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Design a Phinisi-Type Tourist Ship to Increase Tourist Interest in Vacationing at Taka Bonerate National Park

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***Abstract*- Tourism ship with the Phinisi ship concept for the Selayar Islands tourist area are designed to increase the number of tourist attractions in the area. With beach tourism destinations and coral reefs, the Selayar region is very possible to become an alternative tourist destination in Indonesia besides Bunaken, Raja Ampat, Labuan Bajo, and the island of Bali. This ship is designed with wood materials and carries the theme of the traditional Phinisi ship which is the hallmark of ships made by the Bugis-Makassar tribe since 3000 years ago and has been recognized by UNESCO as one of the world's cultural heritage (Art of Boatbuilding in South Sulawesi). This study aims to obtain a tourist ship design that can be an attraction for tourists to vacation in the Selayar Islands. mothership design approach (parent) is the type of method applied in this study, this is method is very commonly used in the ship design process, namely by using a comparison ship as a reference in the design of a new ship. The main ship dimensions obtained from this research are Loa = 26 m, B = 6.1 m, H = 2.48 m, T = 1.6 m, Vs (max) = 10 Knots, and Crew = 6 persons. The room on the ship is made like a classy hotel room and other services can pamper tourists.**

Keywords-Ship Design, Tourist Ship, Phinisi, Taka Bonerate National Park.

I. INTRODUCTION[1]

Selayar Islands Regency has a land area of 1,357.15 km^2 with a population of 130,199 in 2020, where the largest population is in Benteng District and the smallest population is in Buki District. [1] Geographically, the Taka Bonerate National Park Protected Area is located at 120º55' – 121º25' East Longitude and 6º20'-7º10' South Latitude. It has an area of around 530.765 Ha. The Taka Bonerate area is in the southeast of Selayar Island [2], This island is famous for its marine tourism destination, namely Taka Bonerate with its underwater beauty. Statistical data states that in 2021 the number of tourists visiting this area will be 2,734 visitors [3].

So far, visitors in the Taka Bonerate usually only rent fishing boats to do snorkeling and dives in coral reef areas. Functionally, fishing boats are not suitable for travel, if in the Labuan Bajo area, there are many tourist boats then this area is still very lacking. In Labuan Bajo and Bali, many Phinisi tour boats are rented out to tourists with the Phinisi Experience concept which can increase tourist interest in visiting the area. This is what has encouraged research related to the construction of phinisi boats for tourism in the Taka Bonerate area of the Selayar Islands to increase the interest of local and foreign tourists to enjoy time on board equipped with lodging facilities and enjoy sea tourism in the Selayar Islands.

An analytical process that is carried out many times to get optimal results is a must in ship design. Because a perfect design for a ship design must comply with applicable regulations and ship design is almost impossible if it is only done once but immediately gets good results. From the initial stage to the final planning stage, there are several stages of calculation and analysis [4][5]. The ship design concept itself is generally the same as any other ship design process. The design stage starts with finding the main dimensions of the ship, calculating the ship's resistance, drawing the lines plan, and general arrangement of the ship [6]. This concept has been used in many ship designs such as the 70 GT fishing vessel design [7], design a patrol ship to protect and safeguard Natuna waters from the threat of illegal fishing and violations of state sovereignty [8], as well as the design of a ship power plan as an alternative source of electricity for the Kagean Island area, East Java [9]. All of these ship design processes have the same stages, starting from determining the main dimensions to drawing up the general plan of the ship.

the shape of the design and the room on the ship are made as attractive as possible so that tourists are interested in visiting. The rooms are made like the concept of a hotel room, the ship is designed not to sail at high speed, and with the theme of a traditional phinisi ship equipped with three main masts. The concept of this tourist ship has also

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been studied but uses a glass bottom to make it easier for tourists to see the coral reefs on the seabed without having to dive [10].

The main results to be obtained in this study is to produce a design of a phinisi tourist ship made of wood material which will be operated in the Taka Bonerate tourist area of the Selayar Islands. Given the potential for marine tourism in the area that needs to be developed so that it can be like other tourist destinations in Indonesia such as Laguan Bajo, Raja Ampat, and Bali. The hope is that this ship will be able to become a floating hotel and pamper tourists who want to vacation on a ship with beautiful sea views.

