

UTILIZATION OF SOLAR ENERGY TECHNOLOGY TO MEET WATER LOGISTIC SUPPORT IN THE MARITIME BORDER: STUDY AT NAVY POST, LABUAN BAJO, EAST NUSA TENGGARA

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Abstract – The availability of clean water is a large part of the main problem in the area of West Manggarai Regency, East Nusa Tenggara. Eventhough there is correlation between factors of adequate water, health and economic development. One area that represents this condition is in the village of Labuan Bajo. The enchantment of the tourist island of Flores found in West Manggarai Regency, where Labuan Bajo is the gateway to entering the tourist charm is a place that tourists really want to visit. As a government effort to tighten border supervision and safeguards the Labuan Bajo maritime, the government formed the Indonesian Navy post. Therefore, the availability of clean water is needed in the area, besides to meet the needs of the Labuan Bajo community, improve facilities and infrastructure to bring in many tourists, also for fulfilling the logistical support of the Navy's headquarters. To meet water needs, there are 2 options that are expected to solve the problem, namely (1) mapping of underground water in the village of Labuan Bajo and pumping it using electric power from the voltaic photo results, and (2) when there is no item (1) then pumping water from the reservoir is available at a distance about 3 km from the village of Labuan Bajo. Considering the contour of the area, the needed to make new reservoirs and water pumping systems from the reservoir available, so that an adequate level of water is obtained for drain water to the village. Mapping of underground water is carried out with using the geoelectric method. If option 1 is successful, then the system that is built can be used as a model of pumping underground water, mainly in the area of West Manggarai Regency that needed it. Then the water obtained will be processed through the Reverse Osmosis process to produce ready to drink water.

Keywords: clean water supply, photovoltaic, renewable energy, rural area, water pump

Introduction

Indonesia is an archipelago country that has territorial borders spread across ten regions with neighbouring countries, both land and sea. One of the

provinces that has land and sea border areas is East Nusa Tenggara (NTT).

Benefits for Indonesia and neighbouring countries with the presence of border areas can be a potential for cooperation between countries if

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managed properly. On the other hand, border areas have the potential to be vulnerable to border conflicts that can disrupt the security and sovereignty of the The Unitary State of the Republic of Indonesia (NKRI).⁷ Therefore, the role of the Indonesian National Army is very much needed to deal with and anticipate various

forms of threats and disturbances in the maritime border region.

The Labuan Bajo Naval Post is one of the Indonesian maritime forces under the Kupang Lantamal VII Command which lies on the Border of East Nusa Tenggara. The Kupang Lantamal VII Working Area covers the RI - Australia and RI - RDTL maritime boundaries.



Figure 1. The Coordinating Position of the Navy Ship Harbour: 10o13'08''S 123o31'22''E
Source: Google Map, Access February 1, 2019



Figure 2. Lantamal VII Kupang, East Nusa Tenggara
Source: Documentation of researchers, 2019

⁷ Hadiwijoyo, Suryo.S. *Batas Wilayah Negara Indonesia: Dimensi, Permasalahan, dan Strategi Penanganan.*(Yogyakarta: Gava Media, 2009)

In addition to the issue of managing border areas that are prone to occur on the border, another issue faced at the border is the management of border areas. One of them is the limitation of clean water and electricity, where both aspects are aspects of supporting TNI logistics at Indonesian Military-Naval Service (TNI-AL) posts which are very much needed to support the duty of the TNI in securing maritime border areas.

The head of the Development Planning Agency at Sub-National Level (Bappeda) of West Manggarai at the end of 2017 stated that the limitation of clean water in Labuan Bajo was due to the lack of processing clean water into drinking water, so far the needs of Labuan Bajo drinking water are supplied from Ruteng, which is about 133.7 km from Labuan Bajo, so access to getting drinking water is very difficult and requires a large amount of money.⁸ As for the electrification ratio of East Nusa Tenggara, Djoko R. Abumanan Regional Director of East Java Bali Nusa Tenggara revealed, until today the East

Nusa Tenggara elective ratio had only reached 60.1%.⁹ Therefore, to support the Indonesian Navy's duty to guard and deal with and anticipate various forms of threats that could disrupt the security of the maritime border region, especially in Labuan Bajo, a solution is needed to deal with the limitations of clean water and electricity in Labuan Bajo.

Based on the description of the conditions of the limited fulfillment of clean water in Labuan Bajo, it can affect the description of meeting the needs of clean water at the Naval Post Labuan Bajo. Drinking water is very much needed by the TNI as logistical support because water is a primary human need inherent in supporting its needs for survival and quality of life. Drinking water needs of each individual vary depending on the needs of the body which can be seen based on their body weight and activities. The average body need for water is 2 L.

Another source of water that is owned by Labuan Bajo Navy Post which is an abundant and unlimited coastal area is

⁸ Elvi, R. Development Planning Agency at Sub-National Level (BAPPEDA) of West Manggarai: Lack of Drinking Water, in <http://rilis.id/bappeda-manggarai-barat-kami-kekurangan-air-minum.html>, accessed on June 18, 2018.

⁹ Wahyu Rahmawati, Indonesian Electricity Company (PLN) anticipation of electricity in

Labuan Bajo ahead of the annual meeting of IMF-World Bank, in <https://industri.kontan.co.id/news/pln-antisipasi-kelistrikan-labuan-bajo-jelang-pertemuan-tahunan-imf-world-bank>, accessed on June 18, 2018.

sea water, but sea water also has poor water quality because it has a high dissolved salt or TDS so it is not suitable for drinking. One way to overcome the problem of poor water quality so that it can meet the needs of drinking water in the Border, especially in the command area of Kupang Lantamal VII and one of the navy post of Labuan Bajo is by applying water treatment technology that is in accordance with the water quality. Desalination technology with reverse osmosis (RO) is one technology that can be used to convert poor quality water into ready-to-drink water.¹⁰

The quality of raw water to be processed using the RO system greatly affects the RO performance and the age of the membrane. The standard of raw water used for RO unit bait can be seen in Table 1.¹¹

At present, the fulfilment of Indonesia's electricity needs is dominated by fossil energy. The use of fossil energy to meet national energy needs reaches 95% while the contribution of renewable

energy has only reached 5%. Besides, Indonesia is still classified as a country that is wasteful in energy use which is shown by the value of energy intensity which is still high.¹²

Table 1. Raw Water Quality Standards for RO System

No	Parameter	Unit	Raw Water (max)
1	Colour	Pt. Co Scale	100
2	Turbidity	NTU	20
3	Smell	-	Relative
4	Manganese (Mn)	mg/L	1,3
5	Iron (Fe)	mg/L	2,0
6	Chloride (Cl)	mg/L	4.000
7	TDS	mg/L	12.000
8	Organic ingredients	mg/L	40

Source: Wahyu Hidayat, 2007

The conditions for the dependence of fossil energy whose availability is decreasing are vulnerable to disruption to national energy security. In addition, fossil energy is not an environmentally responsible way. The burning of fossil energy will produce CO₂ gas which has an effect on increasing the effect of greenhouse gases. Therefore, dependence on fossil energy must be

¹⁰ Hanna, N and Hadi W. "Kelayakan Teknologi Desalinasi Sebagai Alternatif Penyediaan Air Minum Kota Surabaya (Studi Kasus: 50 Liter per detik)". *Engineering Journal – Sepuluh November Institute of Technology - ITS*. Volume 5, No. 2. 2016. p. 47-52.

¹¹ Wahyu Widayat. "Aplikasi Teknologi Air Asin Desa Tarupa Kecamatan Taka Bonerate

Kabupaten Selayar". *Journal of Technology Application - BPPT*. Volume 3, No. 1. 2007. p. 81-85.

