

Integrated Sustainability: Implementing Regenerative Village Concept in Coastal Settlements, Semarang Border Area

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Abstract

Purposes- In early 2021, several disasters due to floods, earthquakes and landslides were reported almost weekly in Indonesia. Various studies have been conducted previously in coastal settlements in northern Java, especially related to accessibility in border areas. The objectivity of research is to determine how coastal communities can survive side by side with living with water and examine policies implemented as sustainable government programs. **Design/methodology/approach-** According to Doxiadis (1976), The Ekistics element consists of five elements: nature, human, community, shells, and networks. Ekistics element will be used as a variable to observe the phenomenon of coastal settlements in Demak Regency. Qualitative descriptive with natural observation was chosen as the method used in this study. **Findings-** From a physical aspect perspective, network indicator is a significant survival factor during a disaster and after a disaster in the affected settlements. Network indicators will provide accessibility from houses to public facilities, easy reach to clean water and electricity, and an effective evacuation process when a disaster occurs. This study's findings can be considered in determining rural planning policies that can benefit coastal communities in PKPT Program. **Research limitations/implications-** This paper presents an outline sketch illustrating the relevance between an ekistics element in human settlement, regenerative village networks concept, and spatial policies for coastal settlements as an alternative solution for integrated sustainability. **Originality/value-** Regenerative village networks help sustain coastal settlements in the border area.

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Key Words: Ekistics element, Coastal settlement, Regenerative village, Integrated sustainability

1. INTRODUCTION

Flood is one of the disasters that often hits Indonesia, which has a tropical climate, especially in sloping areas. According to Sunarti et al. (2010), there are 5,590 main rivers in all parts of Indonesia, and 600 of them can cause flooding. The flood-prone areas where the main rivers flow reaches 1.4 million hectares. Flood problems began to emerge since humans settled and carried out various activities in the form of flood plains. Floods that harm human settlements occur in cities due to massive development and extension to the outskirts of the city, as happened in the border area of Semarang. Demak regency is a district directly adjacent to the metropolitan city of Semarang which is notorious for its chronic flooding. The last condition shows that Demak regency reported coastal flooding early in February 2021, which inundated the main road suspected of overflowing due to obstructed drainage of the Semarang-Demak toll road project (Sukmawijaya, 2021). Settlements affected by flood disasters have become the central and regional governments' attention in terms of their urgency in preserving coastal settlements. Government policies related to infrastructure development in disaster-affected settlements must be integrated with responses to the annual flood phenomenon's urgency.

Marine and coastal ecosystems play an essential role in the environmental balance because they are interrelated and interact. According to Perdana et al. (2019), the high level of coastal erosion and abrasion is one of the main problems facing coastal areas in Indonesia. Also, several conditions were reported in Sayung District between 1988 and 2017. Almost 25% of land changed from non-water to water from the reported data, and 5% of land changed from non-water margins to coastlines. Comparison with the land use capacity map (LUC) shows that these changes are related in other crops and paddy fields to ponds and ponds to water bodies (Dewi & Bijker, 2020). The data reported above show that flooding affects land-use change in Demak Regency, directly adjacent to the Semarang city boundary.

Some coastal settlements in humid tropical developing countries such as Indonesia face a burden of risk due to their location and because of the relatively low quality of houses that do not meet sustainability requirements. According to De Alencar et al. (2020), the coastal area is a space for political, economic, social,

and other activities that intersect with natural processes. Moreover, tidal flooding disrupts human economic activities, and one of the sectors affected by the result of tidal flooding in agriculture (rice fields and ponds) which reduce people's income (Harini et al., 2018). From these arguments, it can be understood that the tidal flood disaster has a physical impact and impacts the local community's socio-economic life. One of the efforts to integrate government programs with current phenomena facing the community is a sustainable village design strategy. However, the concept of sustainable settlements in coastal areas in Indonesia is not a new approach. Similar studies that have been previously published are as follows (see table 1):

