Financial feasibility analysis of the ice plant construction to support capture fisheries activities in the border Area of Indonesia-Timor Leste, Belu Regency, East Nusa Tenggara

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Abstract. This study analyzes the financial feasibility of establishing an ice plant in the coastal area of Belu Regency, East Nusa Tenggara, to support local fishermen in preserving the quality of their catch. The analysis employs five key indicators: Net Present Value (NPV), Internal Rate of Return (IRR), Profitability Index (PI), Average Rate of Return (ARR), and Payback Period (PP). The results show an NPV of USD 339,932.59, indicating a positive net value for the project. The IRR is 46%, exceeding the predetermined discount rate, deeming the investment profitable. The PI reaches 10.53, reflecting significant profit potential compared to investment costs, while the ARR of 57% indicates a strong return ratio relative to the average investment. The Payback Period is achieved in 3 years, 5 months, and 9 days, suggesting a relatively quick capital recovery. Based on these indicators, the ice plant development is considered financially feasible and is expected to impact the coastal community in Belu Regency.
Key Words: financial feasibility, ice plant, fishermen, East Nusa Tenggara, investment.

Introduction. Belu Regency, located in East Nusa Tenggara (NTT) Province, is classified as a frontier, remote, and outermost region (Terdepan, Tertinggal, dan Terluar—3T). This area possesses significant fishery resource potential, particularly in its coastal regions (Alamsah et al 2024; Mbiri et al 2024). It shares maritime borders with Timor-Leste, with both countries managing the waters of the Ombai Strait (Situmorang et al 2022). Capture fisheries play a crucial role as a primary livelihood for the local community (Supriyadi et al, 2024). However, limited supporting infrastructure, particularly the availability of ice block storage facilities, remains a major challenge. This limitation often leads to a decline in the quality of fish catches and a reduction in their economic value.

As a renewable resource, fisheries have the potential to serve as both an economic driver and a source of new energy, contributing to the development goals of the fisheries sector and other related industries (Juanda & Martunis, 2014). The demand for ice blocks in Belu Regency continues to rise in line with the increasing number of fishers and the growing intensity of fishing activities (Harryes et al 2023). Alamsah et al (2024) stated that due to the lack of infrastructure providing materials/ice that can be used to maintain fish quality, fishermen use ice blocks that are produced independently or sold by local kiosks, the capacity of which is very limited and affects the ability of fishermen to maintain fish quality for longer, so that fishing trips become shorter and affect production capacity.

Listiana et al (2013) highlight that business feasibility is a critical criterion for long-term investment decisions in a specific production sector. Therefore, conducting a feasibility analysis is essential to assess the potential development of this industry. A financial feasibility study serves as an important initial step in evaluating the economic viability of establishing an ice factory in Belu Regency. This analysis includes an assessment of investment costs, operational expenses, revenue projections, and five key financial indicators: Net Present Value (NPV), Internal Rate of Return (IRR), Profitability Index (PI), Average Rate of Return (ARR), and Payback Period (PP).

According to Sugiyanto et al (2010), a business feasibility study is conducted to determine whether a business idea is viable for implementation. In this context, this research aims to provide a comprehensive analysis of the potential profitability and associated risks of establishing an ice factory. The findings of this study are expected to contribute both academically and practically to policymakers, business stakeholders, and the fishing community.

Material and Method

Description of the study sites. This research was carried out during the period from June to October 2024 in Belu Regency, East Nusa Tenggara Province. The research location covers coastal areas, which are the center of capture fisheries activities, with the main focus on fishing villages that have the potential to develop supporting infrastructure, such as ice factories. Primary data was collected through direct interviews with fishermen, fisheries facility managers, and related stakeholders, while secondary data was obtained from official local government reports and relevant literature. The locations that are the research objects are as seen in Figure 1.

