**Disaster management model for eco-pesantren-based drought hazards (Case study of Islamic boarding school SPMAA in Lamongan, East Java district)**

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***Abstract*** *This study aims to determine the disaster management model for eco-pesantren-based drought hazards based SPMAA lamongan Jawa Timur, case study. Optimizing environmental preservation needs to involve all aspects, and religion becomes the primary line to create the character of future generations' attitude to protect nature. As for Islam, it has a clear concept of environmental conservation and is part of being part of a Muslim's faith. The method of this study is a qualitative research method. Data sources used are primary data derived from observation and interviews. Secondary data comes from the review of literature, journals, books. This research uses ecopesantren theory: The eco pesantren indicator is; First, Geographical Factors, Second, the policy of caring and environmentally friendly boarding schools. Third, systems are environment-based curriculum development. Fourth, the development of participatory based environmental activities. Fifth, management of supporting facilities for pesantren are environmentally friendly. This research concludes: First, the SPMAA Islamic Boarding School is one of the eco-pesantren models in Indonesia. Second, geographically located in drought-prone areas. Third, the drought disaster management strategy carried out by the Lamongan SPMAA boarding school implements operational strategy, while the operational strategies were undertaken as follows; (1) Building Reservoirs, (2) Building Embankments, (3) Using Ground Water, (4) Building Ait soil, (5) pumping, (6) adjusting Soil Patterns, (7) drilling wells made, (8) Making Making Biopori*

**Key words:** Disaster management Model, Ekopesantren, Drought Hazards

***Abstrak*** *Penelitian ini bertujuan untuk mengetahui model penanggulangan bencana untuk bahaya kekeringan berbasis pesantren berbasis SPMAA lamongan Jawa Timur, studi kasus. Mengoptimalkan pelestarian lingkungan perlu melibatkan semua aspek, dan agama menjadi garis dasar untuk menciptakan karakter sikap generasi mendatang. untuk melindungi alam. Adapun Islam, memiliki konsep konservasi lingkungan yang jelas dan merupakan bagian dari menjadi bagian dari kepercayaan seorang Muslim. Metode penelitian ini adalah metode penelitian kualitatif. Sumber data yang digunakan adalah data primer yang berasal dari observasi dan wawancara. Data sekunder berasal dari studi literatur, jurnal, buku. Penelitian ini menggunakan teori ecopeantren: Indikator eco pesantren adalah; Pertama, Faktor Geografis, Kedua, kebijakan sekolah berasrama yang ramah lingkungan. Ketiga, kebijakan adalah pengembangan kurikulum berbasis lingkungan. Keempat, pengembangan kegiatan lingkungan berbasis partisipatif. Kelima, pengelolaan fasilitas pendukung pesantren ramah lingkungan. Penelitian ini menyimpulkan: Pertama, Pesantren SPMAA Islamic adalah salah satu model eco-pesantren di Indonesia. Kedua, secara geografis terletak di daerah rawan kekeringan. Ketiga, strategi manajemen bencana kekeringan yang dilakukan oleh pondok pesantren SPMAA Lamongan menerapkan strategi operasional, sedangkan strategi operasional dilakukan sebagai berikut; (1) Waduk Bangunan, (2) Tanggul Bangunan, (3) Menggunakan Air Tanah, (4) Bangunan Ait, (5) pemompaan, (6) menyesuaikan Pola Tanah, (7) sumur bor yang dibuat, (8) Membuat Pembuatan Biopori*

***Kata kunci*** *: Model penanggulangan bencana, Ekopesantren, Bahaya Kekeringan*

**1. Introduction**

Throughout the world, drought ranks first among all the natural hazards in terms of the number of people directly affected ~Obasi 1994; Hewitt 1997; Wilhite 2000a!. Although considered an inherent risk, droughts differ from the other natural hazards in several ways. First, drought is a slow-onset hazard, often described as a creeping phenomenon, making it difficult to determine when a drought begins. Second, droughts do not have a universally accepted definition, confusing whether a drought exists and its severity. ‘‘What is a drought?'' needs to be explicitly defined by region and activity. Third, although drought is not as physically destructive as most natural disasters, it can affect vast areas and cause a wide range of economic, environmental, and social impacts (Wilhite and Glantz 1987)

Drought is one of the problems that hurt the region. Drought is often regarded as a disaster arising from a lack of rainfall. In disaster management, a term “disaster” is defined at least by the two main pillars that cause a disaster event, namely danger and vulnerability to the threat. A Danger itself is a phenomenon caused by nature or a phenomenon due to threatening artificial engineering, whether for human life, property loss, and environmental damage [1]. Drought is a natural phenomenon that generally occurs following the climate cycle in an area related to the hydrological cycle. As a drought hazard caused by nature, where there is a shortage of rainfall than expected to decrease [2]. The danger of drought can be seen not only from the aspect of meteorology, where when there is a lack of rainfall in a specified duration, it will cause an impact of water shortages for other elements so that the affected elements can also be called a drought. However, all types of drought come from a lack of falling rainfall [3] and inadequate rainfall that falls in a certain period

