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Strategy To Maintain The Balance Of The Marine Ecosystem By Utilizing Recycle Economy To Face The Threat Of El Nino

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Abstract

Human dependence on natural resources, especially in the Blue Economy sector or marine ecosystems, has led to a dominant role in ecosystem management. The El Niño phenomenon is a serious challenge that can disrupt marine ecosystems and sustainable economies. This effort aims to reduce the negative impact of El Nino on marine ecosystems, by recycling the economy from wastes in the sea. This research uses a descriptive qualitative approach to reduce the negative impact of El Niño on marine ecosystems through recycling of marine waste, creating a sustainable solution for economic growth and environmental sustainability. SWOT analysis and complex systems theory highlighted several potential strategies to stabilize the marine ecosystem, address the threat of El Niño, and boost the economy. The implementation of these strategies has a positive impact on the sustainability of the marine ecosystem and sustainable economic growth.

Keywords: Recycle Economy, Blue Economy, Marine Ecosystem Balance, Marine Economic Growth, El Nino Threat.

INTRODUCTION

The global economy cannot be separated from every activity related to resources. One aspect of resources that is essential for human life is nature. Humans are very dependent on the environment to obtain food, clothing and shelter. In their efforts to fulfill these needs, humans are involved in various activities that can have a direct or indirect impact on the surrounding environment (Kabar Harian, 2021).

All human needs are generated from nature, holistically humans have a dominant role in ecosystem management, especially in the Blue Economy sector or marine ecosystems. Humans are able to change, accelerate evolution, or even become a polluting factor in the sustainability of the ecosystem. Even though humans have a role as consumers like other living creatures, their presence in the ecosystem is very significant. Humans depend on natural resources for their survival and this need continues to increase, causing continuous changes in the environment, both in terms of quantity and quality. The impact of developments like this can threaten the existence of environmental balance. (Safitri, Putra, & Marini, 2020, pp. 6-7)

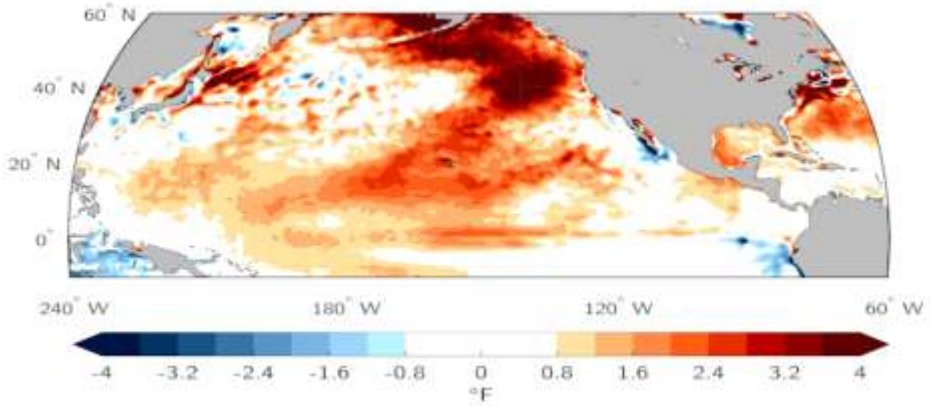
Problems faced to maintain ecosystem balance include the El Nino phenomenon. This has a huge impact on marine ecosystems and also on sustainable economic aspects. Based on data from the BMKG and several World Climate Centers, it is projected that El Nino will continue at a moderate level until December 2023 to February 2024, as stated by the BMKG. This analysis also shows that currently 79% of Indonesia is experiencing the dry season. This data is valid as of September 1 2023. Meanwhile, on September 5 2023, BMKG released a number of regions in Indonesia with a deficit in water availability for plants.

According to BMKG, in August 2023, several areas in Java, NTB, NTT and Aceh will fall into the yellow, orange and red categories in terms of the level of groundwater availability for plants. This red color indicates that water availability in these areas is only around 0 -20%, while orange is only 20-40%, and yellow is 40-60% (Damiana, 2023).