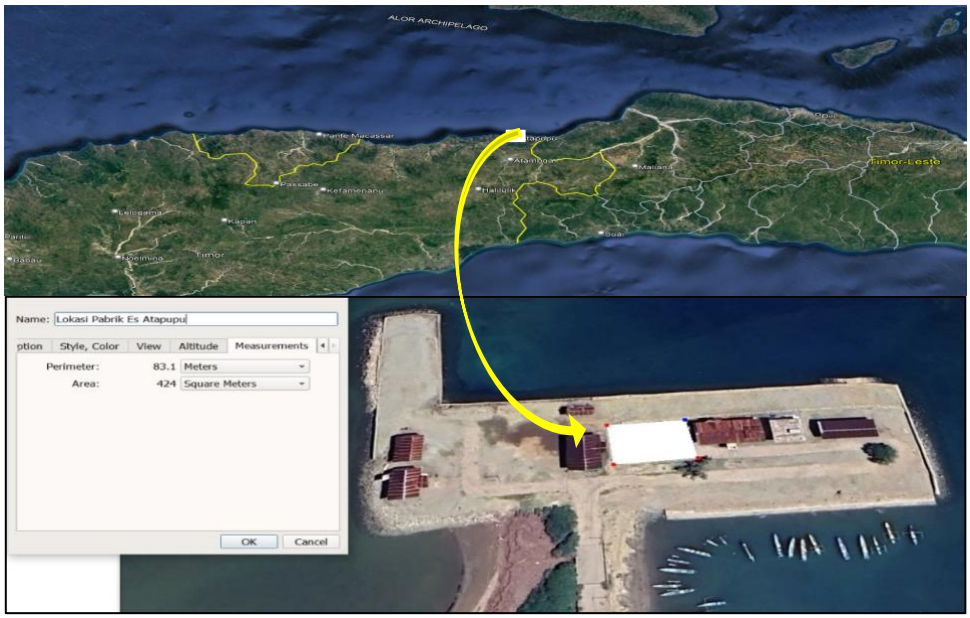

Figure 1. Location of ice block production business plan with a capacity of 3 tons/day (Ice Factory).

Method of collecting data. The data collection method in this research was carried out through qualitative and quantitative approaches. Primary data was collected through in-depth interviews, direct observation in the field, and filling out questionnaires by fishermen and fisheries facility managers. Interviews were conducted using structured question guides to obtain information regarding ice needs, consumption patterns, and challenges faced in capture fisheries activities. Apart from that, field observations were carried out to see directly the condition of the infrastructure and operational activities of fishermen. Secondary data was obtained from official documents, such as annual local government reports, fisheries statistics, and relevant previous studies.

Figure 2. Interview process and data collection in the field.

Data analysis. The data analysis method used in this research involves descriptive and quantitative analysis. Descriptive analysis is used to provide a general overview of the condition of capture fisheries, ice needs, and the potential for building an ice factory. Quantitative analysis is carried out to calculate business feasibility indicators, such as NPV, IRR, Payback Period, ARR, and Profitability Index (PI). The data obtained is processed using statistical software and spreadsheets to ensure calculation accuracy. All analysis results are presented in the form of tables and graphs to facilitate interpretation and decision making.

Business feasibility analysis

Net present value (NPV). It is the difference between the present value of an investment and the present value of net cash receipts in the future (Affanta & Telussa 2019). The NPV is calculated using the formula:

$$Net\ present\ value = \sum_{t=()}^{n} \frac{At}{(1+k)^1}$$

Where:
K: Discount rate used
At: Cash flow in period 1
n: The last period in which Cash flow is expected

Internal rate of return (IRR). IRR is the discount rate that makes NPV equal to zero, calculated by solving the equation:

$$\sum_{t=()}^{n} \left[\frac{A_t}{(1+r)^1}\right] = 0$$

Where:
R: The interest rate that is used as PV from proceeds is the same as PV from Capital Outlays
At: Cash Flow for period t
N: The last period in which the cash flow is expected

Profitability index (PI). PI is calculated by the formula:

$$Profitability\ Index = \frac{Proccesds}{Outlays}$$

Where:
Processes: Net cash receipts
Outlays: Current investment value

Average rate of return (ARR). Average Rate of Return is an investment assessment method that calculates the ratio of the average net profit generated by an investment to the average value of the investment.

$$Average\ rate\ of\ return = \frac{Profit\ after\ tax}{Initial\ investment}\ x\ 100\%$$

Payback period (PP). The payback Period is calculated by determining the cumulative time until the total cash inflow is equal to the initial investment. The formula:

$$PP = \frac{Initial\ investment}{Annual\ net\ cash\ inflow}$$

Results

General conditions of capture fisheries activities in Belu Regency, NTT. Capture fisheries activities in Belu Regency are mostly carried out by traditional fishermen who use simple fishing gear such as gill nets, fishing rods, and traps. This activity generally takes place in coastal waters that have the potential for abundant catches, including small pelagic fish such as mackerel, tuna, and demersal fish such as snapper and grouper (Ismail et al 2024). According to Harryes et al (2023) Belu Regency is one of the areas that has quite good fisheries potential from grass. However, for small pelagic fish such as anchovies or small shrimp caught by fishermen, it is still very limited. This may be because there are no fishermen operating fishing gear to catch this type of fish, such as Lift Net or Fixed Lift Net (Alamsah et al 2020; 2021)