II. METHOD

Various methods are applied in the ship design stages, the most frequently used is the spiral design [11] and mothership (parent) ship. Specifically for this study, the parent ship design was used by taking an example of a ship design that has almost the same shape and characteristics as the ship you want to design. This method is considered more appropriate because the design approach using this method is relatively faster in the stage process. The main dimension of the ship used as a reference is taken from the data of the Pelita Arunika ship, this ship is a ship owned by PT Pelni (a shipping company engaged in Indonesian sea transportation services) [12] which is devoted to supporting the tourism sector in Labuan Bajo [13]. To maintain the form of its cultural values, the ship is still designed using wood material because it is easier and lighter [14] and its designation is not for sailing far away and more just Lego anchors in coastal areas and tourist areas.

III. RESULTS AND DISCUSSION

The Phinisi tourist initial stages of the ship design begin with determining the basic dimensions of the ship, pre-calculating the ship structure, preparing a line plan, calculating the resistance, and finally drawing the general arrangement. The results of the full study can be traced as below.

A. Determining the basic size of the ship

The main dimension used as a reference in this study refers to the Pelita Arunika ship owned by PT Pelni which was specially made to become a tourist ship in Labuan Bajo.

For the main dimention of the ship as follows [13]:

Total length of the ship (LOA)	= 26 m
Ship Breadth (B)	= 6.1 m
Ship Depth (H)	= 2.48 m
Ship Draft (T)	= 1.6 m
Ship Velocity (Vs)	= 10 Kn

From the basic dimensions above, it is used to design ships using Maxsurf modeling software (maxsurf bently student version) [15]

B. Preliminary Ship Design Calculations

Preliminary calculations are performed to determine the value of the Froud number (Fn), Ship Resistance to obtain the ship propulsion engine power

1. Froud Number Calculation

Use the following formula to calculate the froud number:

$$Fn = \frac{Vs}{\sqrt{g.L}} \quad (1)$$

Where,
Fn = Froud Number
Vs = Ship speed (m/s)
g = Acceleration of gravity (9.81 m/s^2)
L = The length of the ship on the waterline (m)
The value of the ship's froud number is then obtained:
Fn = 0.32

2. Calculation of Ship Coefficient

Calculate the ship's coefficients from the obtained Froud number value. Referenced ship coefficients include block coefficient (Cb), midship coefficient (Cm), waterplane coefficient (Cwp), prism coefficient (Cp), volume draft (∇) and displacement (Δ). The calculation of these coefficients is as follows contained in the Parametric Design book follows:

a. Block coefficient (Cb)

$$CB = -4.22 + 27.8\sqrt{Fn} - 39.1\ Fn + 46.6\ Fn^3 \quad (2)$$
$$= 0.52$$

b. Midship coefficient (Cm)

$$Cm = 1.006 - 0.0056\ Cb^{-3.56} \quad (3)$$
$$= 0.97$$

c. Waterplan coefficient (Cwp)

$$Cwp = Cb / (0.471 + 0.551\ Cb) \quad (4)$$
$$= 0.74$$

d. Prismatic coefficient (Cp)

$$Cp = Cb/Cm \quad (5)$$
$$= 0.69$$

e. Volume displacement (∇)

$$\nabla = L \times B \times T \times Cb \quad (6)$$
$$= 150.1392512\ m^3$$

f. Displacement (Δ)

$$\Delta = \nabla \times 1.025 \quad (7)$$
$$= 153.8927325\ ton$$

3. Lines Plan

Lines plan is usually referred to as a depiction of a ship hull section that is projected in a two-dimensional form transversely or longitudinally. There are three designs in the common lines plan that we encounter, namely the body plane, the Sheer plane, and the Half breadth plan. The Lines Plan is the starting point in carrying out ship designs which will later be very vital in design work [6]

The process of making a ship line plan uses the Maxsurf modeler software (maxsurf slightly student version) so that the desired hull shape and dimensions can be obtained and have a coefficient value under the recommended criteria in calculating ship resistance using the Van Oortmersen method [16].