Quoted from (THE CONVERSATION, 2023). EL Nino has the potential to cause

damage to various marine ecosystems. In particular, El Niño can cause very intense and prolonged marine heat waves. This can worsen the increase in global sea temperatures, the impact of heat waves produced by El Nino can put the fisheries sector in a difficult situation. The following is data on the impact of El Nino which can heat sea water by up to 2-3 °C, as in the case of the Northeast Pacific Warm Blod in 2013-2014:

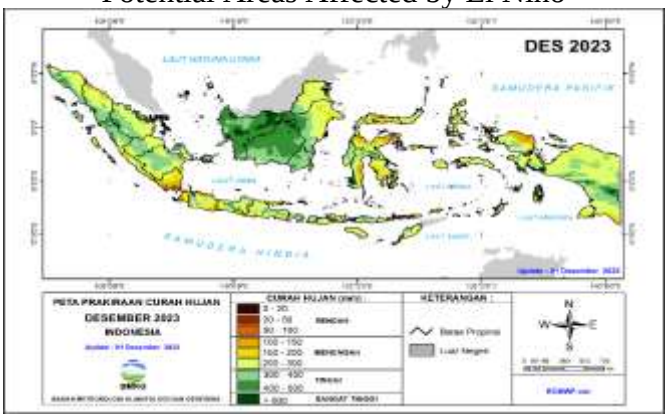
El-Nino Heat Wave



Heat Wave. 1
Source: (THE CONVERSATION, 2023)

An extreme heat wave occurred in 2019 that could destroy marine ecosystems by warming 2-3 °C. The following is data on potential areas affected by El Nino in Indonesia.

Potential Areas Affected by El Nino



Forecast Map. 2
Source: (Agency for Meteorology, Climatology And Geophysics, 2023)

RESEARCH METHODS

According to (Snyder, 2019), in an effort to compile a research project, the first step that must be taken by the author is to explore the world of literature through what is called a literature study or literature review. Literature review is the main foundation in preparing a research plan. In literature studies, searching and exploring various sources of information such as books, scientific journals and other publications relevant to the research topic is key. The aim is to produce an in-depth article that focuses on a particular topic or issue, which will become the basis for further research.

SWOT analysis. SWOT analysis is a classic tool in strategic planning that evaluates internal strengths and weaknesses as well as external opportunities and threats. By considering

these four aspects, this analysis provides a simple approach to understanding and planning strategy implementation. According to Philip Kotler (2009), SWOT analysis is a comprehensive evaluation of these four factors, while Freddy Rangkuti (2013) explains that the aim is to maximize strengths and opportunities, while minimizing weaknesses and threats. As a widely known internal and external environmental analysis instrument, SWOT analysis has become an important tool in making strategic decisions and planning the future of organizations (Robinson, 1997).

RESULT AND DISCUSSION

Descriptive Qualitative Research Data

The data from this research comes from secondary data taken from BMKG, and previous research. This section will discuss the research results starting with case studies and literature as well as the results of online observations.

1) Case Studies and Literature

The following are the results of the research data obtained:

a) El-Nino Impact Research Results

- Research (Safitri S., 2015, p. 155). During the El Nino period, there were recorded deaths due to shortness of breath due to forest fires which produced prolonged smoke haze, even reaching neighboring countries. In addition, there is limited spread of cholera throughout Indonesia due to the impact of drought on the availability of clean water. The El Nino phenomenon also causes a drastic reduction in rainfall in several areas of Indonesia, potentially causing serious impacts.
- Research (ROSSI, Sergio, SOARES, & Oliveira, 2017, p. 9) The impact of El-Nino on coastal ecosystems that occur in Australia's Great Barrier.

Effects of El Niño on the Coastal Ecosystems and Their Related Services

Source: (ROSSI, Sergio, SOARES, & Oliveira, 2017, hal. 9)

Bleaching events in Australia's Great Barrier. After bleaching, coral reefs lose their ability to survive, therefore biodiversity is lost, and productivity decreases. Massive bleaching phenomena become more intense and frequent as ocean temperatures rise.

