

**STUDY RESILIENCE OF SEAWEED CULTIVATOR IN NAIN ISLAND WORI
DISTRICT NORTH MINAHASA REGENCY**

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<https://doi.org/10.35410/IJAEB.2022.5753>

ABSTRACT

Resilience is the ability of a particular ecological system or ecological system to be able to withstand disturbances by absorbing and directing it so that the state of the variables in the system does not change. The purpose of this study is to determine the resilience variable and calculate the resilience status of seaweed farmers on Nain Island, Wori District, North Minahasa Regency. The data collected it is like primary data and secondary data. primary data from observation and secondary data from village government. Sampling method using purposive sampling. The population in this study is all cultivators in Nain Induk and Nain 1 Villages with a total of 180 cultivators. Nain Induk Village has 91 cultivators and Nain Village has 1, 89 cultivators. The sampling in this study was 30% from Nain Induk and Nain 1 Villages, namely 27 respondents. The respondent in this research is seaweed cultivators that doing seaweed cultivation more than

10 years. Data analysis using method analytic descriptive resilience index cultivator from geometry composite. Four variables using in this research is knowledge, adaptation, dependency, perception. Based on research on the resilience status of seaweed cultivators, namely those on Nain Island are 63.92 and categorized as resilient.

Keywords: Resilience, Farmers, Seaweed, Nain Island.

1. INTRODUCTION

Indonesia is the largest produce red seaweed raw material kerajinan that had a name Kappaphycus spp. And Euchema sp. (Buschman et al., 2017 dan Kambey et al., 2020). Seaweed is one of commodity export with revitalization program that hope in the future can improve people's welfare (Asni, 2015).

In 2019 fact is Indonesia has value export 324.84 million USD growth 11.31% compare to year 2018 the value up to 291.83 million USD. The fact is in 2014 until 2019 seaweed national export growth 6.53%. Seaweed Production in 2018 had a 10.18 million tons. MINISTRY OF MARINE AFFAIRS AND FISHERIES REPUBLIC OF INDONESIA targeting in 2020 seaweed production have to reach 10.99 million tons and gaining 12.33 million tons in 2024 (Kementrian Kelautan dan Perikanan, 2020).

Currently, there are various problems that are felt by seaweed farmers, such as a shorter planting season pattern, which has an impact on production results, spatial use conflicts, lack of supervision and community involvement, loss of seaweed cultivation land, and post-harvest handling, in addition to socio-economic and institutional aspects. This increasingly high

utilization of resources has actually put pressure on the coastal environment so that it has the potential to threaten the resilience of the social-ecological system contained in it. (Gowing et al., 2006). Resilience is the ability of an ecological system (Holling, 1973) or social ecological system (Folke, 2006) certain ecological systems to be able to survive disturbances by absorbing and directing it so that the state of the variables in the system does not change. According to Dinas Perikanan Provinsi Sulawesi Utara, Seaweed production in North Sulawesi in the last 5 years is uncertain. In 2017 decreased by 52.2% from the previous year, and increased by 59.8% in 2018 and 9.4% in 2019. In 2020 seaweed production decreased by 51.3%. Problems such as the decrease and increase in production of seaweed faced by seaweed farmers, do not stop them from doing cultivation business. The fact until right now seaweed farmers in Nain Island still doing their job. Based on this research, the authors want to study the resilience of seaweed cultivators in dealing with and overcoming existing problems, so that until now cultivators still persist in doing seaweed cultivation business on Nain Island, Wori District, North Minahasa Regency.

2.METHODS

Study Approach

This research was carried out using a socio-ecological system approach to the people of Nain Island, especially seaweed cultivators. Social resilience is the ability of individuals or communities to cope with external pressures and disturbances due to environmental changes (Shaleh et al., 2014). Social resilience can be described based on two main indicators, namely sensitivity and adaptive capacity as follows:

1.Sensitivity indicators are seen in communities with existing resources (especially seaweed) that change over time and the level of dependence on these resources. The dependence indicator is to see how much the community depends on seaweed, while the knowledge indicator is to see the community's insight regarding changes in conditions and the availability of resources (Wongbusarakum and Loper, 2011).

