenure arrangements due to population growth and large-scale development. Consequently, over exploitation of natural deposits causes degradation of the natural environment, which in turn results in negative impacts on community livelihoods (Singh & Chudasama, 2020).

In addition, social integration of vulnerable communities is as important as financial integration in poverty reduction strategies by removing social barriers (Holland & World, 2007). Social security It is an important tool for tackling inequality and vulnerability. It also induces gender parity due to equal sovereignty in economic, social, and political activities of both men and women. Therefore, the priority agenda of development must include good governance that is relevant to poverty alleviation. However, because of potential weaknesses in political and administrative governance, developing countries face enormous challenges in the areas of social services and security. If poverty is to be reduced while improving the lives of the poor and vulnerable, a participatory, transparent, and accountable form of governance must be strengthened (Datta & Singh, 2018).

2.8. Geographic Information System (GIS)

A Geographic Information System (GIS) is a computer software that captures, stores, manipulates, analyses, manages, and displays various types of geographical data (Pauly & Clerck, 2010). GIS can be used as a

tool for problem solving and decision-making, as well as for data visualization in a spatial environment such coastal or urban planning.

According to Aguilar-Manjarrez and Kapetsky (2007), GIS is an efficient method to use when performing land analysis with a variety of organisms and a variety of complex variables. GIS processes a wide range of data and can provide information on the coverage area. For example, the use of GIS to combine different types of data (biological, chemical, physical, and geological) collected in various ways from various instruments and platforms (ships, moorings, floats, gliders, remotely operated vehicles, aircraft, and satellites) has provided the oceanographic community and policymakers with more information and insight than could be obtained by considering each type of data separately. GIS in this domain has progressed from merely displaying data to multidimensional visualization, simulation and modelling, and decision support.

Before delving into data collection for GIS, it is critical to understand data quality considerations, as this greatly influences the dependability of any final output from GIS. For GIS-related work in inland fisheries or aquaculture, a major source of secondary data will be national mapping or hydrographic agencies in any given country, the addresses of which can be found by searching online (Meaden & Aguilar-Manjarrez, 2013). The cost of obtaining much secondary data, especially if it is in digital format, is a problem, and there may also be copyright rules that apply. GIS users looking for mapping may discover that some larger private companies, such

as Google Earth's satellite imagery and the Environmental Systems Research Institute (ESRI), provide a range of ready-to-use, high-quality data for GIS visualization and analysis (Meaden & Aguilar-Manjarrez, 2013; Pauly & Clerck, 2010).

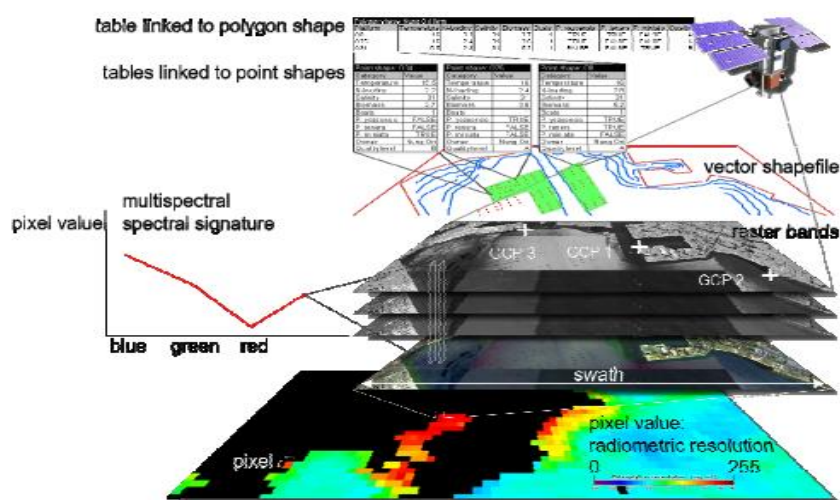


Figure 3: An illustration of GIS data file types and remote sensing of a seaweed farm (Pauly & Clerck, 2010)

Seaweed cultivation is a significant source of income for coastal communities. The location of seaweed cultivation is one of the determining factors that influence the success of seaweed cultivation in the long-term (Jamaluddin, Syam, Mustarin, & Rivai, 2019; Widowati, Ariyati, & Pejeki, 2019) . However, site selection for seaweed culture presents some challenges that necessitate more money, time, and effort (Nirmala, Ratnasari, & Budiman, 2014). Therefore, due to time and financial

constraints, technology such as remote sensing was perceived as viable options for site selection to increase seaweed culture as seen in Figure 3.