[4]. As a result of the drought in Lamongan Regency over the past decade, land damage has reached + 12,000 ha [5]. Another impact caused was the occurrence of puso on agricultural land, which resulted in crop failure [6] and public areas experiencing a crisis of clean water

[7]. Information about the distribution of hazards is needed, as one of the non-structural efforts that can be used as input for the development of the Lamongan Regency area that is prone to drought. Information about further distribution will be used as input for conducting drought disaster risk assessments and conducting disaster risk-oriented water resource management. Rainfall is used as the primary input in this study because it is following the research of Wilhite (2005) that all types of drought are caused by lack of rainfall. The definition of lack of rainfall as a meteorological drought is a period where the difference between actual rain occurs with average rainfall using an absolute time scale, divided by its standard deviation, produces a negative value continuously until a positive value occurs again

[8]. This definition can then be synthesized into an index called the Standardized Precipitation Index (SPI) developed by McKee (1993). SPI is widely used in various countries as a drought index that can monitor drought due to SPI calculations based on rainfall posts. Besides that, based on a study conducted in India, SPI has a stable correlation coefficient between the comparison of its values concerning the Identification of the Distribution of Meteorological Drought-Prone Areas in Lamongan Regency.

Lamongan Regency is one of the districts included in the category of areas prone to drought hazards. The Regional Disaster Management Agency noted that land damage, crop failure, and water shortages have occurred due to drought in Lamongan Regency. Risk management for a disaster is one of the non-structural approaches that can be done to minimize the impact of disasters. At least there are two primary components in conducting an assessment of disaster risk, namely conducting a hazard assessment and conducting an assessment of vulnerability. In the initial stage, it is necessary to limit the area affected by drought hazards.

Lamongan Regency is one of the districts in East Java that has Islamic-based educational institutions, Lamongan district development in the field of education can be demonstrated from the development of Islamic boarding school-based education.

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Islamic boarding school education is social capital and even fun for the development of national education in Indonesia. Mastuhu in the Dynamics of Islamic Boarding School means that Islamic boarding schools are traditional Islamic educational institutions that aim to learn, understand, explore, appreciate and practice the teachings of Islam by emphasizing the importance of religious morality as everyday behavior.

Islamic boarding schools are expected to play a role in sustainable development. In 2009, the United Nations through the UNESCO organization launched Education for Sustainable Development (ESD) which aims to provide long-term solutions to changes in human behavior to live sustainably to find solutions to environmental problems as they are now facing. Deputy Minister of Environment for Environmental Communication and Community Empowerment, Henry Bastaman said that (following the MoU between the Ministry of Environment and Ministry of Religion Number: B-17 / DEP.VI / LH / XII / 2006 and Number: DJ.II / 511E / E / 2006, concerning the Development of the Role of Islamic Education Institutions in Environmental Management which was then followed up with the Eco-Pesantren Program,) Islamic Boarding Schools in Indonesia will be a pilot project for other countries to provide understanding to the public regarding environmental issues. The conference which was held on April 9-10, 2010 was attended by 23 foreign delegates from 14 countries including Egypt, Libya, the Philippines, the United States, Malaysia, Jordan, England, and 75 participants from various Islamic boarding schools in Indonesia. The conference discussed environmental management issues that would be applied to Islamic boarding schools or called "eco pesantren."

Optimizing environmental preservation needs to involve all aspects, and religion becomes the primary line to create a character (Aulia, Firdaus, Mardhiah, & Narulita, 2017) and generation attitude (Mardhiah & Aulia, Growing the Love of the Motherland through the upcoming Eko-pesantren, 2017) for guarding nature. As for Islam, it has a clear concept of environmental conservation and is part of being part of the faith of a Muslim, (Mardhiah, Aulia, & Narulita, Concept of Islamic Ecotourism Movement Study of Civil Society Organizations NU and Muhammadiyyah, 2017). Islamic boarding school-based environmental management offers environmental management that is directly practiced by an Islamic education institution and carries out activities for the preservation and protection of natural resources and the environment (Sudirman, 2012), which later became known as Eko-pesantren. Also, pesantren-based environmental management is considered as one of the active environmental management. It is said to be effective because Islamic boarding schools play a role as essential institutions and are flexible in being actively involved as institutions that are very close to the communities around the pesantren (Mangunjaya, 2014). It was added by the fact that pesantren had become the attention of the world community. It could be considered as a knot of cultural and cultural broker encounters for the flow of modernization ideas from the city (Abdurrahman, 2006) so that the management of the pesantren-based environment can be useful for the area around the pesantren and as an example of environmental management for the community.