2.Adaptive indicators capacity is the community's ability to adapt to the impact of environmental changes. Adaptation capacity can be assessed from the indicators of perception and adaptation. The perception indicator is to see the community's ability to see changes in the coastal environment and resources, while the adaptation indicator is to see the ability of a person or community to adapt to changes in resources (Wongbusarakum and Loper, 2011).

Based on the two indicators above, several indicators can be determined to see the resilience of seaweed farmers, namely knowledge, dependence, adaptation and perception.

Data Collection

Data collected in this research are primary and secondary data. Primary data were obtained directly at the research location through field surveys, observations and interviews with respondents. Secondary data was carried out through library from journals and reports, with research report from village government of nain island.

Primary data using interview method with questionnaires to farmers seaweed with purposive sampling and direct observation in field. According to Gay, Mills and Airasian (2009). Research with using descriptive methods, sample minimal 10% from population and for smallest

population sample minimal 20%. Based on the experts, researcher take samples in this research amount of 30% from populations is 27 respondents in each village. Because number of populations in this village is relatively small. The sample chosen by a criteria that the farmers doing their job more than 10 years also ready to be interviewed.

Data Analysis

In this research the data analyzed using analytical descriptive and resilience analysis farmers based on Resilience Indicators is Knowledge Index (KI), Perception Index (PI), Dependency Index (DI), Adaptation Index (AI). Resilience level of seaweed farmers measured by 5 categories. The category is high resilience (>80-100), resilience (>60-80), enough resilience (>40-60), low resilience (>20-40), not resilience (0-20). Resilience level of seaweed farmers categorized with flagmode.

0 - 20	Not Resilience
>21 - 40	Low Resilience
>41 - 60	Enough Resilience
>61 - 80	Resilience
>81 - 100	High Resilience

Source : Cutter (2010)

Resilience Farmer Index (RFI) used measure the ability of farmers to adapt to changes that occur in the field. The indicator be measured in RFI given a score based on predetermined criteria (Likert scale) from the results of interviews with respondents. Evaluation from each parameter that measured got an average score form respondents. Calculation each RFI can presented such as:

$$IRN_i \left(\prod_{j=1, i=1}^n CI_{ji} \right) \frac{1}{n}$$

IRPi : Resilience Farmer Index in an area to-i

n : Total Index

CIi : Composite Index

J : (1) Knowledge Index (KI),

(2) Perception Index (PI),

(3) Dependency Index (DI),

(4) Adaptation Index (AI).

Indicators and parameters used in the Resilience Farmer Index (RFI) (Table 1 and 2).

Table 1. Sensitivity Indicator and parameter assessment of index Resilience Seaweed farmer Index (RFI)

1.	Knowledge	Benefits of seaweed, correct cultivation techniques, growing season, seaweed disease, cultivation constraints, depreciation of production factors, sea transportation, fishing activities, household waste, water conditions, correct cultivation techniques
2.	Dependency	Length of work, number of dependents, side work, number of livelihoods, income, economic conditions, yields/production cycle, intensity to cultivation locations, workers

Table 2. Indicators of adaptation capacity and assessment parameters of the resilience index seaweed cultivator (IRP)

1.	Perception	How big is the influence of weather on seaweed growth, how big is the effect of disease on production results, how big is the effect of price on business, how important is seaweed cultivation to the family economy, Effect of collectors to seaweed business, influence to water transportation business such a (fisherman boat, Passenger ship)
2.	Adaptation	Selling Price Change, cost of production increase, peningkatan biaya faktor produksi, declining market demand , cleanliness of business location, alternative work.