¹² ESDM, "Peluang Investasi Efisiensi Energi Masih Cukup Besar", in <http://ebtke.esdm.go.id/post/2018/03/01/1899/peluang.investasi.efisiensi.energi.masih.cukup.besar>, accessed on July 20, 2018.

reduced and maximize renewable energy that is environmentally friendly. Solar energy is one of the most sustainable renewable energies.

Indonesia, which is a tropical region, where the sun shines throughout the year has the potential for large solar energy. Indonesia's average radiation is around 4.8 kWh/m²/day. Solar energy can be used as a solar power plant (PLTS) using solar panels.

Researchers in this study will analyze the potential utilization of electricity generated by a solar power plant (PLTS) to overcome the problem of limited water supply in East Nusa Tenggara, especially the Kupang Lantamal VII and navy post areas in Labuan Bajo. Electrical energy generated from the Solar Power Plant (PLTS) is used to operate the water treatment process pump with the RO system.

Research method

This research is descriptive-narrative, using positivist methods (mixed, using theory as a framework of research and using qualitative data for measurement and discussion), and is cross-sectional. Data collection was carried out through in-depth interviews with a number of speakers at Kupang Lantamal VII, Navy

Post of Labuan Bajo, Kupang State Polytechnic, ESDM Office of the East Nusa Tenggara Province (NTT), Nusa Cendana University Kupang East Nusa Tenggara (NTT). This research was conducted in May 2018 until January 2019. The collection of primary data was carried out by direct observation to the research location or through direct interviews with resource persons from civil institutions and military agencies who had interests and capacities in explaining the issue of water logistics support for the TNI at the border, water treatment, new renewable energy and solar power plants. In addition, measurements of the quality of solar radiation were also carried out at the study site.

Discussion

Overview of Kupang VII Lantamal

Lantamal (Main Base of the Navy) VII Kupang is a Indonesian National Military-Naval Service (TNI-AL) military base located in Yos Sudarso Complex Jl. Prof. DR. Herman Yohanes, Namosain, Alak, Kupang City, East Nusa Tenggara. The main task of Kupang Lantamal VII is "to carry out the development of strength and ability to carry out logistical and administrative support for elements of the Navy, to conduct maritime security

patrols, and to carry out the empowerment of marine defence areas in the working area of Lantamal VII". The Functions of Kupang VII Lantamal as follows:¹³

1. Supporting functions of the operating unit include:
 - a. Function to support post facilities.
 - b. Function to support maintenance and repair facilities.
 - c. Function to support debriefing facilities.
 - d. Function to support personnel care facilities.
 - e. Function to support base building facilities.
2. Ocean Security Function.
3. The function of Empowering the Sea Matra.

The Vision and Mission of Kupang VII Lantamal are:¹⁴

- Vision

"The vision is to realize Reliable Lantamal VII Kupang. Be Proud of the Professional Executing Command for Operations Support

of Indonesian Navy Operations in Lantamal VII"

- Missions

1. Able to carry out the 4 R function (Repair, Replenishment, Rest and Recreation) against the Navy operation unit in the Lantamal VII working area, so as to increase the duration of the elements in the Operation Area.
2. Able to carry out limited sea security operations, so as to prevent violations in the Waters of the Lantamal Work Area VII.
3. Able to carry out the empowerment of marine defence regions (Binpotnaskuatmar and Bintermatla) in Lantamal VII Regional Work Areas.

Kupang Lantamal VII is an executive command formed as a supporter of the Republic of Indonesia Fleet Command in the eastern part of Indonesia. The Kupang Lantamal VII Working Area can be seen in Figure 3.

¹³ Lantamal VII Kupang, "Materi Paparan Komandan Lantamal VII Kupang dalam Rangka Studi Strategis dalam Negeri PPRA LVI Tahun 2017 Lemhannas RI" on July 2017.

¹⁴ Lantamal VII Kupang, "Visi dan Misi", in <http://lantamal7.koarmatim.tnial.mil.id/Profil/VisidanMisi.aspx>, diakses pada 10 August 2018.

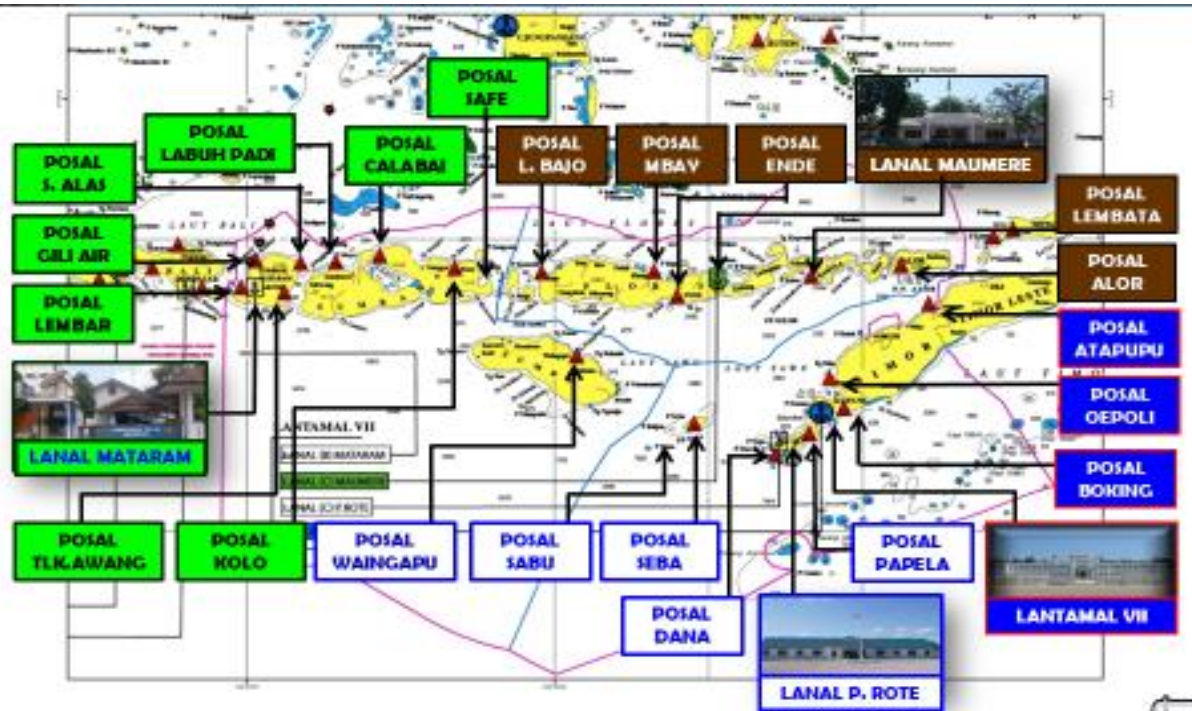


Figure 3. Map of Kupang VII Lantamal Work Area
 Source: Material for Exposure of Commander of Kupang VII Lantamal in the Framework of Domestic Strategic Study of 2017 PPRA LVI Lemhannas RI in July 2017.

Figure 3 shows, one of the Navy Base under the command of Lantamal VII Kupang is Lantal Maumere and Navy Post of Labuan Bajo is a navy post under the Mauamere Lantal Command.

General Conditions of Lantamal VII Kupang dan Navy Post of Labuan Bajo

Kupang Lantamal VII and Navy Post of Labuan Bajo have problems that are not much different. In the field of logistics, in particular, water is still a need that is difficult to fulfil. This is because of the lack of surface water around the location of the Kupang and Navy Post Lantamal VII in Labuan Bajo and in Nusa Tenggara in

general, the climate of the dry Nusa Tenggara Islands, the mountainous land topography, and the type of calcareous soil. As a result, the fulfilment of water must be done by artesianing deep groundwater wells and for extraction and distribution, it requires large energy. The reserves are not large because after being pumped for a while, the water well will run out, but it will be filled again a little while later. Regional Water Supply Companies (PDAMs) also lack a reliable water supply because they have not been able to operate 24 hours. Communities in Kupang generally respond to the difficult situation of water by having water storage tanks in

each house, and it has become an obligation that when building a house, it must be planted under a water storage tank. Kupang Lantamal VII also responds in the same way (has a storage tank), and adds alternative water production by having its own two wells (Kuanheum and Lamakera), in addition to relying on supply from the PDAM. This does not include the groundwater factor in Kupang which contains high levels of calcium and often causes health problems such as the formation of deposits/stones in the kidneys and bladder.