According to the explanation above regarding disaster management, a number of research questions will be raised. What is the new solution for disaster management? what contributions can be made by educational institutions especially based on Islam? what is the appropriate model of disaster management for each characteristic of a disaster area?

**2. The Methods**

This research includes qualitative research. Data collected from interview texts, personal documents, memo notes, field notes, and other official documents. Source of data onto this research comes from both primary data and secondary data. Primary data constructed from observation, interview, and also questionnaire to get direct information about the concept of pesantren-based environmental management. The secondary data used to reinforce the findings and complete the data collected through direct interviews for the pesantren which comes from reading sources and various other sources consisting of books, journals to official documents from various agencies. Besides, attachments to official bodies such as ministry data, study results, theses, dissertations, historical studies, and so on. Data collection techniques used in the form of direct observation, interviews, documentation, and data analysis. This observation is used for systematic, planned research on the concept of pesantren-based environmental management. In addition to that, the interview was conducted directly to the residents (Ustadz, Santri, Kyai, and surrounding communities) of the pesantren. Then the document was written records of the author of the observation, photographs, and records of activities and supporting facilities and infrastructure in Pondok Pesantren. Data analysis done after using the above data collection techniques is to process and analyze the data by using descriptive-qualitative analysis.

**3. Result and Discussion**

**3.1 Drought Management Model**

**3.1.1.** Three (3) approaches taken in efforts to overcome drought problems

The shrinking water reserves are an increasingly critical issue at the beginning of this century. Several drought disasters are strictly related to events of weather and climate pattern deviation phenomena. There three approaches must be taken in efforts to overcome drought problems. First is the Strategic approach that intended to analyze average climate data using historical data for planning purposes. Second is the Tactical approach which based on the development of forecast methods and techniques a more regular season. The last is an operational approach, carried out to anticipate and cope with inevitable disasters, in the form of efforts to overcome and save plants when the season forecasts are missed. Identification of drought-prone areas can be made by identifying areas based on drought, dry periods, E agro-zone, rainfall characteristics, and periods of water surplus-deficit. Drought mitigation can be carried out with several efforts, such as identification of drought-prone areas, development of forecasting techniques, and mitigation efforts in the form of anticipation in case of water shortages. The operational steps of drought prevention efforts can be carried out based on regional identification and the development of forecasting techniques such as optimizing the use of water sources such as the construction of reservoirs, reservoirs, utilization of groundwater and pumping. Plant cultivation that is resistant to drought stress by adjusting the appropriate cropping pattern.

The approaches carried out above constitute a unit which is interrelated with each other and all three support and support each other (Figure 1) in the case of overcoming drought that often occurs. A thorough introduction can make the strategic approach in guessing, diagnosing and overcoming drought of the area in question-based on the characteristics of the region and the possible level of risk of drought that may occur in the region. The analysis can be done in the form of identification of patterns of rainfall events, including evaluation of rainfall characteristics. Include, determination of the beginning of the rainy season and dry season and determination of the duration of the dry season and analysis of land water balance to see periods of surplus and deficit of land water reserves for agriculture in the region.



**Figure 1. The relationship between strategic, tactical, and operational approaches (Bey et al., 1995).**

Furthermore, one form of tactical approach is an effort to anticipate the effects of drought through the development of appropriate climate forecasting techniques. Climate forecasting for agricultural purposes by several parties and agencies related to forecasting activities is still in its infancy.

Improvement, so that in a tactical approach it can be done through a simulation of land water balance analysis techniques, in monitoring the condition of the land surplus and deficit period if the rain does not fall during a specified period. The availability of groundwater will decrease with time, to the extent that it is no longer able to support plant growth. The simulation results of a comprehensive water balance analysis in an area will result in a surplus period, a deficit period and a long period of drought, then by inputting other climate elements, including soil and plant parameters, can be compiled regionally or even nationally with the help of Geographic Information Systems ( GIS). The output of this compilation is mapped so that it can be determined immediately where areas with the highest chance of drought occur or are declared as drought-prone areas quickly and accurately. Other benefits of this mapping can also be used as a basis for early warning systems for future drought problems. The operational approach is an absolute real step that must be done to anticipate and overcome drought if the occurrence of climate pattern deviations that are very detrimental to agriculture occurs and cannot be avoided. The making of a drought early warning system is essential to be built and arranged as a basis for selecting and determining the operational steps that need to be taken. Actions that can be made, such as preparing reservoirs for storing rainwater or building water storage reservoirs and transferring irrigation flow targets based on the priority scale according to information obtained from the early warning system.