Knowledge Index of farmers

Resilience Farmer Index (RFI) obtained based on the geometric mean of each parameter given a score based on the criteria in Table 3. The score value obtained was based on the average number of respondents who answered the criteria for each parameter. Here is the formula used in the calculation.

$$X_i \frac{(\sum s_i)}{N} \dots \dots \dots (2)$$

$$KI_j \left(\prod_{k=1}^n IS_{jk} \right)^{\frac{1}{n}} \dots \dots \dots (3)$$

Where, X_i is parameter value (question) to-i, S_i is question score to-i, N is total number of respondent, KI_j is Knowledge Index to-j (farmer knowledge), IS_k is strategy indicator to-k from index composit to-j, n is the total number of strategy indicator that used to set the index and k is a number 1,2,...n

Table 1. Knowledge Index of farmers

Parameters	Criteria	Score
	Don't know	25
Benefit from Seaweed	Know enough	50
	Know	75
	Very know	100
	Don't know	25
Using right technique	Know enough	50
	Know	75
	Very Know	100
	Nothing	25
Planting season	Know enough	50
	Know	75
	Very know	100
	Attack in rainy season	25
Seaweed disease (Ice-ice)	Infectious	50
	Getting older and lack of nutrition	75
	Caused by salinity, water temperature and intensity of light.	100
	Don't Know	25
Production depreciation	Know enough	50
	Know and don't care	75
	Different	100
	Nothing	25
Fishing Activity	Quite Influent	50
	Influent with the location	75
	Very influent	100
	Don't know	25
Household Trash	Quite Influent	50
	Know and don't care	75
	Affect to seaweed growth	100
	Nothing	25
Obstacles	wave and tides	50
	wave and rain	75
	wind, rain and storm	100

	Don't know	25
Water condition	Know enough	50
	Know and it doesn't matter	75
	Affect growth	100

Dependency Resilience Index of farmers

Dependency Resilience Index of farmers obtained based on geometry average from every parameter that given score every criterion in (table 4). The score based on average total respondent that answer the questions from each criterion in every parameter. The following is the formula to calculation the Dependency Resilience Index of farmers:

$$DI_j \left(\prod_{k=1}^n IS_{jk} \right)^{\frac{1}{n}} \dots \dots \dots (4)$$

Where, DI_j is dependency index of resilience ke-j (Fishermen's dependency on the ecosystem), IS_k adalah indikator strategis ke-k dari komposit index ke-j, n n is the total number of strategy indicator that used to set the index to-j and k is a number 1,2,...n

Table 4. Dependency Resilience Index of farmers Table

Parameters	Criteria	Score
	10-13 years	25
	>13-16 years	50
Length of work	>16-20 years	75
	>20 years	100
	0-1	25
Number of dependents	2-3	50
	3-4	75
	>5	100
	>3	25
Side job	2	50
	1	75
	Nothing	100
	500.000-3.000.000	25
Income/Production cycle	>3.000.000-5.000.000	50
produksi (Amount of) (Rp)	>5.000.000-10.000.000	75
	>10.000.000	100
	Less satisfied	25
Economic condition	Enough satisfied	50
	Satisfied	75
	Very satisfied	100
	100-500kg	25

Yields/Production Cycle	>500-1.000kg	50
	>1.000-2.000kg	75
	>2.000	100
	1-2 times/week	25
Intensity to culture location	3-4 times/week	50
	5-6 times/ week	75
	> 7times	100
	0-1	25
Workers	1-2	50
	3-4	75
	>5	100
	Own	25
Capital Source	Friend/relative loan	50
	Collector loan	75
	Bank loan	100

Adaptation Resilience Index of Farmers

Adaptation Resilience Index of Farmers obtained based on geometric average from each paramters that given score based on the criteria in (table 4). The score based on average total respondent that answer the questions from each criteria in every parameters. The following is the formula to calculation the Adaptation Resilience Index of Farmers:

$$AI_j \left(\prod_{k=1}^n IS_{jk} \right)^{\frac{1}{n}} \dots \dots \dots (5)$$

Where, AI_j is Adaptation index to-*j* (farmer adaptation to every changer), IS_k is Strategy indicator to-*k* from composite index to-*j*, n is the total number of strategy indicator that used to set the index to-*j* and k is a number 1,2,...n