As with Navy Post of Labuan Bajo, water needs are still a problem. This is due to the character of calcareous soil, the absence of surface water, mountainous topography, and low rainfall (1,000 mm per year in Labuan Bajo and 1,200 mm per year in Kupang).

The fulfilment of water from the PDAM is also not maximized, and because Labuan Bajo is transforming into a new tourist area, of course, the "competition" to get ground water and from the PDAM will be higher for the Navy Post of Labuan Bajo in the future. The area around Navy Post of Labuan Bajo is also already crowded and currently, there are many new building developments which indicate that the fulfilment of water needs

will be increasingly difficult. The condition in Labuan Bajo is currently too crowded and the waters around it are often passed by domestic and foreign ships such as cruise ships, yachts, fishing boats, passenger transport vessels, container ships and cargo ships. Navy Post of Labuan Bajo has been initiated to turn into Lanal to adjust conditions in the field and this is a very good step. At present, there are only 6 personnel in Navy Post of Labuan Bajo with greater responsibility in the security sector so that the raising Navy Post's status to become Lanal is a priority and plays a significant role in the realization of security in the area.

Another problem is the accuracy of personnel crisis, especially in Kupang VII Lantamal. It is because up to now the Personnel Composition List (DSP) which should have been in the ideal number of 1995 personnel, only fulfilled 304 people (if added with personnel at Lanal, it would be 665 people so the realization was only 30%). This shows the high overwork and the many performances of the posts/units that are operating at this time have not been effective due to the fulfilment of personnel below the ideal number. In fact, the security threat in the Kupang Lantamal VII working area is quite complex and has the potential to increase.

Tourism is now a new sector that is being developed by the Governor of East Nusa Tenggara. The presence of tourists in the future can lead to the emergence of negative externalities such as drug smuggling, human trafficking, the presence/location of foreign intelligence services to carry out information transactions, smuggling of alcoholic and non-taxable goods, and making Labuan Bajo and other tourist areas as targets of terrorist attacks. Kupang Lantamal VII is also responsible for the ability to support Guspurlatim from traditional threats that

arise from the south (Australia and the United States) and Guskamla Koarmada II on ships that pass ALKI III as well as the practice of smuggling East Timorese goods and Middle Eastern-African-Sub asylum seekers Indian continent that transits to Australia. Personnel in the Navy Post of Labuan Bajo, which is only 6 people (one person is currently conducting education), are too few to respond to the increasingly complex security threat in Labuan Bajo due to increased investment in tourism.

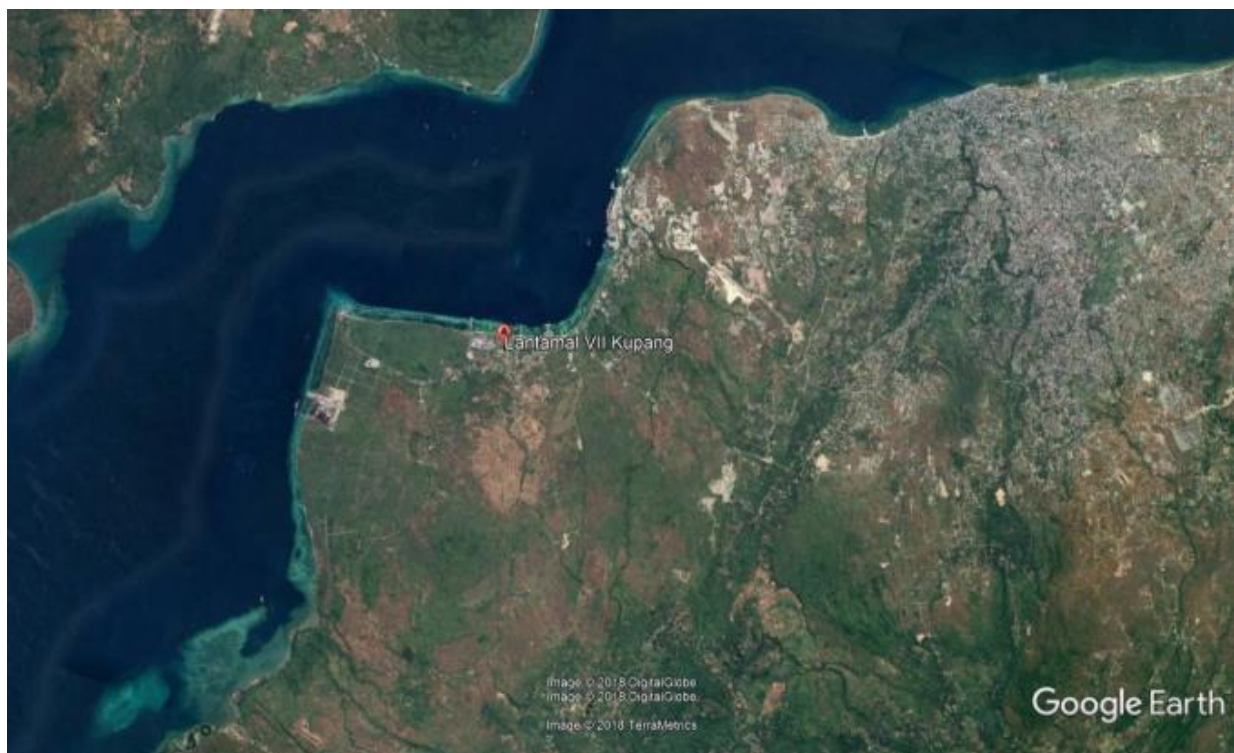


Figure 4. Location of Lantamal VII Kupang
Source: Google Map,2018.



Figure 5. Mako Scetch for Kupang Lantamal VII, 2018
 Source: Google Map,2018.

Maritime Security Issues and strategies to improve the Capabilities of Lantamal VII Kupang in Responding to Threats and Functions of Support Base

The frequent threats of maritime security in the Lantamal VII Kupang working area are the smuggling of used clothes and illegal liquor from Timor Leste. In addition, this area is often the place for asylum-seekers to transit to Australia. Indonesian fishermen are also often dragged into Australia to carry or are accused of crossing the maritime border of Australia, although according to Indonesian fishermen it is not. Natural resources, especially around Timor Island are also large and diverse. The continental shelf of Timor contains many nodules and mineral

deposits such as manganese to the west of Timor Island, and oil and gas in Selaru Island requiring supervision to avoid illegal research, exploration, and exploitation. The natural challenge in the Lantamal Kupang VII work area is also quite heavy, characterized by the high strength of underwater currents, high sea waves, and strong winds making it difficult for navigation. Non-traditional threats and heavy natural challenges require Lantamal VII Kupang to have additional strategic assets and an adequate fleet of vessels to better respond to threats and protect the base better.