Belu Regency has 1,642 fishermen, of whom 931 have a Maritime and Fisheries Business Card (Kusuka) (Alamsah et al 2025). Of the fishermen in Belu Regency, most still rely on small motorboats with limited carrying capacity. In addition, supporting infrastructure such as docks, fish auction places, and cold storage facilities is still inadequate. This affects the efficiency of the supply chain and the quality of fish distributed to local and regional markets. Limited access to ice blocks for storing the catch is one of the main challenges. Fishermen often have to sell fish immediately after catching them to avoid damage, even at a less favorable price. This condition creates an urgent need for the provision of better storage facilities to increase the competitiveness of local fishery products.

The socio-economic aspects of fishermen are also a concern. The majority of fishermen have low income levels, which are influenced by fluctuations in catches and high operational costs. With adequate infrastructure support, including ice factories, it is hoped that this condition can be improved, thereby improving the welfare of coastal communities as a whole.

Ice requirements for handling caught fish. Ice blocks play a very important role in maintaining the quality of fish caught in Belu Regency. As stated by Sugianto et al (2024) which states that the function of ice blocks is as a material to maintain the quality of fish during fishing operations until they are sold to consumers as an effort to maintain the cold chain system in the process of controlling the quality of the catch. The low temperature produced by ice helps slow down the rotting process, so that the fish stays fresh during the storage and distribution process. For fishermen in Belu Regency, the availability of ice not only affects the quality of the catch but also the selling value of fish in the market. The need for ice in handling fish varies depending on the type of fish and the duration of the sea voyage. For example, small pelagic fish usually require an ice-to-fish ratio of around 1:1 to maintain their freshness for 24-48 hours. However, currently, fishermen often face difficulties in meeting this need due to the limited supply of ice in the local area.

This limitation forces fishermen to look for ice from other areas, which increases operational costs and reduces profit margins. In addition, the time it takes to get ice often causes delays in the fish cooling process, which risks reducing the quality of the catch. Therefore, the existence of a local ice factory that can provide ice in sufficient quantities

and at affordable prices will have a significant positive impact on the productivity and welfare of fishermen in Belu Regency.

Costs in ice factory construction activities. The assumption data used for the financial analysis of the construction of a 3-ton-per-day ice block factory in Belu Regency, NTT, can be seen in Table 1. It can be seen that the average revenue growth is estimated at 10% per year, which reflects an increase in the potential profit of fishermen or factories. The inflation rate is assumed to be 7.4% per year, which will affect operational costs, raw materials, and the selling price of ice blocks. In addition, a credit interest rate of 20% is used as a basis for calculating interest expenses if the factory is funded through a bank loan. Meanwhile, as a comparison, a savings interest rate of 14% is used. This data is taken from one of the largest banks in Indonesia, namely BRI (Bank Rakyat Indonesia), which is used to assess the potential investment returns from other options, such as deposits..

The factory's operational assumptions include 25 working days per month, or equivalent to 300 days per year, which is the basis for calculating the annual ice block production capacity. All of these assumptions are important for producing cost, revenue, and profit projections to determine the economic feasibility of building an ice block factory to support the needs of coastal fishermen in the area.

Table 1

Financial feasibility assumption data for the construction of an ice block factory

Assumption data	*Mark*
Average income growth	10%
Average inflation	7.4%
Average credit interest rate	20%
Average deposit interest rate	14%
Working days per month	25 day
Working days per year	300 day
USD to IDR	16,800

Another assumption used is related to Employee Salaries/Honors and the amount of meal allowance received, as listed in Table 2. The amount of honorarium/salary has been adjusted to the UMR of Belu NTT Regency. It can be seen that the UMR of Belu NTT Regency in 2024 is USD 130.17 (BPS 2024), which is still lower when compared to the salary and meal allowance of cleaning and security personnel, which reaches USD 141.37 per month.