Table 1. Review of Previous Studies

| Researchers | Title | Contents |
|--|--|---|
| Muchhibi (2015) | Planning a Mangrove Park in Morosari Demak Coastal Area as an Education and Recreation Space (Emphasis on Ecological Architectural Design) | Mangrove park planning includes an architectural approach (climatology, accessibility, view, topography, noise) accompanied by an emphasis on ecological architecture design |
| Risianti (2016) | S.M.A.R.T. Eco-village for Hazardous Coastal Area in Bedono Village, Demak Regency | The concept of "smart eco-village" is the idea of solving the problem in flood-affected settlements by integrating ecological, social, spiritual and sustainable economies with an eco-village approach through the principles of SMART (sustainable management and redesign settlement). Eco-village integrates the social environment as a "low impact" or low-risk life support capacity |
| Widjajanti, Antariksa, Leksono, & Subadyo (2018) | Socio-cultural studies in public open space (fisherman settlement in Prigi) | The concept of open space that accommodates the socio-cultural activities of coastal communities can be implemented through a systems approach and several sustainability indicators, such as the three pillars of sustainable development coupled with technological aspects. |
| Perdana et al. (2019) | Assessing Willingness-To-Pay for Coastal Defenses: A Case Study in Timbulsloko Village, Sayung, Demak, Indonesia | Coastal rehabilitation programs, such as the mangrove planting program, construction-hybrid engineering of bamboo, has been implemented offshore and green belt |
| De Alencar et al. (2020) | Circles of coastal sustainability: A framework for coastal management | Circles of coastal sustainability (C.C.S.) provides a holistic assessment of four interdependent boundary domains: environment and ecology, social and culture, economics, and governance and policy |

Source: Author, (2020)

The objectivity of this research is to determine how coastal communities can survive side by side with 'living with water' and examine policies implemented as sustainable government programs. This study's findings are expected to be part of the academic contribution to previous research's novelty. This study aims to determine the condition of residential self-sufficiency and how the roles of architects, urban planners, and the government as policymakers help communities survive both during disasters and post-disaster adaptation.

2. LITERATURE REVIEW

2.1. Semarang Border Area as Locus of The Research

According to Khadiyanto et al. (2017), Semarang's history of flood goes back as far as 1913, where the first recorded significant flood hit in Bodjong street. Another flood recorded occurred in 1990 due to the collapse of the *Banjir Kanal Barat* Embankment, which resulted in massive flooding in large parts of the city. The research location was selected in Sayung sub-district, which is located on the border of the metropolitan city of Semarang. The border area is an area that requires development control through regional policies so that there is no imbalance in spatial planning due to its proximity to the city. However, based on the regional spatial planning regulations for Demak regency in RTRW 2011-2031¹, Sayung sub-district is designated as a district prone to tidal flooding and abrasion. Also, this location is included in the planning area unit I (SWP1)², the main activity center in Demak Regency. Several aspects that need to be integrated according to spatial planning regulations are (1) industry sector development; (2) transportation; (3) housing and supporting facilities; (4) prevention of flooding (RTRW, 2010). According to (RPJMD 2016)³, the locus of research can be seen in the GIS map below (see figure 1):

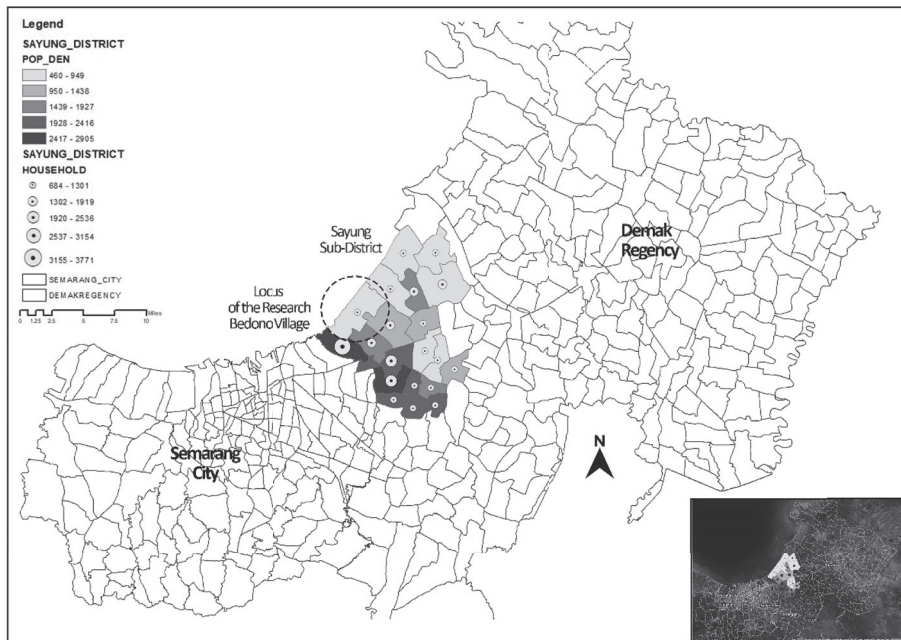


Fig.1: Population Density in the Locus of Research

Source: GIS Map & Googleearth (2020)