By combining data such as the Landsat 8 satellite to be used for site selection, with parameters such as sea surface temperature (SST), total suspended matter (TSM), and protected location could be used to determine the best location for seaweed culture through the maps overlay technique (Nirmala et al., 2014) in GIS application. Moreover, GIS is also able to evaluate suitable location of seaweed farming based on the condition of the water quality (Mujiyanto, Syam, Wijaya, & Purnamaningtyas, 2020). For instance, the suitability of coastal areas was analysed using GIS software from coordinate data and water quality parameters, which were compared. The category "suitable" has a score of 4, the category "suitable enough" has a score of 3, the category "suitable with conditionals" has a score of 2, and the category "not suitable" has a score of 1. Thus, this classification can make the local governments to develop the seaweed commodities in its region.

2.9. SWOT Analysis

The Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis is the systematic identification of various factors to formulate an organization's strategy. This analysis is based on the logic of maximizing strengths and opportunities while minimizing weaknesses and threats in organization's environments to formulate its strategy accordingly (Sammut-

Bonnici & Galea, 2015). It has been recommended as a knowledge-based tool for strategic planning in small and medium-sized businesses, as well as for whole-industry sectors such as fisheries (Nurhidayati, Huang, Hanani, & Sujarwo, 2020) and aquaculture (Rahman et al., 2020). Strategic decision-making is integrally linked to the development of an organization's mission, goals, strategies, and policies. As a result, a strategic planner should assess the organization's strategic factors, such as strengths, weaknesses, opportunities, and threats, in the current environment.

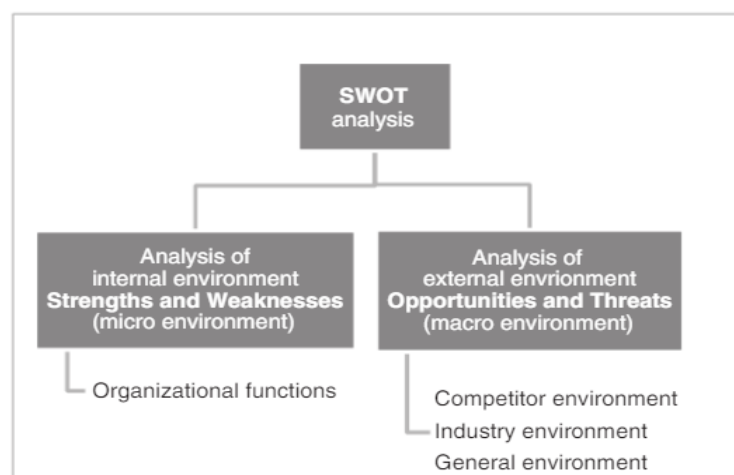


Figure 4: SWOT analysis main components (Sammut-Bonnici & Galea, 2015)

According to Sammut-Bonnici and Galea (2015), in order to conduct a more in-depth analysis of the SWOT, it is necessary to consider both external and internal factors as important components of the SWOT

analysis as seen in Figure 4. The internal factor influences the development of strengths and weaknesses (S and W). Whereas this factor is related to the conditions that occur within the organization or program, which also influences the formation of decision-making organization. The resources of the organization are divided into functional categories of financial, managerial, infrastructural, suppliers, manufacturing, distribution, marketing, and innovation resources in an internal analysis of strengths and weaknesses (Sammut-Bonnici & Galea, 2015).

The goal of an external environment analysis is to assist organizations in recognizing significant developments and future implications. The external environment consists of variables that are beyond an organization's control but necessitate analysis to realign corporate strategy to shifting business environments (Sammut-Bonnici & Galea, 2015). An external analysis identifies potential threats and opportunities for future growth (Moogouei, 2014). These external factors have an impact on the development of opportunities and threats (O and T). This factor involves external conditions that affect decision making that occur outside of the organization or program.