To the south of Timor Island, there is also Australia, a country that has always

undergone a tidal wave of diplomatic relations with Indonesia. In Darwin City, a distance of less than 1,000 km from Timor Island is not just an Australian military base, but also US Marine placement that routinely conducts military exercises annually since 2012 and will be carried out continuously until 2040. In 2018, about 1,500 US marines landed in Darwin for joint exercises with the Australian military. Military exercises involving marines should be closely watched because marine resources are naval landing so that the run-of-the-way war scenarios will not be far from the island, quick response, or quick attack of command troops to the strategic point in the coastal area. If the goal is Australian mainland defence, of course, it is not marine because the marines have an aggressive fundamental function. For joint exercises with the Australian military in 2018, the United States marines brought modern gearboxes for a quick response such as 8 units of Osprey haulage and 6 howitzer 155mm M777 cannons.¹⁵

This suggests the seriousness for them to enhance combat capabilities that are desirable to seize deeper areas of the

coast through artillery support or the deployment of strategic trooper forces. Things that need to be concerned are Australian intentions to have a dozen French Barracuda-Class submarines fleet in the next 10-30 years (theguardian.com). Australia also owns Canberra-Class helicopter platform (LHD) which is believed to accommodate advanced F-35 combat aircraft since 2014, similar to Japan's Izumo-Class helicopter destroyer. This suggests that Australia is focusing on enhancing the capabilities of long-range expeditions and the support of the landing of amphibious forces that must be looked into Indonesia. Australia is increasingly looking to besiege Indonesia with its intention to build and own a joint military base (with Papua New Guinea) on Manus Island, north of Papua New Guinea. The Australian and US movements should be alerted to Indonesia so that the capabilities of the Lantamal VII Kupang support function which is closest to the concentration of Australian-US troops in Darwin should be increased.

Lantamal VII Kupang needs to be increased its support capacity to deal with various security threat scenarios. In

¹⁵ ABC.net..2018. *Record numbers of US Marines arrive in Darwin for six months of joint trainin*, in <https://www.abc.net.au/news/2018-04->

[23/largest-ever-contingent-of-us-marines-arrive-in-darwin/9689326](https://www.abc.net.au/news/2018-04-23/largest-ever-contingent-of-us-marines-arrive-in-darwin/9689326), accessed on January 15, 2019.

addition to providing support functions to Guskamla Koarmada II, Lantamal VII Kupang should be deemed to be able to provide the support function of Guspurla Koarmada II in conducting maritime operations that may occur between Indonesia-Australia in the future. Lantamal VII Kupang must also have a more ideal KAL or KRI asset capable of providing protection and better defence functions for the base, in accordance with its marine character which is difficult to navigate small and fibre-based vessels. Lantamal VII Kupang requires an iron vessel and the size of the vessel is at least 60 meters in order to be able to navigate safely in high waves, windy, and strong currents.

The sea / maritime radar plots on the coastal or hilly terrain on the southern part of Timor Island, Rote, Sumbawa, Sumba, Flores, Sabu, Wetar, Alor, and Pantar are also required for the purposes of persistence surveillance on ships- the passing boat. To date, surveillance in the Timor Sea, Sawu, and the Indonesian Ocean in the archipelago of Nusa Tenggara islands still rely on radar KRI which is not necessarily capable of 24 hours providing radar cover, whether it should be deployed to other priority areas, bad weather disturbances, or

unsafe waves to sail. The Navy Post presence at a certain point for marine surveillance is likely to be less effective due to limited coverage (maximum 6 miles) while the vessel can sail beyond the horizon of the naked eye. This indicates that the existence of maritime radar / maritime need to be a priority, especially if it is also equipped with a Vessel Monitoring System (VMS) facilities to make easier cruise control.

Number of KRI which become Organic Lantamal VII should also be increased. Currently only KAL Welling and Kembang (under 60 meters in size) can be operated by Lantamal VII Kupang, plus some Sea Hunter and Sea Rider for sea security patrols. In the near future, KRI Tongkol will be able to operate and assist patrol and security base, but according to the researcher, it is not enough. Lantamal VII Kupang requires some fast-paced missile ships (at least 12 units, 40-60 meters in size, and iron-based) as base defence assets, due to the proximity of traditional threats from (Australia). Navy Post and strategic points on the southern coast of Timor Island also need to begin preparing its mapping for placement of ground-based anti-ship missile launchers for coastal defence or denial access tactics. In the straits, it also needs to be



Figure 6. KRI Tongkol 813
Source: poskotanews.com,2012



Figure 7. KAL Weling I-7-15
Source: duta. news, 2016

installed acoustic sensors to detect the intrusion of enemy submarines, mainly in the straits that are the path to Lantamal VII Kupang.

Regarding the increase in base support capabilities, there are several important aspects that must be met. The following is the discussion:

1. First is a clean water supply, both for drinking and non-drinking needs. At present, the procurement of water is still quite difficult in Kupang VII Lantamal due to the lack of surface water, geographic character and low rainfall. Apart from ground water, Kupang's Lantamal VII requires additional water supply that can be

obtained from the desalination process using solar energy. However, it is very good if the central government through its infrastructure program builds dams, reservoirs and waterways that can drain water from many water areas to difficult water areas, especially to Kupang City and exclusively to Kupang VII Lantamal. If the Kupang VII Lantamal wants to be used as a defence-security hub in the eastern part of southern Indonesia, water production capacity and the ability to meet water needs must be increased. If the current demand for clean water for 304 personnel for a month is 1,498,720 litres, then if it is adjusted to the ideal DSP of 1,995 personnel, 9,835,350 litres of water is needed only for personnel needs at Kupang Lantamal VII. This does not include the water needs of KAL and organic KRI Lantamal which is predicted to increase, and of course, the needs of other vessels that will do anchor at Kupang Lantamal VII. This means that the ability to procure clean water from Kupang Lantamal VII must be significantly improved for better supporting capacity.

2. Second, are personnel. Previously it was explained that the Kupang VII Lantamal experienced a large shortage

of personnel, namely up to 1,691 personnel. Fulfilment of the number of personnel is very important so that the function of Lantamal runs more effectively. This means that a lot of mutations are needed to be transferred to Kupang Lantamal VII or the soldier's reconciliation. Researchers predict Kupang's Lantamal VII will become a hub base that accommodates many warships in the southern region so that in the future it will require more personnel than just 1,995 people. Therefore, a further study is needed on how to make new housing/resident for the soldiers, fulfil the needs of water, food, and energy to accommodate increasingly large personnel in the future.

3. The third is fuel. In the future, Pertamina needs to be required to have a backup and distribution facility for larger fuels to follow the request of Lantamal VII Kupang. Lantamal will also need its own oil bunkers in the future so that the refuelling process for the leaning ships will be faster because it does not only rely on Pertamina. It is expected that in the future the Masela and Selaru Blocks where the position is not too far from Lantamal VII can already be exploited to shorten the fuel

supply logistics chain. Lantamal VII Kupang must also begin to exploit new renewable energy from now on, such as solar power not only for clean water desalination facilities, but also for lighting buildings, turning on air conditioners, water pumps, and other residential needs to save fuel. This is because Kupang is an area that is ideal for exploiting solar power.

4. Fourth are food ingredients. "An army marches on its stomach" or a soldier moves depending on the food in his stomach. This means that the smooth logistics network of food-producing centres such as Flores, Sumbawa and Sumba Island needs to be improved through large port facilities that also operate large-sized vessels, construction of highways and toll roads, construction of food processing industries (canned food factories), construction of irrigation facilities, railroad network, and so on. Of course, this development is not borne by Lantamal VII Kupang, but it must be coordinated with the Central Government and also explained the importance of the logistics chain in the Nusa Tenggara Islands for the continuity of the logistics of Lantamal VII Kupang. The inefficient logistics

chain in Nusa Tenggara is reinforced by the fact that prices are relatively high compared to Java.

5. Fifth is the ship dock facility. Lantamal VII Kupang relatively does not yet have a wide berth facility so it needs to be planned in the future where this location must be built. It should be borne in mind that the ship mooring place must be deep enough because the operating ships in the work area of Kupang and surrounding Lantamal VII must be large in order to be better able to resist natural obstacles. This facility must also be closed using sea walls or other artificial barriers to avoid strong current hazards that can damage or shift the ship to an undesirable place.
6. Sixth is a ship maintenance and repair facility (discussed). Until now, there are no government-owned or private shipyards in the Nusa Tenggara Islands, so the ships have difficulty making repairs, especially general overhauls. Fasharkan is very far away in Surabaya, Batam or Jakarta, so it causes inefficiencies in time and costs. It means that it is necessary to build facilities to support naval vessels, of course, which are not too far from Lantamal VII Kupang.