Figure 1 above shows the population density and number of households in Sayung District as the research locus (BPS, 2020). According to Muskananfoli et al. (2020), the south-western section (Sriwulan and Bedono village) is eroding much faster towards land than the north-eastern section (Surodadi and Timbulsloko village). However, Bedono village in Sayung sub-district is the largest area compared to other villages. The spatial variability of shoreline change may be due to variations in driving factors such as the coast's morphology covered by mangroves, the bathymetry's shape, and the water depth. Also, Sriwulan village is inundated by tidal flooding from a few centimetres to more than one meter. From 2003 to 2016, 60 hectares of land have been lost, consisting of 51 hectares of fishponds and 9 hectares of residential areas. However, the government has not taken concrete steps to address the problem (Muryani et al., 2017). Tidal abrasion indeed threatens the function of land-use in Sayung sub-district as a residential area.

In December 2017, the tidal flood disaster hit several areas on the north coast of Java, including in Sayung sub-district (Susilorini et al., 2019). As a consequence of coastal flooding, the livelihoods of the residents who previously worked as farmers shifted to other sectors, the community's primary source of livelihood is

as agricultural labourers who work on other people's land in other villages. According to Harini et al. (2018), human resource potential in the coastal areas of Demak in several villages tends to be low. From the results of their research, it was found that 90% of the households sampled were food insecure households. Also, from the population data, the average number of family members in Bedono Village is four people in one family. Educational facilities in Sayung District have elementary to high school levels and health support facilities. Motorized vehicles owned by residents are dominated by motorbikes and wooden canoes (BPS, 2020). In floating settlements, wooden canoe provides easy access to the crossing to the house surrounded by water.

2.2. Disaster Management in Settlements and Understanding of Regenerative Village Concept

Flood disaster risk management needs to be carried out at the central and regional levels by considering flood risk map and notes on existing limitations. To reduce the risk of flood disasters that policymakers can carry out at the central level are as follows: 1) improve and refine the national flood risk map to make it more accurate, 2) coordinating watershed management policies so that there is synergic cooperation between sectors that regulate land use and sectors that seek conservation, 3) striving for a national movement that builds awareness for each region to solve the problem of flooding, especially annual floods that "regularly" occur, 4) optimizing national capacity in providing weather and climate information for early warning of flood disasters, and 5) strive for the right funding scheme to deal with flood disasters (Sunarti et al., 2010).

According to Ekistics's principles (man, shells, society, network, and nature), assessment of the condition of coastal settlements can be carried out by looking at field conditions during a disaster and after a disaster. One of the sustainable concepts that can be applied to disaster-affected settlements is the regenerative village concept. The regenerative village initiative is a model blueprint for the industry, government, and academic action to accelerate the spread of affordable integrated village designs that empower and feed self-sustaining communities to address the challenges expected from climate change overpopulation from an economic, social, and environmental perspective. The "regen" concept defines sustainability by integrating proven technologies such as positive housing for built environment energy, renewable electricity and micro-distribution networks, and living machines for water and waste management (Ehrlich, 2015). According to Liaros (2019), Each village should not be imagined as a gated community but

will remain connected to the broader community, obey its laws and participate in the local, regional and global economy openly and transparently. The integration between the basic needs of human settlements and the potential for integrating the sustainability of the regenerative village concept will provide design recommendations that help the survival of communities in border areas.