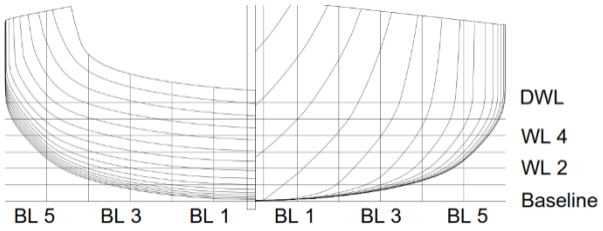

Figure 1. Ship's Body Plan

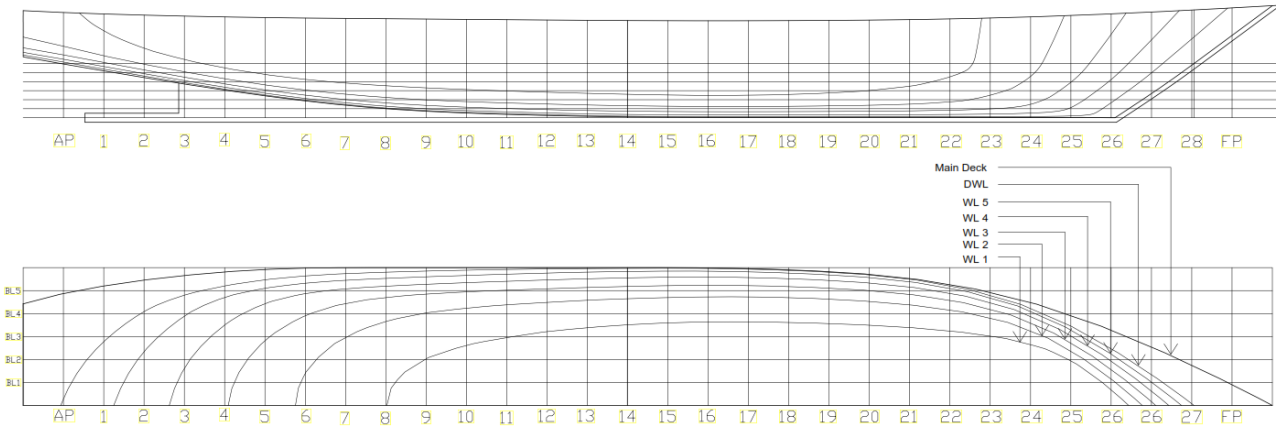

Figure 2. Bread and Sheer plan

4. Total Resistance of the Ship

Ship resistance is a form of velocity, flow rate, and fluid force (in this case seawater because ships operate at sea) which hinders the ship's direction of motion. This form of fluid flow usually including from waves tossing the ship hull /body of the ship below the water surface and also gusts of the wind blowis over the hull, all of which make the ship slow in sailing [17].

The calculation of ship resistance using the Van Oortmersen method with parameter requirements can be seen from the Table 1.

TABLE 1.
LIMITATION PARAMETERS OF THE VAN OORTMERSEN METHOD

Requirement	Ship Data	
8 m < L < 80 m	L	26 m
3 m < L/B < 6,2 m	L/B	4.3 m
0,5 < Cp < 0,73	Cp	0.7
-8% < LCG/L < 2,8%	LCG/L	0.21%
5 < V < 3000	V	115 m^3
1,9 m < B/T < 4,0 m	B/T	3.81 m
0,70 < Cm < 0,97	Cm	0.85
10 < iE < 46	iE	32

Table 1 shows the limiting parameters for the Van Oortmersen method used in calculating ship resistance and this phinisi ship size data meets the requirements above. From the requirements that have been met then calculate the ship's total resistance with that method.

Determination of the overall resistance of the ship, you can use the calculation formula for residual resistance (Rr) plus friction resistance (Rf)

$R_T = R_R + R_F$
$= 1.22 + 2621$
$= 2673$ N
$= 26.731$ kN

5. Calculation of Propulsion Requirements

In calculating the need for ship propulsion, using the Fyson method [18]

a) Thrust (tr)

$EHP_{tr} = Rt \times v$ (8)
$= 26.731 \times 5.144$
$= 137.50$ kW
$= 186.95$ HP

b) Effective Horse Power (EHP)

$EHP_s = rl \times EHP_{tr}$ (9)
$= (1+0.4) \times 186.95$
$= 261.73$ HP

Dimana rl = 1 + 40%

c) Horse Power Supplied Delivered (DHP)