Table 2. Adaptation Resilience Index of Farmers Table

Parameters	Criteria	Score
	Not important	25
Increase of production cost	not too important	50
	Important	75
	Common	100
	Nothing	25
Decrease in market demand	Stop while do work	50
	Do the work but not tu much	75

	Still do the work	100
	Nothing	25
keep the location clean	Don't throw out the trash in sea	50
	Cleaning the areas	75
	Don't throw out the household trash in sea	100
	Unthinkable	25
Alternative job	Fisherman	50
	Stick to the firs job	75
	Collector and farmer	100

Perception Resilience Index of farmer

Perception Resilience Index of farmer obtained based on geometric average from each paramters that given score based on the criteria in (table 6). The score based on average total respondent that answer the questions from each criteria in every parameters. The following is the formula to calculation the Adaptation Resilience Index of Farmers:

$$PI_j \left(\prod_{k=1}^n IS_{jk} \right)^{\frac{1}{n}} \dots \dots \dots (6)$$

Where, PI_j is Perception Index to- j (perception of farmers about.....), IS_k IS k is Strategy indicator to- k from composite index to- j , n is the total number of strategy indicator that used to set the index to- j and k is a number $1, 2, \dots, n$

Table 3. Perception Resilience Index of farmer table

Parameters	Criteria	Score
	Not big	25
How much weather influence against seaweed growth	Large enough	50
	Big	75
	Very large	100
	Not big	25
How much the disease Influence the production reslut	Large enough	50
	Big	75
	Very large	100
	Not big	25
How much the price	Large enough	50

Influence the business	Big	75
	Very large	100
	Nothing	25
How much the seaweed business	Large enough	50
influence the family economic	Big	75
	Very large	100
	Not influent	25
The seaweed business	Quite influent	50
Influence to collector	Influent	75
	Very influent	100
	Not interfere	25
Water transportation affect (fisherman boat, passanger ship)	Quite interfere	50
	Bother	75
	Very annoying	100
	Not important	25
The influent of workers To the business	not too important	50
	Important	75
	Very Important	100

3.RESULTS AND DISCUSSION

General Condition of the Research Site

Nain Island is located in Wori District, North Minahasa Regency, North Sulawesi. In the past Nain Island consists of two villages namely Nain Village and Tatampi Village. In 2012 the village is growing, Nain Village become Nain Induk Village and Nain 1 Village. The society ethnic in Nain Induk Village is Bajo while Nain 1 Siau-tagulandang, and Tatampi village Tarente. Majorities of the peoples in this three-village worked as a farmer of seaweed. This research takes two village with the largest society in Nain and Nain 1 village. These two villages are located side by side. Then the Tatampi Village the people must ride a boat or walked for 30 to 45 minutes to Nain Induk Village. The majorities of Nain Induk Villages muslim and Nain 1 Village is Christian. These two villages have a high tolerance, because their respect about each culture and religious events. In the Ramadhan, the peoples Nain 1 Village will come and visit Nain induk Village, even so Nain 1 Village come the Nain Induk Village in the Christmas.

Society in Nain Induk Village have a culture that can draw attention outsider, every year their held a traditional event called “Mandi Safar” right in the month safar. This thing held “Bungin” or they called “Pasir Timbul Nain”. The whole society of *Bajo* wearing white clothes and usually held a meal with a whole society. This traditional thing purposed to cleaning the body. Society in Nain Induk Village will be invited to celebrate together.

Nain Induk Village have springs called ‘Aer Jere’ it had 2 wells inside that bordering with a beach in the next monument sign in Nain Induk Village. According to local people, ‘Aer

Jere’ never dry even though the village had a long dry season. The local people also take ‘Aer Jere’ for household needs.

Farmer Knowledge

Indicator of knowledge farmer seaweed used to measuring comprehension and ability or how the farmer ability to adapted with changes in field. In this indicator the farmer required to understand about influent to seaweed start from right time to doing cultivation, decrease production result, water condition and reduced selling value from goods investments and will increasing value production stuff.