3. METHODOLOGY

Primary data collection was carried out by direct field observation in August 2018. Observations were made in a series of international field school (creative thinking of resilience) events organized by the department of architecture, Diponegoro University. The analysis begins with sketching concept diagrams, literature studies, and reviews of current government policies. The observation scheme can be seen in the following diagram (see figure 2):

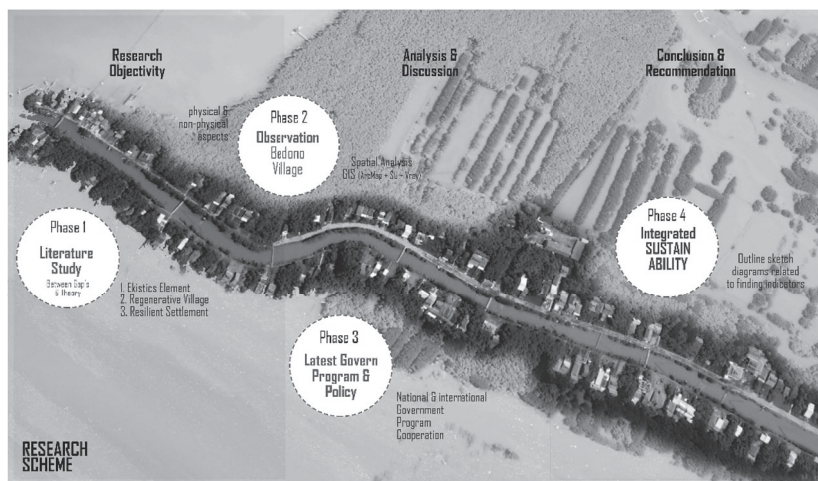


Fig.2: Research Scheme

Source: Author (2020)

The method used in this research is descriptive qualitative with natural observation. Qualitative research is the process of capturing the life experiences of individuals, groups and communities. Also, researchers' role in this approach is as an instrument for collecting data (Richa, 2019). According to Doxiadis (1970), there are two elements of the settlement, namely content (human) and place (container), which can be described through the five elements of ekistics in human settlements. Ekistics element is formed by five main elements consisting of

nature, shells, humans, society and networks. This study aims to see how the integration of five ekistics elements in human settlement can be achieved with sustainable policies through a regenerative village network design strategy.

4. DISCUSSION

In general, during the last few decades, coastal areas have experienced tidal was caused by flooding. which causes climate change and human activities that impact social, economic, and environmental aspects. According to Sharvina et al. (2017), the needs to find long-term solutions that will ensure human existence and well-being are more prominent than seeking appropriate terminology to describe humankind need. Various adaptation efforts have been made to deal with the tidal flood phenomenon, such as landfills, floors elevation, and household furniture arrangement (Rudiarto et al., 2020). In the adaptation process carried out by coastal communities, local governments participate in its implementation through a national scale program called *pengembangan kawasan pesisir tangguh* program (PKPT)⁴. coastal zone development is a national program for community empowerment for marine and fishery self-sufficiency which is regulated in fisheries and marine regulation number 07/Permen-KP/2012 that has been implemented in 2012-2014. This program's form is human development assistance, resources, infrastructure, business and disaster, and climate change preparedness. Regarding climate change preparedness, abrasion that exceeds the coastline and reaches settlement is one indicator that needs attetion because it indicates that the area around the coast is beginning to be inundated.

The coastline needs special attention to achieve ecological balance in the coastal area, which is included in discussing nature indicators in ekistics elements. Here, shoreline changes play an essential role in deteriorating the surrounding environment and the loss of socio-economic, environmental aspects, such as damage to natural and artificial coastal defences and loss of residential areas to damage infrastructure (Muskananfolo et al., 2020). Apart from shoreline observations, mangroves also play an important role in protecting the coast from waves, winds, and storms. Mangrove stands can protect settlements, buildings and farms from strong winds and break the currents of high tides. Ecologically, it plays a crucial role in nutrient turnover or elements in the surrounding coastal waters, which are aided by tides movement (Atmari et al., 2019). Mangrove planting in Sayung sub-district has been carried out by the local government and international cooperation such as Tokio Marine Nichido and OISCA since 1999-

2017⁵. The community was perceiving the benefits of mangrove and now actively participating in tree planting activities.