7. Seventh is the shipping industry. The shipping industry does not yet exist in the Nusa Tenggara Islands so that shipbuilders or even the Navy must order ships from distant shipyards, such as in Batam, Jakarta, Surabaya or abroad. The potential of the shipping market in Nusa Tenggara is very large considering the lack of competition and the need for high mobility due to the character of the island's geography. It should be borne in mind that Nusa Tenggara is rich in minerals that are important for shipbuilding such as manganese and iron so that in the future it can cut large logistical costs if it has to be imported or brought in from other islands.
8. Eighth is to provide more facilities and health personnel in the field of kidney and bladder health. Water in the Nusa Tenggara region tends to be calcareous, especially in the Kupang City area. Therefore, to anticipate health problems that might arise due to consumption of high limestone groundwater, Lantamal VII Kupang needs to provide more doctors in the fields of kidney and bladder health. It is very good if Lantamal VII Kupang can provide additional incentives so that

soldiers who work under it can access more suitable drinking water.

Maritime Security Issues and the Navy Post of Labuan Bajo Capability Enhancement Strategy in Responding to Threats

The threat of maritime security that often occurs in Labuan Bajo is a ship accident. In addition, the possibility of the emergence of terrorist attacks should be noted also because the location of Labuan Bajo is between terrorist cells in Bima and Poso. When Labuan Bajo is increasingly well-known, it will certainly be more attractive for terrorists to target it. Marine pollution and pollution also threaten the natural sustainability of Labuan Bajo which can be triggered by the higher activity of the ship there. In addition, ports are increasingly busy because there are quite a lot of goods imported from outside, as well as more and more residents and tourists on land that can produce a lot of gas, liquid, and solid waste. The area of Labuan Bajo is also very dry, hilly geographical, and difficult to find surface water so that the provision of clean water becomes more difficult.

The risk of smuggling illegal/non-taxable goods and narcotics in Labuan Bajo is also very high. Tourists are

predicted to increase, especially after the Lombok Earthquake and previously erupting mountains in Bali so that Labuan Bajo will become increasingly popular and become an alternative choice for tours. A surge in tourists in the future will encourage smuggling of goods such as liquor, illegal cigarettes, and of course narcotics. Labuan Bajo is in the middle of the province's vortex with a record of bad drug cases, namely East Java, Bali and South Sulawesi, so it is only a matter of time when the bandar starts operating in Labuan Bajo. The safety of tourists from natural hazards must also be considered. The safety of tourists from the danger of dragging the flow must be watched out because the territorial waters of Labuan Bajo have strong underwater currents that change over a certain period of time. These risks making the tourist vessels and tourists themselves washed away by the flow of water.

The threat of tourist abduction must also be watched out, given that there are still many areas that have not been monitored due to the lack of infrastructure and security forces. Foreign intelligence agents are also very likely to stop by and operate to Labuan Bajo to exchange and gather information, or

maybe do social engineering for their sake.

Based on the above problems, researchers offer several solutions, namely:

1. Build a Vessel Monitoring System (VMS) and install marine radars in crowded areas that become ship crossings, and are suspected of being a place for illegal boat activities. VMS plays a role in preventing ship accidents in crowded crossing areas, while marine radar serves to supervise the outer islands and monitor ship activities in and out of Labuan Bajo, and detect suspicious vessel activity. The results of supervision from VMS and marine radar must be relayed to all security institutions such as the Navy, Water Police, Bakamla, Indonesian Army, Sea Transportation Agency, etc. so that effective maritime domain awareness is formed. This VMS also includes shipping guidance and shipping maps that can be accessed by ships that have an Automatic Identification System (AIS).
2. Goods and tourist ports in Labuan Bajo must implement the ISPS Code. This is to ensure that ships, goods, and people who enter and exit the port of Labuan Bajo have passed high-security

standards and narrowed the space for maritime crimes such as smuggling and terrorism.

3. Maritime intelligence assets must be improved, both from the aspect of personnel and equipment so that the ability to detect terrorist action plans (especially from Bima and Poso cells) and kidnapping can be increased, while at the same time being able to counter-intelligence against foreign intelligence,
4. Navy Post's status must be immediately upgraded to Lanal, along with the provision of facilities and equipment to support greater naval activities for maritime security in Labuan Bajo. The tasks of the Indonesian Navy in Labuan Bajo are numerous and complex, starting from preventing smuggling, kidnapping, terrorism, pollution, sea accidents and counter-intelligence. Navy Post of Labuan Bajo is currently developing its building infrastructure to become Lanal and this is a very good thing, but needs to be accelerated. Planning to determine the location of the Indonesian Navy patrol boat must also be immediately carried out before Labuan Bajo will become too crowded and the Indonesian Navy will find it

difficult to get an ideal position. Later after Lanal Labuan Bajo is finished, it is necessary to increase the assets of ships and personnel so that the area of the Indonesian Navy's reach becomes more effective and able to counteract the threat of maritime security.

5. Using New Renewable Energy (EBT) for Lanal Labuan Bajo. In the future, competition for getting electricity and water is getting bigger in Labuan Bajo. Therefore, Lanal Labuan Bajo must immediately prepare a location/infrastructure for the placement of solar panels which energy can be used for light electricity needs such as turning on the TV in the recreation room, lighting at night, turning on the AC, and so on. The most important thing is to use solar panels as energy to desalinate seawater/land to supply Lanal clean water. PDAM cannot always be relied on to distribute water, especially later there will be more new buildings in Labuan Bajo to accommodate tourists, signalling the increasing competition for water. Furthermore, the ships and Navy personnel in Labuan Bajo will be increasing so that the plan to procure electricity and clean water must be prepared.

6. Build Indonesian National Military-Naval Service (TNI-AL) observation posts on the outermost parts of the islands around Labuan Bajo. The aim is to increase the presence of Navy personnel to monitor and respond to incidents that occur as soon as possible. Given the islands in Labuan Bajo, including remote areas, the provision of energy in these posts requires renewable energy facilities such as solar panels equipped with batteries. Its function is to reduce the burden of using the generator. Energy from solar panels is large enough to provide energy for lighting at night, turn on the TV in the recreation room, air conditioning in the observation and recreation room, and other needs. Of course, the electrical equipment used must also be energy efficient. Regarding facilities that have to be lit continuously such as signal amplifiers, communication radios, computers, water pumps, lighthouses, etc. of course they must be supplied from generators which output power is more reliable.
7. Increasing Postal's logistics capabilities and Lanal for the next. The future challenge of Lanal Labuan Bajo is how to procure logistics in a crowded

location with ship crossings and narrow shipping lines. In addition, the strategy to fulfil clean water needs must also be a priority because it is quite difficult for Labuan Bajo to occur due to natural factors. Lanal Labuan Bajo must have a dock with an ideal location that facilitates the supply of goods and is very good if it has its own seawater desalination facility to help procure clean water. Regarding the fulfilment of clean water, it is highly suggested Lanal Labuan Bajo having an organic vessel with seawater desalination. Its function is to supply clean water at observation posts located in the outermost areas of the islands around Labuan Bajo which require security and safety supervision.

8. Install the drone detection radar to monitor its use. Drones in other parts of the world can be used as tools to carry out terror to espionage. Therefore, the use of drones in particular by tourists must be closely monitored, whether by enforcing a drone aviation law which has now been established by the Ministry of Transportation, filling out an agreement or intention to use a drone, or imposing a tax on the bearer and fines if violating applicable legal

provisions. For this reason, a drone detection radar is needed, especially in restricted locations such as airports or police and military facilities (including Bakamla).