Table 7. Farmer Knowledge Index

No	Parameter	Score	Maximum Score
1	Benefit of seaweed	56,02	100
2	Right month to do a cultivation	57,41	100
3	Depreciation of factors of production	75,00	100
4	Influent of trash and household waste	71,76	100
5	Effect of “ice-ice” is bad water condition, salinity, water temperature light intensity.	65,28	100
6	Influent of wave, tides, rain, wind and storm	69,91	100
7	Harvesting seaweed for 40 until 45 days	47,22	100
Knowledge Resilience = Resilience			63,2

According to Knowledge Resilience Index farmer to some parameters that calculated is amount of 63.2. This number showing that knowledge of farmer to cultivating the seaweed is good. Parameter indicator knowledge resilience of farmer the first is Depreciation of factors of production, disease and water condition. Depreciation of production factor for calculating that to do business of cultivation farmer knowing that production factors like workers, capital, goods investment will experience price change and the Investment goods are getting less and less selling value. Water condition also influent growth of seaweed, Water condition in Nain Island quite polluted because of household weld this also the reason appearance the “ice-ice”. But even the farmer know that household weld is the caused. Peoples in Nain Island especially Nain Induk Village are Bajo their don’t know to throw their garbage. Eventually sea is their choice to theow away their trash. Wongbusarakum and Loper (2011) stated that knowledge is very important in measuring how the community can understand about natural resources, the surrounding ecosystem and the disturbances that occur due to changes that occur in the field.

Perception of farmer

Indicator perception to calculated how much the influent to seaweed business when there is changes in the fieldwork.

Table 8. Perception of farmer index

No	Parameter	Score	Maximum score
1	influence of weather on seaweed growth	60,2	100
2	Influence of “Ice-ice” disease	71,7	100
3	Influence of price change to business	76,8	100
4	Influence the business to family economic	69,0	100
5	Role collector to cultivation business	43,5	100
6	Impact from water transportation to area	55,5	100
7	Influence of workers to business	39,00	100
8	Influence of fisherman activity	53,2	100
Perception Resilience = Enough Resilience		59,38	

According to perception indicator of farmers obtained value 59.38. enough resilience to the indicator. In this research perception indicator to calculation the response or viewpoint of farmer during their job and things influent to this business.

In parameter how much influent of weather and “ice-ice” disease to seaweed growth to see viewpoint or perception of the farmer to the disease that influent seaweed itself. This parameter got a good value 60.2 and 71.2 it means most of the farmers think bad weather and disease can influent to seaweed growth.

Next parameter about how big is ther role of collector and how much influent of the workers in supporting this business. Value of the score is 43.5 and 39. It proving that collector and workers not really influent to this business. The role collector is to giving loan or donation in case to start this business. Result of this research prove that just a little bit donation their giving to start this business. Role of collector in this research just a buyer. Next for the farmers most of them don’t really need a worker besides from their own family.

Dependency of farmers

Evaluation to dependency indicator from this cultivation business calculated to knowing how much dependent the farmer to this seaweed business. With a few parameter that can be calculation.

Table 9. Dependency of farmer index

No	Parameter	Score	Maximum score
1	length of work	91,7	100
2	Total of family responsibilities	51,5	100
3	Side job	75,4	100
4	income/production cycle	50,9	100
5	Family economic condition	56,9	100
6	Harvest/production cycle	50,2	100
7	Intensity to cultivation site	66,2	100
8	Workers	32,8	100
Dependency Resilience = Resilience		60,94	

According to analysis obtained value 60.94. this categorized that dependency of farmers to seaweed is not to high or stable. This result show that most of farmers had a side job beside seaweed cultivation. Their side job like fisherman, farmer, breeder, entrepreneur, builder and village staff. Seaweed cultivation can be the only source of income but it would be better not to used it as the one of the main sources of income (Zacharia *dkk.*, 2015). According to table 9 length of work parameter gets the highest score that is 91.7 which means majority of farmers working for more than twenty years. According to them this business can support and help their family economic problem.