Apart from planting mangroves, resilience is needed to adapt shells (building) and networks (including road, water, wasting, and electricity management). According to Cin et al. (2020), the climate-induced risk assessment of flood-affected coastal areas plays a vital role in planning practical actions for adaptation plans. The adaptations that the community in Sayung sub-district has carried out are the elevation of houses and addition of a dock. Wooden canoe area means of transportation that makes it easier for people from their homes to reach the ground (main road) or cross to other villages. Besides raising the house floor, adaptations for making road access consisting of roads in soil material and bamboo binding structures have also begun to be implemented. The forms of adaptation that have been carried out by the community and supported by government programs in the research locations are as follows (See Figure 3):



Fig.3: Adaptation strategy for houses and roads

Source: Field Survey (2018)

According to Ristianti (2016), abrasion is a problem that causes Bedono village to be almost partially submerged. Some of the houses which were isolated due to high tide still survive today. This condition causes significant problems,

such as the decline in coastal settlements in Pandansari, Bedono, and Tambaksari village. Besides, the first public facility in Morosari villages (near Bedono village) that to be developed focused on road infrastructure problems and then followed by the needs of other public facilities such as schools, health facilities supported by a sound drainage system, and clean water distribution (Riskiyanto et al., 2019). Based on a field survey, the roads consist of concrete, asphalt, sidewalks, and soil layers, while several permanent houses have tiled floors. Several houses have permanent dirt floors, semi-permanent ceramic floors, and houses with dirt floors (Rudiarto et al., 2020). The network elements (accessibility) that need to be considered in the PKPT program are as follows:



Fig.4: Existing accessibility conditions

Source: Field Survey (2018)

From a physical aspect perspective, village networks' indicators constitute a significant factor for survival during disaster periods & post-disaster. Network indicators will provide accessibility from houses to public facilities, easy reach to clean water & electricity, and an effective evacuation process when a disaster occurs. The term sustainable comprehensively discuss the ecology, economy and society of a building in the context of its community. The variable that can facilitate integrated sustainability during and after a disaster is a network indicator in the Ekistics elements (ease of accessibility). The three aspects of ease of accessibility that need to be considered are as follows (see table 2):

Table 2. Findings of network indicators at the research location

| Indicator | Findings and design recommendation |
|--------------------------------|---|
| Land & water access facilities | <ul style="list-style-type: none"> • Access roads are mostly still flooded. Roads that are now not flooded may one day be inundated if the tide comes. Mapping of ground-level abrasion vulnerability is required before the implementation of the planned road construction. • For waterway access, residents have adapted by using wooden canoes to reach other villages. Path simulation can provide clear direction and avoid the danger of high water currents; easy to pull over |
| Bridge Design | <ul style="list-style-type: none"> • Several bridges are still flooded. The bridge material is susceptible to weathering because it is only made of bamboo material. The bamboo bonds were not strong enough and could quickly come off when the big flood came. • When the tide comes, the residents have difficulty distinguishing which bridge and river. This condition is quite dangerous in the evacuation process. • The design recommendation for bridge design can be to use a floating system such as a bridge module that remains above the water level. The joint bond structure can be adjusted to make the bridge easy to pass during and after flooding |
| Dock for parking | <ul style="list-style-type: none"> • Residents who work as fishermen respond well to settlement adjustments by adding a dock in front of their house. However, a design proposal is still needed to design a safe and useful dock parking space. • The aluminium floating dock can be applied to all houses (not only fishermen) to facilitate accessibility if one day the entire area sinks due to flooding. |

Source: Author, (2020)

Historically, the coastal area has attracted humans because of its rich resources; for logistical activities, as it offers an access point to trade and sea transportation; for recreational or cultural activities; or simply because of their sense of place at the meeting between land and sea (Cin et al., 2020). The accommodation strategy reduces the impact of sea-level rise through human behaviour changes or infrastructure while maintaining coastal areas' existing uses. For example, it involves modifying existing infrastructure for adaptive land use, rising land levels or improving drainage utility, encouraging planting salt-resistant crops, restoring sandy beaches, and improving flood warning systems (Lee, 2014). The modifications that can be made to support the elements of man and society are as follows (see figure 5):