The condition of Resources and Provision of Energy and Water in East Nusa Tenggara Province

The need for clean water continues to increase along with population growth, making it the most important resource in the world. Integration of clean water supply and clean energy is one solution in dealing with climate change, causing damaging environmental impacts throughout the world with the riskiest being people in developing countries, especially people located along the coastline. Often villages located in coastal areas have access to large amounts of seawater but have limited access to clean water.

Lantamal VII Kupang is one of the Main Naval Base located in the Eastern Indonesia Border which is located in the coastal area of Kupang City which has limited access to clean water, especially for drinking water. Because the lime content is high in groundwater sources in the city of Kupang, so it does not meet the

requirements like drinking water. Provision of drinking water for Lantamal personnel has an important role in improving environmental health and personnel to support personnel performance in maintaining Indonesian security at the Border.

Water Needs for Lantamal VII Kupang

Currently to fulfil the water needs in Lantamal VII Kupang, the water is supplied from 2 artesian wells that have been built in 2008, namely the Kunheum artesian well with a water discharge capacity of 8 Liters/second located in Bolok Sub-District West Kupang District and streamed to Lantamal VII Command Headquarters for support the KRI element and office needs. The second well is the Bor Lamakera with a water discharge capacity of 5 litres/second located on Jl. Yos Sudarso, Namosain Subdistrict, Alak Subdistrict and streamed to Yos Sudarso complex to support the needs of Lantamal VII Kupang's residents in the Osmok Navy Complex.

The calculation of the need for clean water and drinking water at the Lantamal VII Kupang Command Headquarters is calculated based on the amount according to the appropriate filling data (DSP). The

description of clean water needs based on the number of personnel that can be seen in Table 2.

Table 2. Clean Water Needs for Lantamal VII Kupang

Personil	Jumlah	Asumsi Pemakaian (L)	Kebutuhan	
			(L/hari)	(m ³ /thn)
Perwira	478	40	19.120	19
Bintara	829	40	33.160	33
Tamtama	431	40	17.420	17
PNS	257	40	10.280	10
Total			79.800	80

Source: Processed by the researcher, 2018

The need for clean water flowed to the Lantamal VII Command Headquarters from the Kunheum well to support KRI elements and office needs can be sufficient, but the need for industrial water in the Yos Sudarso complex supplied from the Lamankera well is insufficient. Therefore, to fulfil the need for water, the Yos Sudarso complex is supported by water from the Local water company (PDAM). The service of the Local water company (PDAM) is still limited because of the many requests from the community, the Yos Sudarso complex is supplied with clean water once a week. Consequently, even though the clean water needs of the Yos Sudarso complex are supplied from wells and Local water

companies (PDAM), they will not meet the needs of personnel.

The water originating from both wells to meet the clean water needs of Lantamal VII Kupang's personnel is not used for drinking water because the water quality is poor contains a lot of lime. Meeting the needs of drinking water personnel is supplied from the purchase of bottled gallon water at a price of IDR. 36,000/gallon (19 L).

Solar power plant (PLTS) in East Nusa Tenggara Province

Solar power as a natural resource which is potential energy and available throughout Indonesia has been widely used for electricity generation through the application of photovoltaic technology or solar power plants. East Nusa Tenggara is one of the regions that has good solar power potential. Until now, the State Electricity Company (PLN) electricity network cannot enter community housing which is located in rural areas. In addition, PLTS can also be built in urban areas or not remote areas that have installed PLN electricity network in an effort to conserve energy. Broadly speaking, the types of solar power plants built in East

Nusa Tenggara region are divided into centralized PLTS and SHS PLTS (Solar Home System). As for some NTT areas

that have installed PLTS can be seen in Table 3.

Table 3. The Construction of Centralized Solar Power Plants (PLTS) Installation in East Nusa Tenggara by Ministry of Energy and Mineral Resources (KESDM)

No.	Regency	District	Village	Cap.(kw)	Year
1	Timor Tengah Selatan	Nunkolo	Hoeneo	15	2015
2	Rote Ndao	Rote Ndao Barat	Lidor	15	2012
3	Belu	Io Kufeu	Ikan Tuan Beis	15	2012
4	Belu	Lasiolat	Fatulou	15	2012
5	Malaka	Malaka Tengah	Barene	15	2012
6	Kupang	Amarasi Barat	Erbaun	15	2013
7	Rote Ndao	Rote Barat Daya	Olelasin	15	2013
8	Sabu Raijua	Sabu liae	Dainao	15	2013
9	Timor Tengah Selatan	Kokbaun	Lotas	30	2013
10	Sumba Tengah	Mamboro	Ole Dewo, Ole Ate, Wellurey	50	2013
11	Kupang	Amfomang Timur	Netemnanu Utara	20	2014
12	Alor	Pureman	Langkuru	30	2014
13	Sabu Raijua	Liae	Mehona	15	2015
14	Sabu Raijua	Raijua	Landeunu/Ledeke	50	2015
15	Ngada	Aimere	Heawea	20	2015
16	Ende	Detukeli	Kanganara	15	2015
17	Alor	Pantar Barat Laut	Kayang	30	2015
18	Alor	Alor Selatan	Tamanapui	20	2015
19	Alor	Alor Selatan	Manmas	20	2015
20	Alor	Pantar Timur	Tereweng	30	2015
21	Rote Ndao	Landuleko	Daiama	75	2016
22	Alor	Pantar Tengah	Mauta	30	2016
23	Alor	Alor Timur Laut	Kenarimbala	15	2016
24	Alor	Pantar Tengah	Tude	30	2016
25	Alor	Alor Selatan	Kelasi Tengah	30	2016
26	Alor	Mataru	Lakatuli	15	2016
27	Alor	Alor Timur Laut	Pido	30	2016
28	Alor	Pantar Tengah	Tube	30	2016
29	Alor	Pantar Barat	Piringsina	20	2016
30	Alor	Alor Tengah Utara	Welai Selatan	15	2016
31	Alor	Alor Timur	Balemana	20	2016
32	Alor	Pantar Tengah	Bagang	20	2016
33	Rote Ndao	Rote Barat Daya	Mbokak	50	2016
34	Alor	Mataru	Mataru Selatan	50	2017
35	Alor	Alor Barat Daya	Tribur	75	2017
36	Alor	Alor Barat Laut	P. Buaya	100	2017
37	West Manggarai	Boleng	Pontianak (P. Longos)	150	2017

38	West Sumba	Tana Righu	Lolo Tana	20	2017
39		Tana Righu	Kalebu Ana Kaka	10	
40		Lamboya	Watu Karere	10	
41		Lamboya	Laboya Bawah	10	
42	East Mangg	Sambi Rampas	Ulung Baras	25	

Source: MEMR East Nusa Tenggara, 2018 (processed by Authors)

Table 4. SHS Distribution in Kupang for 2007-2017

No.	District	Village	Total (Unit)	Remark	Year
1	Kupang Tengah	Tanah Merah	30	EMR	2008
2	Nekamese	Oenif	30	Same as above	2008
3	Fatuleu	Oelbifeno	23	Same as above	2008
4	Semau	Lifuleo	30	Same as above	2008
5	Sabu	Ledeae	30	Same as above	2008
6	Sabu Raijua	Ledum	25	Same as above	2008
7	Alak	Kuanheun	25	EMR	2009
8	Maulafa	Sikumana	21	Same as above	2009
9		Bai Lu	25	Same as above	2009
10	Alak	Manutapen	40	Lighting of Public road	2011
11	Amarasi Barat	Erbaun	38		2012
12	Amfoang Barat	Fuames	52	PLTS SEHEN 15 wp	2015
13	Amabi Oefeto Timur	Oemolo	54	PLTS SEHEN 20 wp	216
14	Fatuleu	Tuamanu	25	PLTS SEHEN 20 wp	2017
15	Fatuleu Barat	Tuakau	25		2017

Source: MEMR East Nusa Tenggara, 2018 (processed by Authors)

Table 3 presents the distribution of Solar Power Plants (PLTS) which are centralized in the East Nusa Tenggara province. In addition, the government has also provided PLS SHS assistance in various remote areas for lighting. Based on information from the Ministry of Energy and Mineral Resources of the East Nusa Tenggara Province from 2007-2017,

the PLS SHS has been distributed to the community by 10,576 units. Communities in Kupang and Kupang regency received as many as 473 SHS assistance from the overall total, with details listed in Table 4.