Adaptation Perception

Last indicator is Adaptation of farmers. There are four Adaptation indicator can be calculated and costumized with condition and situation in Nain Induk and Nain 1 Villages.

Table 10. Farmer Perception index

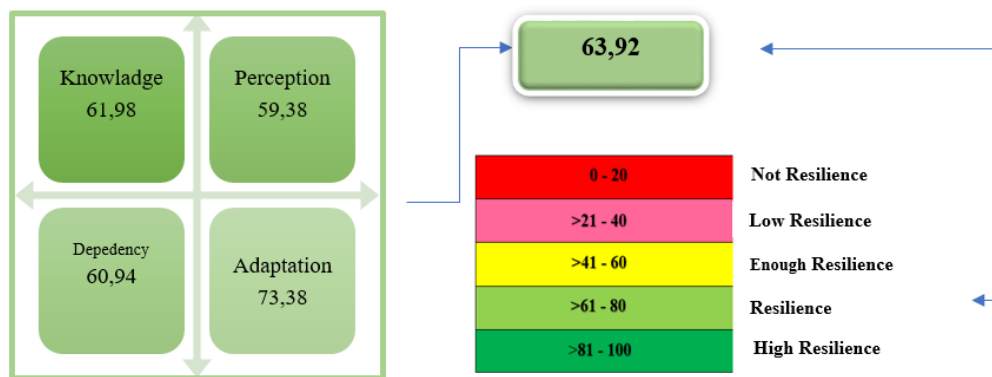
No	Parameter	Score	Maksimum Score
1	increase price of factors of production	80,1	100
2	Decrease market demand to seaweed	81,9	100
3	Affection of the cultivation area	68,00	100
4	Alternative job	63,4	100
Adaptation Resilience = Resilience		73,38	

According to analysis obtained value 73.38. it means farmers are resilience to operating their business. To understand complex about resilience social ecology system are to identified the component such a self-organizing and adaptation as a response to external factor that influent the stability of social and ecology system (Folke *et al.*, 2002; Adger *et al.*, 2005). Each parameter is to important for adaptation index, start from increase price of factors of production like investment goods and next production when market demand of seaweed si decreased. In this parameter the score is 81.9 when seaweed is not bought anymore from collector or companies, the farmer will stick doing their business their expect seaweed will still be sold because it has high economic value. Berkes and Folke (1998) stated that Through the management of natural resources, social and ecological systems actually shape each other through the process of interaction that occurs.

Resilience Status of Farmer

There are four indicator that calculated form resilience farmers there are Knowledge Index, Perception Index, Dependency Index, and Adaptation Index. From the research get an average score is 63.92 which mean Resilience Status of farmer seaweed in Nain Induk and Nain 1 Village categorized resilience appropriate with *flagmode* in picture 4. Social resilience is described as the ability of humans, both individuals and communities, to withstand external disturbances including broader economic, political or cultural disturbances (Adger, 2000). It

means, farmer resilience to the changes in the field. Their using this resilience to face the pressure that can influent their business. Such a unexpected changes price selling, increased cost of production, nature and the others. This research some parameter that calculated in each indicator have a contribution, impact also can have a big influent to the evaluation.



Picture 1. Resilience Status of Farmer

This score giving a good impact when farmer do their business continuously. According to this it means farmer can adapted when facing some pressure that in others day will be impact to their business. Lot of alternative way that can farmer do if the changes happen unexpected. The adaptation process is really important when there some incident have a big impact to their business. They know what strategy that their can do so that their business can sustainable.

4.CONCLUSION AND SUGGESTION

Conclusion

1. According to this research about evaluation to farmer seaweed resilience on Nain Island, Wori District, North Minahasa Regency there are four variables can be used to determine resilience status there are Knowledge, Perception, Dependency and Adaptation of farmers.
2. Resilience status about 63.92 categorized as a resilience from the four variable that calculate.

Ssuggestion

Takes a socialization or service and other useful activities for the development of seaweed cultivation business for the people of Nain Island, seeing that the resilience value of the perception variable is lower among the other three variables.

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