$DHP = \frac{EHP_s}{Pc+g}$ (10)
$= \frac{261.73}{0.55125 + (-0.0133)}$
$= 486.549$ HP

d) Horse Power Brake (BHP)

$BHP = DHP \times (1+0.003)$
$= 486.549 \times (1+0.003)$
$= 488.009$ HP
$= 358.9304$ kW

Because the ship is intended for tourism and does not move from place to place like other ships operating from port to port so that the speed of the ship is not too high, this has the effect of not having a large engine prime

mover. The higher the engine output, the worse the fuel consumption too [21] [22].

6. Determination of Prime Mover

Once you have the Brake Horsepower (BHP) value, the next step is to select the ship's main engine as the ship's primary propulsion system. The prime mover used has relatively small dimensions so it doesn't take up too much space. Table 2 and Figure 3 are the engine specifications used on phinisi tourist ship.

TABLE 2.
MAIN ENGINE SPECIFICATIONS

Engine Specification	Unit
Model	C18 ACERT IMO II
Power out put	454-715 bhp (339-533 bkW)
Speed engine	1800-2100 rpm
Confi of engine	In-line 6, 4-Stroke-Cycle Diesel
Displ engine	18.1 I
Max Dry Weight	1950 kg

Source: caterpillar c18 marine engine manual 2023 [21]

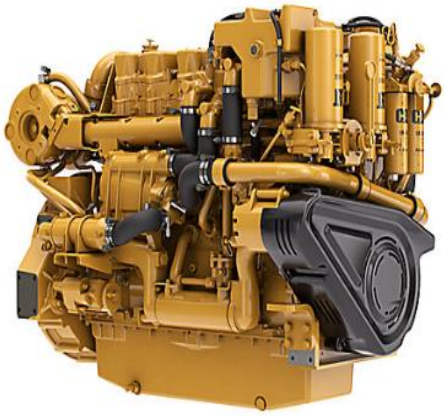

Figure 3. Caterpillar c18 Marine Engine [21]

7. General Arrangement of Phinisi

The general arrangement layout can be interpreted as a blueprint and spatial layout according to the location and access required for all ship needs and equipment. Create an overall plan based on the line plan created earlier. With the help of a lines plan, the outline of the hull form becomes visible, making it easier to plan and determine the layout of the rooms according to their function. General planning includes planning for cargo stowage, equipment and supplies placement, and bulkhead division. Autocad Software is used to drawn the general arrangement (Student version) [22].