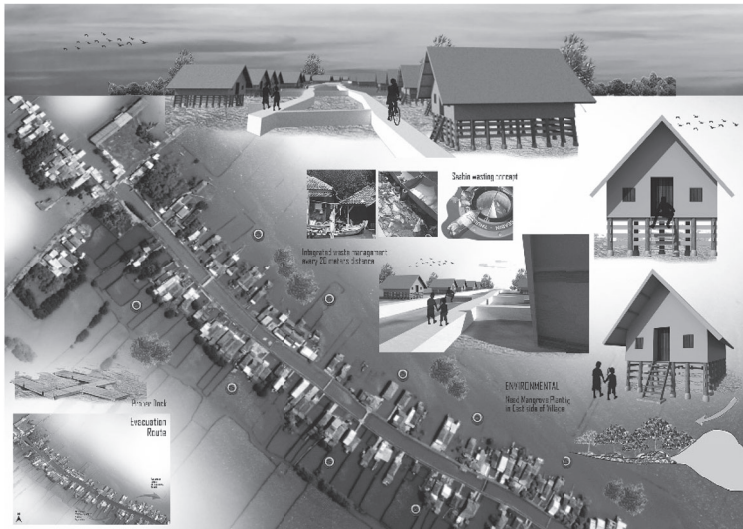


Fig.5: Regenerative village networks concept in coastal settlement

Source: Author's analysis (2020)

Accessibility between villages can be facilitated by designing bridges, land and water accessibility routes, and clarity of evacuation routes. Waste disposal management by implementing seabin every twenty meters distance will improve cleanliness in the settlement area. Mangrove planting has been allocated to focus on the northern part of the settlement by involving the community in cooperation efforts (Javanese called *Gotong Royong*)⁶ to promote social engagement (society element). According to Dhiman et al. (2019), community-based adaptation strategies at the grassroots level supported by local governments have shown some success in adapting to address urban flood risk scenarios. Regenerative village networks will be formed with these efforts and will facilitate disaster management in physical and non-physical aspects to the community.

The continuous integration of settlement theory, government policies, and design strategies that benefit the community during a disaster and after a disaster will benefit the government and coastal communities. Moreover, to obtain the funding, the community group must be directed towards developing village income and spending budget (APBDes)⁷ to increase the funding allocation (Purnaweni et al., 2018). In the end, as the overall implementation goal, active community involvement, strategic design accuracy, and clarity of government funding will help the community's survival in implementing the regenerative village network concept.

5. CONCLUSION

Architecture can be seen as an adaptive optimization of various normative values and external factors that continuously seek a balance to create a final form, especially in human settlements consisting of content (humans) and containers (places). Therefore, resilient architecture aims to respond successfully to hazards directly affecting the location and the hazards outside the location boundaries (Kosanovi et al., 2018)). The concept of a regenerative village in a coastal area is one of the strategic designs where the community's understanding of the needs for settlements, field conditions, and the necessary policies can be implemented in an integrated and sustainable manner under the urgency of the problem. One of the variables that can facilitate integrated sustainability during a disaster and after a disaster is networks, which includes accessibility, easy access to clean water and electricity, and evacuation. According to Liaros (2019), the concept of regenerative development is emerging as a new approach to land development. Proponents argue that we need to move beyond sustainability - defending ourselves and the environment - towards regenerative development to positively impact land and ecosystems. This paper concludes that it is important to combine the ekistics element theory in human settlements, the selection of fundamental principles as input for the regenerative village design concept, and creating a sustainable coastal settlement community. These findings can be considered in determining the coastal settlement planning policy in *Program Pengembangan Kawasan Pesisir Tangguh* (PKPT) as a national program, which can benefit the Government and coastal communities.

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Notes

- ¹ RTRW: *Rencana tata ruang wilayah* (Regional spatial planning regulation)
- ² SWP: *Satuan wilayah perencanaan* (Planning area unit)
- ³ RPJMD: *Rencana pembangunan jangka menengah daerah* (Regional medium term development plan)
- ⁴ PKPT: *Program pengembangan kawasan pesisir* (coastal zone development-national

- program)
- ⁵ OISCA: The organization for industrial, spiritual, and cultural advancement-International. Retrieved from <http://www.oisca-international.org/> on 18 March 2021
 - ⁶ *Gotong Royong* is local wisdom which means “raising together” or work together to achieve mutual success. *Gotong* means “raising” and *Royong* means “together”
 - ⁷ APBDes: *Anggaran pendapatan belanja desa* (Village expenditure budget)

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