In addition, the largest Solar Power Plant (PLTS) in Kupang has been built in Indonesia, which was inaugurated by the President of the Republic of Indonesia in

2015. The capacity of the PLTS is 5 MWp located in the village of Oelpuah, Kupang Tengah, East Nusa Tenggara. The PLTS was built by PT. Surya Energi Indotama (SEI) a subsidiary of PT. Len Persero. The operation of the PLTS has also been running since eight December 2015 and is even able to serve the needs of the surrounding community to 5,500 households.

Potential of Solar Power Plant (PLTS) in Kupang

The amount of energy output of solar cells generated from PLTS can be influenced by several environmental parameters such as solar radiation, temperature, humidity in the morning, afternoon and evening. Based on the research of Sinaga, R (2011), in the morning, afternoon and evening, sunlight radiation illumination has an effect on energy output in solar power plants. If the illumination increases by 1 Lux, the energy output will increase by 0.001 Wh assuming a constant temperature. At noon, the temperature affects the energy output in the solar power plant. If the temperature increases by 1 degree, the PLTS energy output will increase by 0.121 Wh assuming constant solar radiation illumination. In the

morning, afternoon and evening the humidity does not affect the energy output in the PLTS (Rusman, 2011). The potential of solar energy in Kupang based on the measurement of the Director General of EBTKE in 2011, at the positions of 10009'S and 123036'E has daily average radiation of 5.12 kWh / m². Solar radiation is a very important source for generating electricity by PLTS. Solar radiation describes the energy available in sunlight. Based on the results of processing the BMKG El-tari radiation measurement data in Kupang, sunshine radiation conditions were obtained every hour in Kupang as shown in Figure 8.

Figure 8 shows that the duration of optimal solar radiation in the city of Kupang which can produce solar radiation lasts for 6 hours. Solar radiation emitted by the sun will be captured by photovoltaic solar panels and then converted into electrical energy. The amount of electrical energy produced by solar panels varies depending on the number of solar cells combined in the solar panel. The output of this solar panel is in the form of direct current electricity (DC) with a large output voltage depending on the number of solar cells installed in the solar panel and the amount

of sunlight that shines on the solar panel. The average daily solar radiation in Kupang City can be seen in Figure 9.

In addition to the influence of the magnitude of radiation, the environmental influences that can affect the high output energy of a solar module to be installed are temperature. Very rapid and extreme changes in temperature can cause disruption of electricity production

in a Solar Power Plant. The increase in the temperature of this solar cell affects the open-circuit voltage of a solar cell. The condition of the temperature in Kupang city is classified as high and varies between 21-34°C in a year as shown in Figure 11. Figure 10 shows the coordinates for temperature and radiation data collection using Google Earth version 7.1. at position 10011'03 "S 12304006" E 972 m.

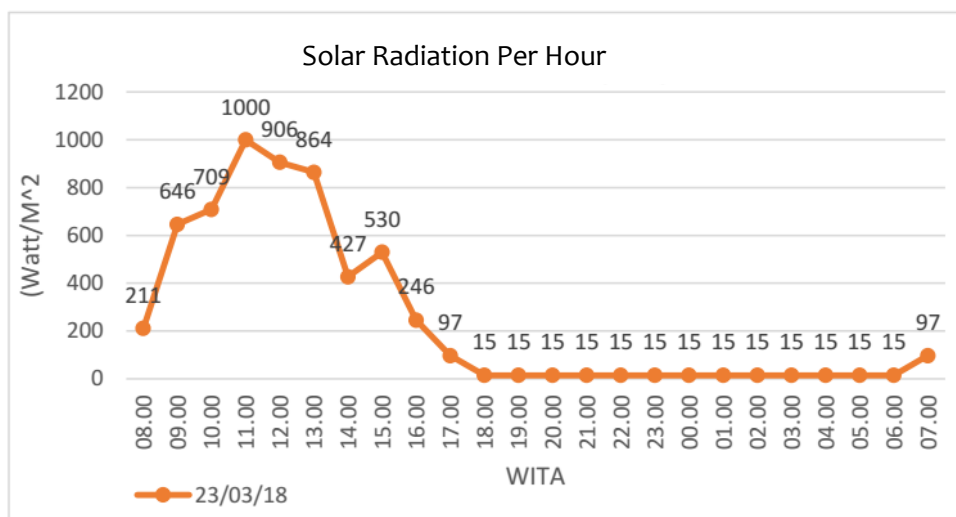


Figure 8. Solar Radiation per Hour of the City of Kupang
Source: processed from BMKG Eltari Kupang data, 2018

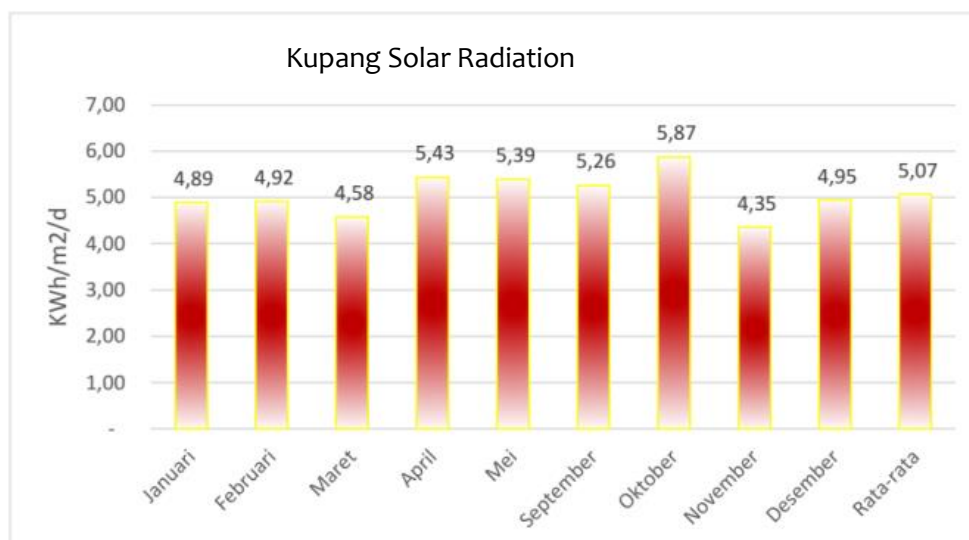


Figure 9. Kupang Solar Radiation in 2017
Source: processed from BMKG Eltari Kupang data, 2018



Figure 10. Data Collection of Coordinate Points

Source: Google Earth, 2018

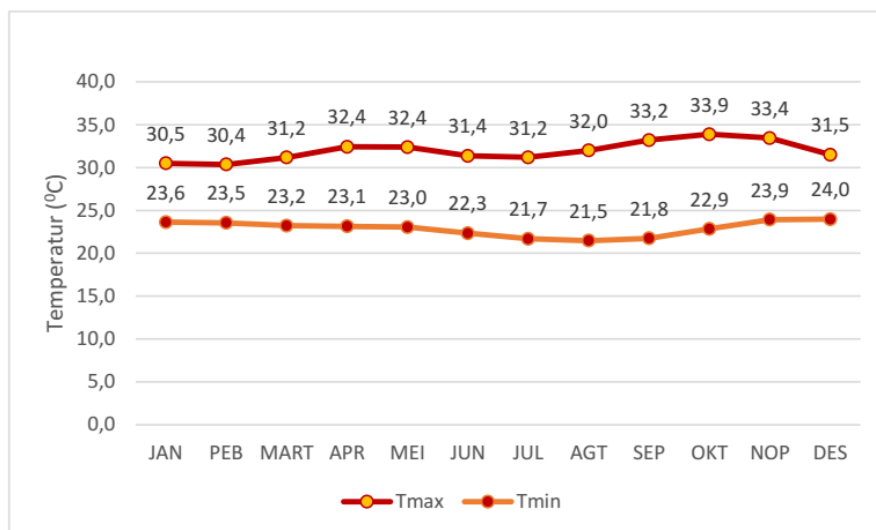


Figure 11. Average temperature conditions of Kupang per month for 40 years (1978-2017))

Source: processed from BMKG Eltari Kupang data, 2018

The outside of solar cells can also be influenced by the location of the placement of solar cell modules on the earth, solar modules must be installed with a certain slope from the horizontal surface. Thus, the absorption of scattered radiation will be far greater than direct radiation.