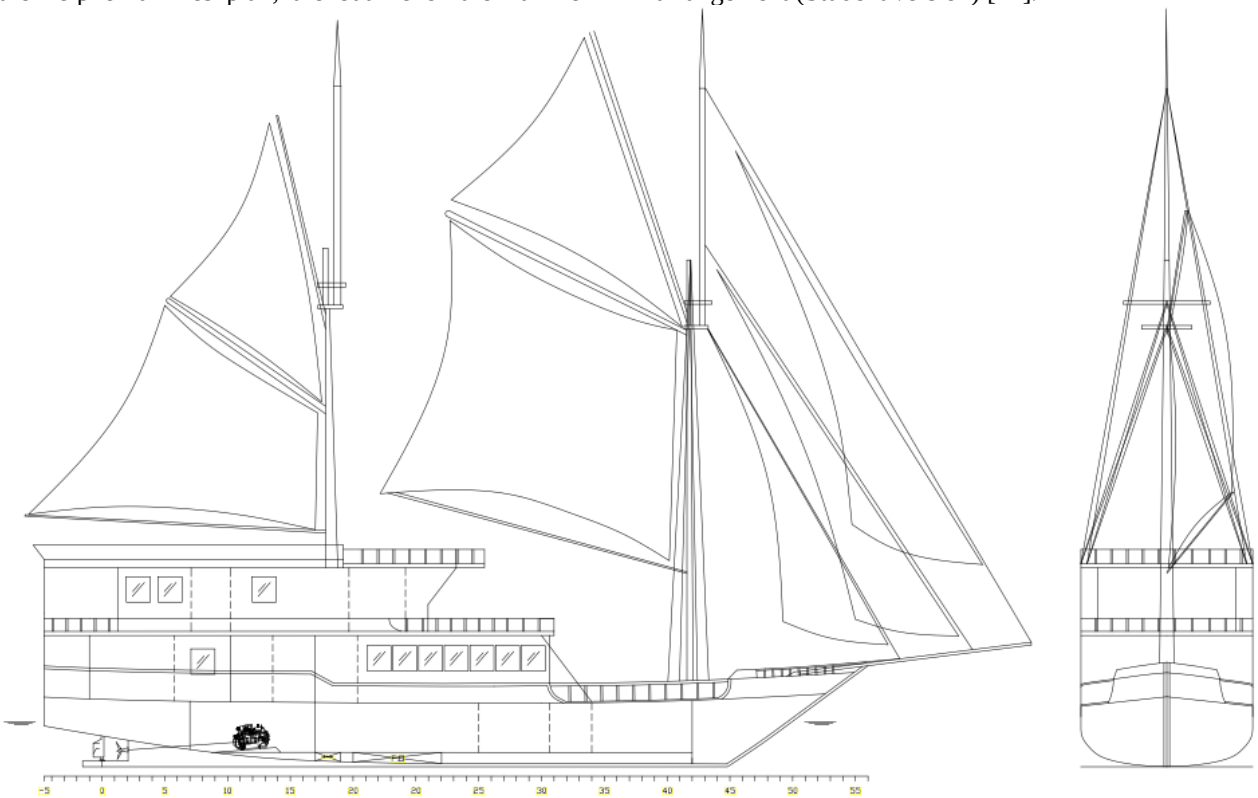

Figure 4. General Arrangement of Phinisi Tourist Ship (Side and Front View)

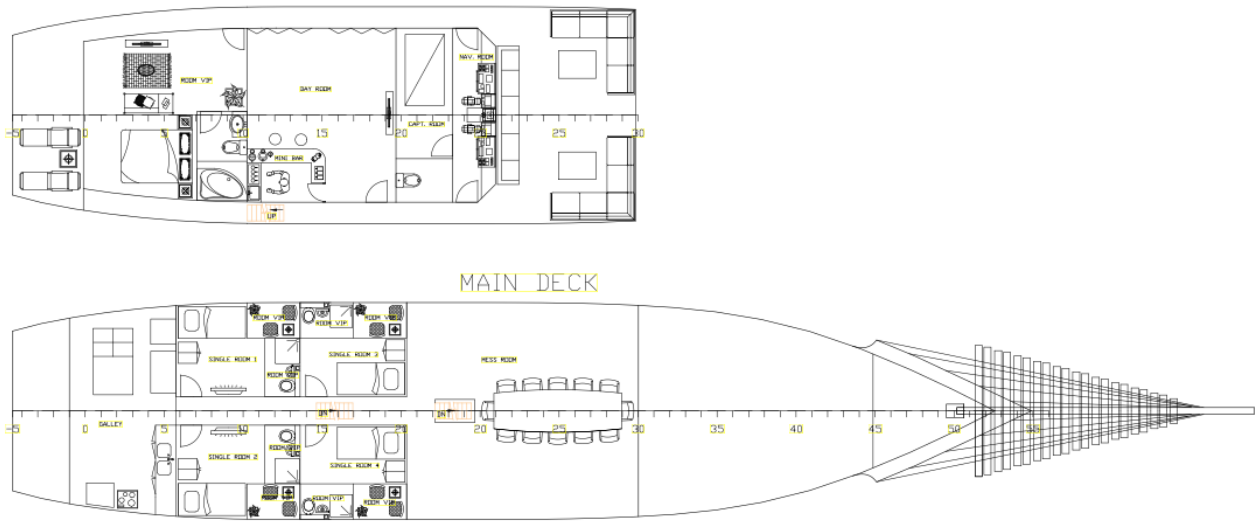

Figure 5. General Arrangement of Phinisi Tourist Ship (Top View)