- Research (FACHRY, 2023, p. 27) says. In 2019, there was a weak El Nino followed by a strong positive IOD. The result of these two phenomena is a decrease in the amount of rain in several areas of Indonesia from July to October 2019, as well as a significant increase in forest and land fire incidents. The following is a graph of El Nino events in 2019:

Figure a.1. Graph of El Nino and IOD Events in 2023
which has almost the same pattern as in 2019

Source : (FACHRY, 2023, hal. 27)

b) Recycle Economy Research Results

- From research (Dewita & Huda, 2011, pp. 28-29) states: Several steps to overcome problems and related to overall lake management are included in the policy options that can be implemented (when mass fish deaths occur), namely:
  - ❖ Temporarily postpone cultivation activities until weather conditions improve and pollution levels return to normal. Next, immediately clean the dead fish carcasses. In this situation, people also need to be directed to catch fish or look for alternative sources of income outside the fisheries sector.
  - ❖ Sucking and/or dredging waste from fish farming activities from the bottom of the waters. This waste can be used as plant fertilizer. This effort can also be done by reducing the amount of pollutants organically through cultivating shellfish or other types of biota that can consume or break down cultivation waste, so that the waste does not become toxic.
  - ❖ Farmers who have limited capital and experience fish deaths require new operational capital to be able to continue their business. The importance of providing low-interest loans is to prevent them from getting into debt with capital owners or being forced to only work as laborers.
  - ❖ Development of a monitoring system that functions as an early warning against the emergence of natural phenomena.

c) Research Results Maintaining the Balance of Marine Ecosystems

- According to research (Muzani, Jayanti, Wardana, Sari, & Br.Ginting, 2020, pp. 1, 6-12) seagrass beds can balance the marine ecosystem. The growth of seagrass beds is also influenced by tides, which means that if there is a drought caused by El Nino, the spread or cultivation of seagrass beds in the sea can be one of the main factors in maintaining the balance of the marine ecosystem. Seagrass beds can even mitigate or reduce the impact of El Nino on marine ecosystems by: stabilizing water temperature, with the role of seagrass beds that can reduce fluctuations in sea water temperature and help keep water temperatures stable, seagrass beds in this case also play a role in mitigation and adaptation climate change. Then seagrass beds can become habitat and food sources, as well as absorb carbon dioxide (CO2) in the ocean. This research shows that seagrass beds are very useful for maintaining the balance of marine ecosystems. In this research, seagrass beds also have economic value that can be cultivated by fishermen so that they can be used as a factor in managing the recycling economy.
- Research (Rachman, et al., 2023, pp. 42-43) shows that one of the factors that can support the balance of marine ecosystems is managing mangrove forests. Deli Serdang Regency has quite extensive mangrove forests, and one of the areas in this Regency that has mangrove forests is Tanjung Rejo Village. The mangrove ecosystem area is an area along

the sea coast which is a natural habitat for mangrove forests, functioning as natural protection for life on the coast and sea. Efforts to strengthen resilience, restore and manage mangrove forests in Tanjung Rejo Village reflect the implementation of the sustainable development paradigm. This step is realized through transformation into a mangrove tourism area. This research can be used as a basis for preserving mangrove forests to maintain the balance of marine ecosystems. This research also explains that active community participation can help manage mangrove forests.

2) Online Observation

The following are the results of the data obtained through online observation:

- Researchers found that the number of fishermen in Indonesia continues to decline due to the climate crisis in 2010-2019. In 2010 the number of fishermen was recorded at 2.16 million people, and in 2019 the number decreased to 1.83 million people. There was a decrease in the number of fishermen by 330,000 people during 2010-2019 (Press Release, 2022). This data is in line with the impact of El Nino that occurred in 2019, which had an impact on marine organisms or ecosystems, including economic turnover in the marine and coastal sectors. Management of marine resources will become increasingly scarce if the number of fishermen in Indonesia also decreases.
- Business Insider (Widyaningrum, 2020). From these results we can see that climate change can cause the death of shellfish, which holistically explains that the entire marine ecosystem can be disrupted.
- Reported from (Aminudin, 2023). Fish cage farmers in Karangkates Village, Sumberpucung, Malang, expressed their concerns regarding the decrease in cage water discharge caused by reduced water flow from the dam. This decrease in water discharge occurred due to the dry season which was influenced by El Nino, and the impact was immediately felt by the increase in the number of farmed fish dying.

Data from online observations shows that the impact of El-Nino is the thing that has the greatest impact on marine ecosystems, and also has an impact on the economy.