Water Desalination Model with Solar Power Plant (PLTS) support

Sulamu Village is one of the villages located in Sulamu District, Kupang Regency, which is geographically located at $10^{\circ} 1'15''S 123^{\circ} 36'0''E$. The majority of the residents of the village of Sulamu are from the Bajo tribe, which is an

archipelago which is often known as a sailor. Since long time ago, the Bajo have often travelled by boat, so that the population of the Bajo tribe is spread in the Indonesian coastal areas, one of which is in the Sulamu Village. Because of the ancestors of the Bajo were sailors, the majority of the people are fishermen and seaweed farmers.

The fishermen in Sulamu Village, due to lack of funds to carry out activities as fishermen such as buying seeds and seaweed cultivation equipment, residents borrowed from daily cooperatives. However, the problem is that residents have to pay instalments on debt bills to daily cooperatives even though they have not yet harvested so that it is very burdensome and detrimental to the fishermen because the results obtained are not optimal. In addition to the problems in seaweed farming, trash from other coastal areas pollutes the Sulamu coastal area so that it can reduce the

amount of seaweed harvest.

The problem that is often complained about by Sulamu residents is the lack of clean water. The Well Bor closest to the Sulamu Village is in the sub-district, but the water has not been channelled to the coastal area due to long distances. As a result, the fulfilment of the clean water needs for Sulamu people are supplied by the tank from the sub-district which is sent every day, but the water is not enough to supply the population of around 440 households. The type of water consumed by residents is divided into two, namely, water used for cooking and bathing, which is purchased at a price of IDR. 3,000 / 20 L with the quality of water not fulfilling as clean water because it is brackish water which has a high level of salinity. The second type of water is drinking water supplied from the mountains purchased at a price of IDR. 25,000 for 1 cart containing 10 jerry cans or about 2500 per jerry can.



Figure 12. Water Retrieval by Residents of Sulamu District to Meet Water Needs
Source: Documentation, 2018



Figure 13. Sea Conditions and Fulfillment of Water in the Coastal of Sulamu, East Nusa Tenggara
 Source: Documentation, 2018



Figure 14. Discussion of the Research Team with the Villagers of Sulamu
 Source: Documentation, 2018

Some solutions for dealing with a number of problems in Sulamu village are as follows:

1. Further handling of seaweed cultivation is needed such as making derivatives of seaweed products such as seaweed dodol, seaweed chips and so on. But training for the community is needed. It is also necessary to handle rubbish so as not to damage seaweed such as the provision of trash bins, and so on.
2. It is necessary to establish a group of fishermen to manage marine products and prevent the actions of other parties that can harm the fishermen.
3. The creation of a water pumping system which is flowed from the sub-district to the coastal Sulamu village with a solar power assistance system as a source of electricity.
4. New wells are needed, but due to the quality of the groundwater produced is brackish water, it is necessary to use water treatment technology to convert the brackish water into ready-to-drink

water such as using a desalination water system.

The offered PV-Desalination System Design and will be Built in Kupang

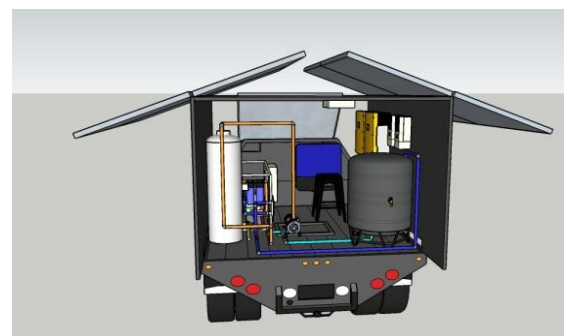
The desalination water design using PV can be seen in Figure 15.

Water treatment carried out is using reverse osmosis technology with the help of electricity supply from Photovoltaic. Electrical energy produced from PLTS can also be used to meet the supply needs of

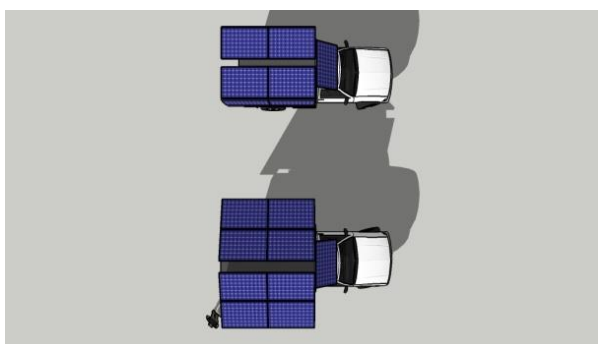
the local electricity network, so this system is suitable to be applied in areas that are not covered by electricity as long as there is brackish water or seawater. One of the advantages of using this system is that it can reduce CO₂ emissions and can save on environmental maintenance costs. The types of PV used are 215 watts in number, 9 units, charger control SMA Sunny Island Charger 50 is 1 piece, inverter sunny island 2224 is 1 piece, and battery sunny island 6.0 H is 2 pieces.



(a)



(b)



(c)



(d)

Figure 15. PV-Desalination System Design. (a) side view design, (b) back view design, (c) top view design, dan (d) front view design

Source: Researcher's Design, 2018

Conclusions

1. The average need for clean water for Lantamal VII Kupang is 79,800 L / day.
2. The quality of existing water sources is in a bad category. The water source used to meet the water needs of Lantamal VII Kupang is supplied from 2 artesian wells, namely the Kunheum artesian well with a water discharge capacity of 8 Liters / second and a Lamakera artesian well with a water discharge capacity of 5 Liters / second. The water from the two wells is not used for drinking because of the poor quality, so the personnel at Lantamal VII Kupang buy bottled gallon water.
3. The electricity supply in Lantamal VII Kupang to date shows that the power consumption of Lantamal VII Kupang in 2017 amounted to 95,578 kWh / month and was met by a local Diesel Power Plant (PLTD). In addition to using electricity from the PLTD, Lantamal VII Kupang has a 550 KVA Genset as a backup to meet electricity needs which are fuel from fossil energy as well.
4. East Nusa Tenggara is one of the provinces that has a large potential of solar energy, which is 5.12 kWh / m² / day. So that in East Nusa Tenggara, Solar Power Plant (PLTS) with a 5 MWp capacity has also been implemented

which is located in the village of Oelpuah, Kupang Tengah, East Nusa Tenggara. The PLTS was built by PT. Surya Energi Indotama (SEI) a subsidiary of PT. Len Persero.

5. The solution offered is to see the potential of existing solar energy, is the use of solar energy for processing brackish water and or sea water into clean water by applying desalination technology to the reverse osmosis process. The system is called the PV-Desalination System. The use of solar energy is also one way to reduce dependence on fossil energy and includes environmentally sustainable technology so that it can reduce greenhouse gas emissions.

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