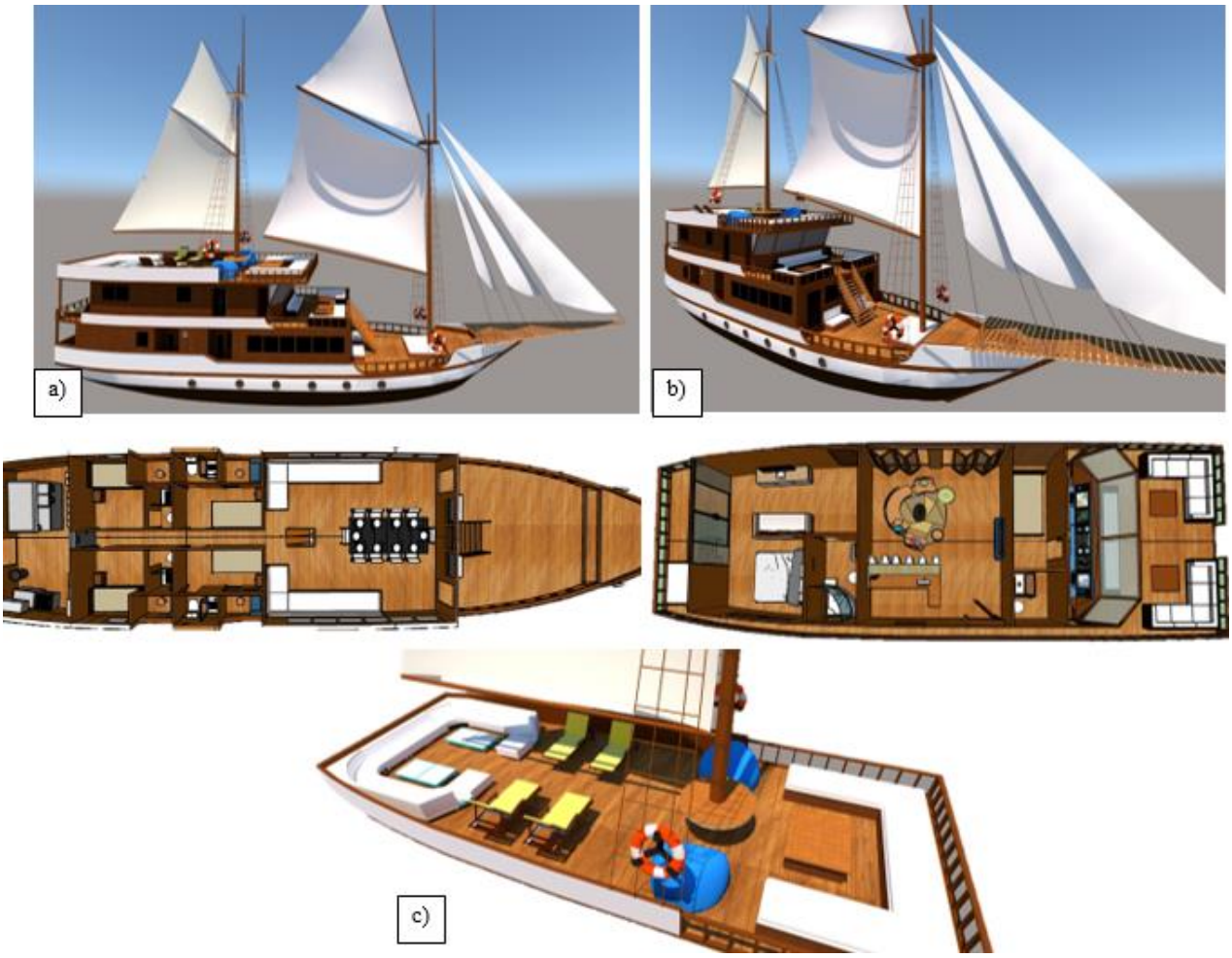

Figure 6. Isometric View of phinisi tourist ship 3d design. a) side view, b) front view, c) design of each deck

IV. CONCLUSION

Based on analysis and technical calculations of Phinisi-type tourist boats used to increase tourist interest in vacationing in Taka Bonerate, the main dimensions of the planned vessel are LOA: 26 meters and B: 6.10 meters. can be concluded. , H: 2.48 m, D: 1.6 m, Vs: 10 knots and crew: 6 person. This traditional ship that carries the concept of tourism is expected to be an attraction for tourists to be able to vacation in the Selayar Islands area, especially in the Taka Bonerate national park tourism object.

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