SWOT Analysis and Complex Systems Theory Based on Ecological and Social Analysis

From the resulting data, researchers will enter it into SWOT analysis tables and complex systems, so that they can formulate appropriate strategies. The following is a SWOT analysis table based on the data obtained:

SWOT analysis table

NO.	STRATEGY	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
1.	Temporarily postpone cultivation activities until weather conditions improve and pollution levels return to normal	Maintaining ecosystem conditions to make them more stable	This hampers the community's economy	-	The number of fishermen in Indonesia continues to decline
2	Clean dead fish carcasses then process the fish carcasses into organic fertilizer	The impact of El Nino causes a lot of waste or fish carcasses in the	Farmers who have limited capital for fish farmers if they experience fish death require new	Management of fish waste is directly proportional to climate change which causes mass	-

		sea so that they can be utilized	capital for operational costs to be able to continue the business and the number of people who cannot be confirmed as managers	fish deaths. When these fish carcasses are found on the sea coast, they can be collected and processed into organic fertilizer, and maintain the stability of the marine ecosystem	
3	Development of a monitoring system that functions as an early warning against the emergence of natural phenomena	Find out the results of climate change and sea temperature analysis	There is still a lack of government cooperation with fishermen to predict and help with this problem	There is a BMKG application and website and other climate detectors so that they can measure climate and temperature changes in the sea	This could be a driving factor in the number of fishermen in Indonesia continuing to decline, due to a lack of good cooperation between the community and the government (lack of attention)
4	Utilizing the potential of shellfish waste as a material for creating creative arts and crafts products	The increase in temperature and tides of sea water result in a large amount of shellfish waste	The number of shell waste managers in Indonesia is still unknown, including the processing industry, and how many people are interested in managing it	Management of shellfish waste is directly proportional to climate change which causes mass amounts of shellfish waste. These shells can be collected and processed into creative crafts, and avoid the accumulation of marine waste to maintain the stability of the marine ecosystem	-
5	Simping shellfish shell waste which is used as an ingredient in making cookies is rich in calcium	The increase in temperature and tides of sea water result in a large amount of shellfish waste	The number of simping shells in each region is still unknown and the number of shellfish waste managers is	The management of shellfish waste is directly proportional to climate change which causes mass	

			still unknown, including the processing industry, and how many people are interested in managing it.	amounts of shellfish waste.	
6	Seagrass cultivation to maintain the balance of marine ecosystems and the economy	maintain the balance of marine ecosystems and the economy	Requires active community participation (awareness), which can help manage seagrass beds	The growth of seagrass beds is also influenced by tides, which means that if there is a drought caused by El Nino, the seagrass beds can still survive. Seagrass beds are also one of the factors that can reduce the impact of El Nino	
7	Preserving mangrove forests to maintain the balance of the marine ecosystem	Maintaining the balance of marine ecosystems and the economy	Requires active community participation (awareness), which can help manage mangrove forests	One of the factors that can support the balance of the marine ecosystem	

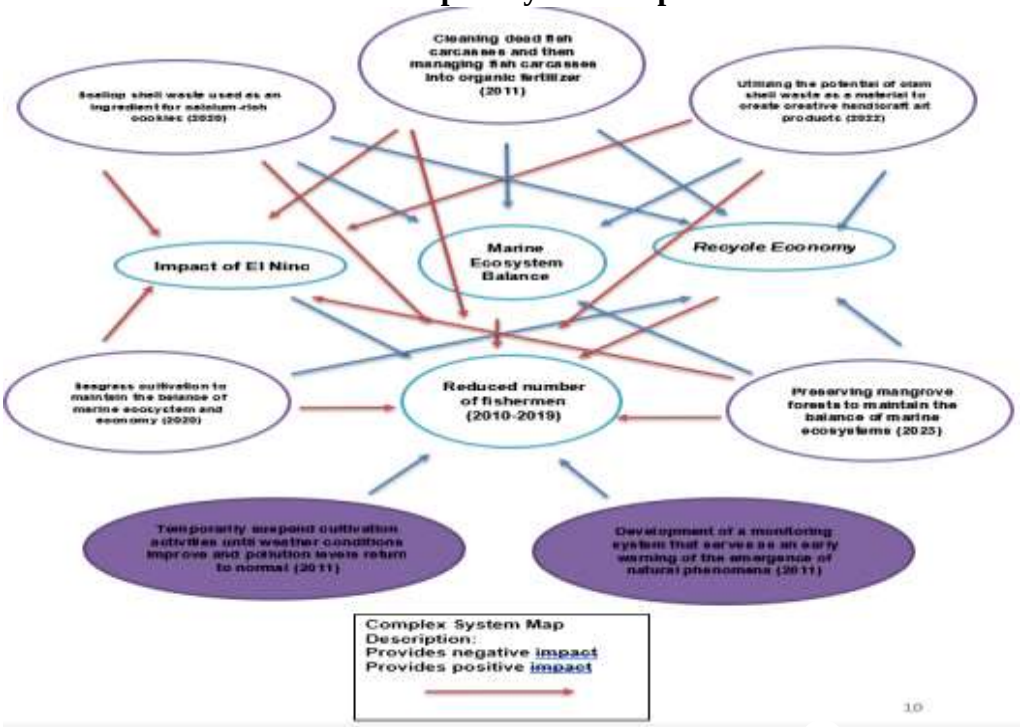
From the SWOT analysis it can be seen that there are several strategies that have no threats and have the same opportunities. Here the researcher will only include strategies that have a high potential for success in facing the threat of El Nino and improving the economy and maintaining the stability of the marine ecosystem, including:

a. Clean dead fish carcasses then process the fish carcasses into organic fertilizer
b. Utilizing the potential of shellfish waste as material for creating creative arts and crafts products
c. Simping shellfish shell waste which is used as an ingredient in making cookies is rich in calcium
d. Cultivate seagrass beds to maintain the balance of marine ecosystems and the economy
e. Preserve mangrove forests to maintain the balance of the marine ecosystem

There are 5 strategies that have the potential to achieve researchers' goals and possibly provide good solutions for marine ecosystem stability and economic stability.

Then the researcher will include the complex system map into this research analysis. The complex system map aims to show that the resulting strategy has interdependent impacts, and proves that this strategy has high success in maintaining the stability of the marine ecosystem, recycling economy, and preventing and reducing the impact of El Nino.

Complex System Map



Source: processed by researchers

This intricate system map clarifies the advantages and disadvantages of earlier study findings. This map demonstrates how these tactics are influenced by one another. The analysis's findings, which are grounded in complex systems theory, are as follows:

1. Fish carcasses are cleaned and then processed to create organic fertilizer (2011). This tactic has a negative effect on El Nino's effects and the decline in fishing populations, but it has a positive impact on the economy and the preservation of the marine ecosystem's balance. However, the fact that the number of fishermen decreased consistently between 2010 and 2019 indicates that, although this strategy has not yet been shown to be able to maintain the decrease in the number of fishermen.
2. Making innovative arts and crafts products by utilizing shellfish waste as a material (2022). This tactic has a negative effect on El Nino's effects and the decline in fishing populations, but it has a positive impact on the economy and the preservation of the marine ecosystem's balance. Prior studies have demonstrated that the utilization of shells as trinkets can lead to an increase in the number of workers and fishersman. This research even reveals the fact that the community established the "Ori Ma Fala" group in order to enhance the abilities and inventiveness of artisans, thereby lessening the effects of El Nino and raising interest in fishing among those living along the coast. (Abubakar, et al., 2022, p. 47).
3. Simping shellfish waste, which is a rich source of calcium and is used to make cookies (2020). This tactic has a negative effect on El Nino's effects and the decline in fishing populations, but it has a positive impact on the economy and the preservation of the marine ecosystem's balance. Fishermen who can weather the economic downturn and cut back on their fishing operations can apply previous research because other studies have demonstrated that lowering the amount of fish and shellfish waste can lower marine pollution.
4. Seagrass cultivation to maintain balance in marine ecosystems and the economy (2020). This strategy has a positive impact on improving the economy and

maintaining the balance of the marine ecosystem, and has a negative impact on the impact of El-Nino and reducing the number of fishermen. According to previous research, seagrass beds can even mitigate or reduce the impact of El Nino on marine ecosystems by stabilizing water temperature which helps keep water temperatures stable, then seagrass beds also play a role in mitigating and adapting to climate change. Seagrass beds also function as a habitat for economically valuable marine biota (Muzani, Jayanti, Wardana, Sari, & Br.Ginting, 2020, p. 12)