Table 2

Assumptions on the amount of salary and meal allowance

Item	*Quantity*	*Unit*	*Price per day (IDR)*
Factory head honorarium	1	Person	7.42
Administrative staff salary	2	Person	5.93
Production staff salary	3	Person	5.34
Cleaning & security staff salary	2	Person	4.75
Meal allowance	8	Person	0.9

Working capital. Working capital in financial analysis or financial feasibility refers to the financial resources needed to support the daily operations of a business or project. Working capital includes funds used to finance operational needs such as purchasing raw materials, paying employee salaries, marketing costs, and other needs that support smooth operations in the short term. Working capital in the ice block factory business activity can be seen in Table 3. Where it can be seen that working capital consists of several costs such as: Personal Costs, Office Costs, Building/Installation Costs, and Material Costs per Month.

Table 3

Working Capital for ice block factory business production capacity: 3 tons/day

Description	*Number*	*Unit*	*Price (USD)*	*Monthly fee (USD) / Month (USD)*
Personal costs				
Factory manager's honorarium	1	Person	7	186
Administration staff salary	2	Person	6	149
Production staff salary	3	Person	5	134
Cleaning and security personnel	2	Person	5	119
Meal allowance	8	Person	1	22
Total I				610
Office expenses				
Office stationery	1	Package	6	6
Telephone/wifi fees	1	Package	27	27
Electricity	1	Package	714	714
Contributions	1	Package	30	30
Total II				777
Building/installation cost				
Building repair and maintenance	1	Package	71	6
Refrigeration machine maintenance	1	Package	1,429	119
Total III				125
Monthly material purchase				
Clean water	4	ton	-	-
Refrigerant	2	unit	15	30
Compressor oil	0.5	liter	4	2
Anti-fungus	1	liter	3	3
Total IV				35
Working Capital				1,547

Investment costs. The investment cost of an ice block factory business on the coast of Belu Regency, East Nusa Tenggara, is the total funds needed to establish and start operating the business. This cost includes several main components, such as land acquisition and construction of factory buildings, including storage warehouses and other supporting facilities. In addition, the procurement of ice block-making machines, cooling systems, and ice transportation equipment is are important part of the equipment costs. No less important, the costs of supporting infrastructure such as electricity, water, and drainage system installations, as well as the construction of access roads to the location, must also be taken into account. Administrative aspects, such as processing business permits, legal documents, and the cost of establishing a business entity, are also part of the initial investment. The investment costs required to build an ice block factory can be seen in Table 4.

Table 4

Investment costs for a ice block factory with a production capacity of 3 tons/day

Item	*Amount*	*Unit*	*Price/Unit (IDR)*	*Value (IDR)*
A. Preparation costs				
Licensing and feasibility study	1	Package	3,571	3,571
Total A				3,571
B.1. Office investment				
Building construction	250	m^2	45	11,161
Electrical installation	1	Package	238	238
Water installation	1	Package	2,976	2,976
Wooden table	8	Unit	30	238
Wooden chair	8	Unit	18	143
Counting machine	4	Unit	15	60
Telephone	2	Unit	149	298
Safe	1	Unit	179	179
B.2. Transportation				
Pick up car (1500 cc)	1	Unit	14,881	14,881
Automatic motorcycle (125 cc)	1	Unit	1,607	1,607
3 wheel motorcycle (Viar/Tossa)	1	Unit	2,083	2,083
Total B				33,863
C. Production tools				
Ice cube making machine with 3 ton capacity	1	Unit	26,786	26,786
PPE equipment	8	Unit	89	714
Light fire extinguisher	2	Unit	42	83
Basket	10	Unit	9	89
Hancu	8	Unit	3	24
Total C				27,696
D. Investment without shrinking				
Land	424	m^2	30	12,619
Working capital	1	Package	18,563	18,563
Total D				31,182
Final investment value				96,313

Operational costs. It includes all expenses required to run and maintain the daily activities of a business or enterprise. In the context of an ice block factory, operating costs include various types of expenses required for the factory to function optimally. These costs include the cost of raw materials such as water and chemicals used in the production of ice blocks, the cost of energy (electricity or fuel) to operate the ice-making machine, and salaries and benefits for workers. In addition, the cost of machine maintenance and repair, transportation for ice distribution, and other routine expenses such as taxes, permits, and administration are also included in this category. Operating costs are an important component in financial management because they affect the efficiency and profitability of the business as a whole. The operational costs required to build an ice block factory can be seen in Table 5.