Additionally, to extract information from the situation analysis and categorize it into internal and external factors, the SWOT matrix is used as a tool for compiling the organization's strategic factors. This matrix clearly describes how the organization's external opportunities and threats can be balanced against its strengths and weaknesses. The Internal Strategic

Factors Analysis Summary (IFAS) matrix, External Strategic Factors Analysis Summary matrix (EFAS matrix), SWOT matrix, and decision-making matrix can be used to analyse and arrange the strength, weakness, opportunity, and threat factors. Table 2 depicts a decision-making matrix. The tool used to compile the strategic factors of organization factors of the organization is the SWOT matrix. This matrix can clearly describe how the external opportunities and threats faced by the organization can be adjusted to the strengths and weaknesses it has.

Table 2: SWOT Decision-Making Matrix

IFAS EFAS	Strength (S)	Weakness (W)
Opportunity (O)	SO Strategy (Strategies that use strengths and take advantage of opportunities)	WO Strategy (Strategies that minimize weaknesses and take advantage of opportunities)
Threat (T)	ST Strategy (Strategies that use strength and overcome threats)	WT Strategy (Strategies that minimize weaknesses and avoid threats)

Source: (Rangkuti, 2016)

2.10. Previous Research Findings

A considerable number of studies with different approaches and field studies, especially related to poverty alleviation study and the utilization of spatial analysis and sustainable livelihood framework (SLF) as tools to assess the livelihood of coastal commodities and to evaluate the access of

the poor to their capitals and resources. A study from Kusumanti, Ferse, and Glaser (2021) found that the SLF asset pentagon allows for the visual presentation of information about people's assets, highlighting the important interrelationships between various assets. Depending on the condition and community structure of the respective area, different shapes of the pentagon were obtained based on changes in or availability of assets. The pentagon's shape does not represent absolute or numerical values, but rather a qualitative impression of the extent of various types of livelihood assets. The findings show that different assets in livelihood portfolios are currently not performing to their full potential. Consequently, the capacity of people to adapt can be enhanced with targeted strategies to reduce vulnerability. One of the internal dominant factors that contribute to the failure of poverty alleviation programs in coastal communities is a lack of mastery of modern fish capture tools and the use of unskilled fish capture methods caused the degradation of the coastal resources (Pattiasina, 2010). Some poor fishers rely solely on the sea for a living (Stanford, Wiryawan, Bengen, Febriamansyah, & Haluan, 2013).

Furthermore, few studies have analysed the direct contribution of seaweed to poverty. Researchers who have previously studied seaweed farming had various objectives and thus obtained different results. Kassila et al. (2019), Small-scale fishermen should be encouraged to form of livelihood through seaweed farming. However, despite existing demand for raw materials and a stable technological foundation for cultivation, a lack of

added-value products and low-cost biomass may have a negative impact on the livelihood of those involved in aquaculture operations, creating uncertainties for long-term expansion (Henriquez-Antipa & Carcamo, 2019). Consequently, the role of cooperatives in promoting education and literacy, gaining access to scientific information and research institutions on fisheries, and assisting in the enforcement of regulations is significant to strengthen seaweed farming sustainability (Aslan et al., 2018).

Moreover, Mariño, Breckwoldt, Teichberg, Kase, and Reuter (2019) studied seaweed farming in southwestern Rote, where 50% of homes rely solely on income, causing two-thirds of families to live below the poverty line. They found that families with additional sources of income appear to fare better during the low season of seaweed production. However, seaweed can provide benefits by focusing on increased seaweed farming productivity. Also, a study from Larson et al. (2021) found that seaweed contributes significantly to household income, which has a positive economic and social impact. There are no negative effects of seaweed farming, and evidence of increased life satisfaction across villages, both among women and non-farmers.

Finally, several studies use spatial analysis or SWOT analysis to build strategies for sustainable livelihood from sustainable aquaculture including seaweed cultivation (Gurning & Cahyagi, 2018; Moogouei, 2014; Pauly & Clerck, 2010; Rahim et al., 2019; Zamroni, 2021). The ability to map the distribution of seaweed commodities is critical for cultured seaweed

management and development to formulate strategic policy decision (Langford, Waldron, Sulfahri, & Saleh, 2021). Therefore, the SLF will be focused on this study to assess the capital assets seaweed farmers to make sure the sustainability of this activity as their main source of income by considering the spatial distribution of seaweed cultivation and then formulating the sustainable seaweed cultivation strategies.