5. Postpone cultivation activities temporarily until weather conditions improve and pollution levels return to normal (2011). This strategy has a positive impact on reducing the number of fishermen. This is proven by the large reduction in the number of fishermen in 2010-2019. In fact, this strategy cannot be proven to have a positive impact on the balance of the marine ecosystem, preventing the impact of El Nino, and the recycling economy.
6. Development of a monitoring system that functions as an early warning against the emergence of natural phenomena (2011). This strategy also proves the same thing as the previous point. This research has a positive impact on reducing the number of fishermen. This is proven by the large reduction in the number of fishermen in 2010-2019. In fact, this strategy cannot be proven to have a positive impact on the balance of the marine ecosystem, preventing the impact of El Nino, and the recycling economy.

   From the results of SWOT analysis and complex systems theory, several strategies can be used, including:

- Clean dead fish carcasses then process the fish carcasses into organic fertilizer
- Simping shellfish shell waste which is used as an ingredient in making cookies is rich in calcium
- Utilizing the potential of shellfish waste as material for creating creative arts and crafts products
- Cultivate seagrass beds to maintain the balance of marine ecosystems and the economy
- Development of a monitoring system that functions as an early warning against the emergence of natural phenomena

In the SWOT analysis, even though the development of a monitoring system has threats. However, the system development has been carried out by BMKG through the creation of an application, what is needed is good cooperation between the government and the community. Each strategy has weaknesses, but only one strategy has a threat, even though this strategy does not have a positive impact on the balance of the marine ecosystem, preventing the impact of El Nino, and the recycling economy.

All of these strategies have a great influence on ecology and society, where variables with previous research results need and are related to each other, so that researchers can analyze strategies that create goals that are in accordance with the research results. The results of this discussion can also have an impact on social influence, namely, the welfare of the people. Through the resulting recycling economy, this has a positive impact on increasing the number of fishermen and improving the community's economy. This strategy only requires care, awareness and government cooperation to be implemented.

CONCLUSION

The conclusion from the results of the SWOT analysis and the application of complex systems theory shows that there are several strategies that have high potential to achieve research objectives, namely maintaining the stability of marine ecosystems, facing the threat of El Nino, and improving the economy. The five strategies include:

1. Cleaning dead fish carcasses then processing the fish carcasses into organic fertilizer (2011): This strategy has a positive impact on improving the economy and balance of the marine ecosystem. Although it has not been proven effective in reducing the number of fishermen, processing fish carcasses into organic fertilizer has the potential to provide a sustainable solution.
2. Utilizing the potential of shellfish waste as a material for creating creative arts and crafts products (2022): This strategy has been proven to have a positive impact on the economy and balance of the marine ecosystem. Utilizing shellfish waste for arts and crafts products can increase the interest of coastal communities to become fishermen and create new jobs.
3. Simping shellfish shell waste used as an ingredient in making calcium-rich cookies (2020): This strategy shows a positive impact on the economy and balance of the marine ecosystem. Utilizing shellfish waste to make food products can be a sustainable alternative and support the sustainability of marine ecosystems.
4. Preserving mangrove forests to maintain the balance of marine ecosystems (2023): This strategy has a positive impact on the economy and balance of marine ecosystems. Preserving mangrove forests not only supports the sustainability of marine ecosystems but also provides economic benefits through ecotourism and biodiversity conservation.
5. Cultivating seagrass beds to maintain the balance of marine ecosystems and the economy (2020): Cultivating seagrass beds can have a positive impact on the economy and balance of marine ecosystems. Seagrass beds have an important role in maintaining water temperature, mitigating climate change, and as a habitat for economically valuable marine biota.
6. Apart from that, the development of a monitoring system that functions as an early warning of natural phenomena (2011) is also considered as a potential strategy, although it requires good cooperation between the government and the community.

However, the strategies of "Temporarily postponing cultivation activities until weather conditions improve and pollution levels return to normal" and "Developing a monitoring system" are less proven to have a positive impact on the balance of marine ecosystems, preventing the impact of El Nino, and the recycle economy. Overall, these strategies create positive impacts that are interrelated between ecological and social aspects, with the potential to improve the welfare of coastal communities through recycling economy efforts and preserving marine ecosystem.

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