Table 5

Operational costs of the ice block factory business in months and years

Description	*Amount*	*Unit*	*Price (USD)*	*Cost (USD)*	
				Monthly	*Annual*
Personal costs					
Factory manager's honorarium	1	person	7.44	186	2,232
Administration staff salary	2	person	5.95	149	1,786
Production staff salary	3	person	5.36	134	1,607
Cleaning and Security Personnel	2	person	4.76	119	1,429
Meal allowance	8	person	0.89	22	268
Total I				610	7,321
Office expenses					
Office stationery	1	package	5.95	6	71
Telephone/wifi fees	1	package	26.79	27	321
Electricity	1	package	714.29	714	8,571
Contributions	1	package	29.76	30	357
Total II				777	9,321
Building/installation cost					
Building repair and maintenance	1	package	71.43	6	71
Refrigeration machine maintenance	1	package	1,428.57	119	1,429
Total III				125	1,500
Monthly material purchase					
Clean water	4	ton	-	-	-
Refrigerant	2	unit	14.88	30	357
Compressor oil	0.5	liter	4.46	2	27
Anti-fungus	1	liter	2.98	3	36
Total IV				35	420
Working capital				1,547	18,563

Feasibility of ice factory development business. Ice Factory Development Business in Perisis Atapupu, Belu Regency, East Nusa Tenggara is a very promising step to take. It can be seen that currently, no infrastructure supports capture fisheries activities such as ice factories. However, on the other hand, the development of an ice factory business also needs to be analyzed so that its level of usefulness can be measured, especially in the financial sector, to support business sustainability. Many aspects need to be analyzed in starting a business development. Currently, the author focuses on the financial aspect, which uses several indicators such as NPV, IRR, PP, ARR, and PI. Table 6 presents the assumption of the Ice Factory Business Cash Flow from year 1 to year 10. As a basis for calculating several indicators used.

Table 6

Cash flow assumptions for ice factory business (USD)

Year	In flow		Out flow		Profit after tax	Depreciation	Proceed
	Profit	Investment without depreciation	Investment	tax			
0			96,313				(96,313)
1	(206)			(25)	(181)	7,629	(362)
2	12,489			1,499	10,990	7,629	21,981
3	25,559			3,067	22,492	7,629	44,984
4	39,031			4,684	34,348	7,629	68,695
5	52,936			6,352	46,584	7,629	93,168
6	67,306			8,077	59,229	7,629	118,458
7	82,174			9,861	72,313	7,629	144,625
8	97,577			11,709	85,868	7,629	171,736
9	113,556			13,627	99,930	7,629	199,859
10	130,153	18,563		15,618	114,535	7,629	247,632
Average and Total					54,611		1,014,464

Business feasibility is assessed through various financial indicators that provide an overview of business profitability and risk. Some of the main indicators include:

Net present value (NPV). Measures the net value of cash inflows and outflows over the life of the project by taking into account the time value of money. A project is considered feasible if NPV>0.

$$NPV = -96{,}312.50 + \frac{-362.15}{(1+0.14)^1} + \frac{21{,}980.99}{(1+0.14)^2} \dots\dots\dots + \frac{247{,}632.05}{(1+0.14)^{10}}$$

Internal rate of return (IRR). This is a method used to assess the rate of return of internal results based on the analysis value of Net Present Value and interest rate (Kasmir & Jakfar., 2012; Ariadi et al 2019). If the IRR is greater than the cost of capital, then the project is feasible to implement.

$$A_0 = \frac{-362.15}{(1+0{,}14)^1} + \frac{21{,}980.99}{(1+0.14)^2} \dots\dots\dots + \frac{247{,}632.05}{(1+0.14)^{10}}$$

Payback period. It is a certain period that shows when the total cash inflow cumulatively reaches the initial investment value in the form of present value. This calculation can be done using the formula proposed by Djamin (1992) and Syafril et al (2022). The shorter the payback period, the better.

$$PP = \frac{96{,}312.50}{33{,}824.53}$$

Average rate of return (ARR). Is the ratio of the average net profit generated by an investment to the average investment value issued. The ARR in the intended ice factory business plan is as follows:

$$ARR = \frac{54{,}610.69}{96{,}312.50}\ x\ 100\%$$

Profitability index (PI). Is the ratio between the present value of cash inflows to the initial investment. A project is considered profitable if PI > 1.

$$PI = \frac{1{,}014{,}463.90}{96{,}312.50}$$

The results of this business feasibility analysis, based on five key indicators, demonstrate that the establishment of an ice block factory is viable. The Net Present Value (NPV) of USD 339,932.59 indicates a positive net value, suggesting that the revenue generated throughout the project's lifespan is sufficient to cover both investment and operational costs. The Internal Rate of Return (IRR) of 46% significantly exceeds the predetermined discount rate, further reinforcing the conclusion that this investment is highly profitable. Additionally, the Profitability Index (PI) of 10.53 suggests that each rupiah invested will yield a substantial return, highlighting the strong profit potential relative to investment costs.

Another key indicator, the Average Rate of Return (ARR), is recorded at 57%, reflecting a high return rate on the average invested capital. Furthermore, the Payback Period (PP) of 3 years, 5 months, and 9 days indicates that the initial capital can be recovered within a relatively short timeframe, thereby mitigating investment risks. Based on these calculations, it can be concluded that the development of an ice block factory in Belu Regency is highly feasible from a financial perspective. In addition to generating economic benefits for investors, this venture is also expected to provide significant positive impacts on coastal communities, particularly in supporting the fisheries sector, which relies on ice blocks as the primary cooling agent.

Discussions. Alamsah et al (2024) stated that fishermen in Belu Regency are dominated by traditional fishermen who are highly dependent on local resources. Limited infrastructure forces fishermen to optimize existing potential, such as procuring ice blocks independently or looking for them from small kiosk traders. The construction of an ice block factory in the coastal area of Belu Regency is an urgent need and needs to be a top priority in efforts to increase the productivity of the capture fisheries sector. This facility is expected to help fishermen optimize fishing activities, thus having a direct impact on increasing their income (Wibowo et al 2023).

The results of the financial evaluation show a Positive Net Present Value (NPV) of USD 339,932.59, which indicates that this project can generate net profit during its operational period. A positive NPV value confirms that the cumulative discounted cash inflows exceed the total cash outflows, thus strengthening the potential for sustainability and profitability of the project in the long term. In line with the opinion of Prasetyo et al (2016) if the NPV value is positive, the investment is feasible; conversely, if it is negative, the investment is rejected or not feasible, and if the NPV value = 0, the business can be feasible. Furthermore, the Internal Rate of Return (IRR) of 46% shows a very strong investment appeal, because it far exceeds the discount rate commonly used in similar projects. This figure shows that the project is not only able to return the invested capital, but also generates a significant profit surplus, making it competitive compared to other investment alternatives (Newnan et al 2020).

The Profitability Index (PI) of 10.53 also supports the efficiency of this investment, which shows that each investment unit can generate returns of more than ten times. This reflects the creation of extraordinary value for stakeholders. In addition, the Average Rate of Return (ARR) of 57% indicates a very strong average annual return, reflecting the consistency of the project's profitability throughout the investment period. In terms of return on capital, the Payback Period (PP) was recorded at 3 years, 5 months, 9 days, indicating a relatively short investment return period. This condition reduces the possibility of financial risk and increases investor confidence in this project. The fast payback period is a distinct advantage in a dynamic market environment, ensuring that the project quickly reaches breakeven and begins to generate stable income (Newnan et al 2020).

In addition to the financial aspect, the construction of this ice block factory is also projected to provide significant socio-economic benefits to the local community. The availability of reliable and affordable ice blocks will improve the quality of catch preservation, reduce post-harvest losses, and increase the competitiveness of fishery products in the domestic and export markets. Overall, the implementation of this project is expected to contribute to regional economic growth, create new jobs, and strengthen the fisheries value chain in this border area (Wibowo et al 2023). Based on all these considerations, the ice block factory construction project is declared not only financially

feasible, but also strategic in supporting the socio-economic development goals of Belu Regency.

Conclusions. Based on the results of the financial feasibility analysis, the construction of an ice factory in Belu Regency, East Nusa Tenggara, is considered very feasible to implement. This project shows positive results through key indicators such as a large NPV, IRR much higher than the discount rate, PI reflecting significant profits, ARR indicating strong returns on investment, and a relatively short PP. In addition to promising financial benefits, this project also has the potential to provide positive socio-economic impacts, especially in supporting the capture fisheries sector by providing efficient ice for fish preservation. Thus, this project is not only profitable for investors, but will also strengthen the local economy and improve the welfare of coastal communities in border areas. The results of this study can also be a basis for the development of marine and fisheries infrastructure in Belu Regency, support the sustainability of the capture fisheries sector, and improve the welfare of coastal communities.

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