**3.1.2. Strategic approach**

Strategic approach is a strategy intended to analyze climate data that is of an average nature using historical data for general (broad scale) and long-term planning purposes, besides that in this strategic approach is done through identification of regions according to status, level and intensity of drought based on water and moisture balance and study of rainfall patterns. The results obtained from the strategic approach is locations prone to dryness can be used as a reference in determining various policy actions.

**3.1.3 Tactical approach.**

This approach is based on the development of more reliable and predictable season forecasting methods and techniques

**3.1.4 Operational Approach**.

This approach is carried out to anticipate and cope with inevitable disasters, in the form of efforts to overcome and rescue plants when the seasonal forecasts are missed, including in this case the irrigation diversion, adjusting cropping patterns and water availability.

**3.2. Eco-Pesantren**

Islamic boarding schools, as a typical Indonesian educational institution, based on Islamic values, have their way of looking at the environment. The views of pesantren on the environment as a principle for the realization of one's religious attitudes that are following the Koran and Hadith are as follows (Aulia, Mardhiah, Gunawan, & Isnaini, 2018): first, respect for nature. Second, moral responsibility for life. Third, universal solidarity. Fourth, caring for the environment.

In addition to the views of pesantren on the environment, several studies have revealed the critical role of Islamic boarding schools in contributing to solving environmental degradation which became known as the eco pesantren program (Aulia, Firdaus, Gunawan, & Isnaini, 2017). Ecopesantren comes from the word eco for the science of ecology and the word pesantren. Ecopesantren is an effort to give the label "environmentally friendly" or green at the stage where the pesantren can show its contribution or participation in conservation or environmental conservation (Mangunjaya, 2014)

The eco pesantren indicator is; *First* is the Geographical Factor, consisting of; geographical location, strategic position, and ecological conditions. *Second,* the policies of the pesantren are caring and environmentally sound. *Third,* the policy of developing an environment-based curriculum. *Fourth* is the development of participatory based environmental activities. *Fifth,* management of supporting facilities for environmentally friendly Islamic boarding schools (Rihlah Nur Aulia, 2018)

The view of the pesantren on the environment plus the second eco-pesantren indicator regarding curriculum development policies results in the delivery of environmental material to students (students). Environmental content can be delivered through an integrated and integrated curriculum or individual subjects. Ecological education in pesantren is commonly called Fiqhul Bi'ah (environmental fiqh). Various learning models and learning methods are carried out to provide an understanding of the students about the environment associated with daily routines. Development of the curriculum can be in the form of; development of integrated learning models, excavation and construction of environmental material that exists in the community, development of Islamic environment-based learning methods, development of curricular activities to increase the knowledge and awareness of santri about the environment, practice of Islamic teachings about the environment in eco-pesantren activities (Aulia, Firdaus, Gunawan, & Isnaini, 2017).

**3.3. the pesantren-based drought-prone disaster management model**

SPMAA Islamic Boarding School has a high awareness of the environment. The formation of the vision and mission, the slogan, and the values ​​of the pesantren is based on an environmental awareness attitude. The concept of the pesantren that shows the existence of an environmentally friendly side is: Together with the parties to restore values, human rights, the earth, nature, and its contents to the original. The background for the development of a caring and aesthetic vision and mission policy at the SPMAA boarding school is encouragement from the thoughts and views of the founders of the pesantren is Muhammad Abdullah Mukhtar.

SPMAA as an Indonesian boarding school-based education institution in Turi District, Lamongan Regency, according to data from the Head of Lamongan BPBD, Suprapro, Lamongan Regency is threatened with drought. Four hundred eighty-five hectares of rice fields in Turi sub-district, hundreds of hectares of land are in five villages, namely Sukorejo 75 hectares, in Sukoanyar village 150 hectares, Tawangrejo village 100 hectares, and in Wangunrejo village 125 hectares and 35 hectares in Turi village where Islamic boarding schools SPMAA is located. Indeed, the puso (crop failure) has not yet been threatened, but the relevant Regional Organizations (OPD) must immediately reorganize agricultural irrigation management in the Bengawan Jero region.

The drought disaster management strategy carried out by the Lamongan SPMAA boarding school implements the operational procedure, while the operational plan was undertaken as follows drought determines the sustainability of food crop agricultural production systems. Prolonged droughts occur in specific cycles, so the coping efforts must be prepared conceptually mature. The target of short-term drought mitigation should not ignore the prospects and impacts in the long term. If drought has severe consequences for agriculture, then preparation must be focused on areas prone to drought and water deficits, such as Lamongan Regency. Such regional results certainly need real operational actions as a countermeasure in the event of drought; the operational steps in question are:

**1.Building a Reservoir**

Reservoirs have long been developed in Indonesia, both large and small. This is nothing but an effort to store excess water during the rainy season and use it in the dry season. In the pluvial sub-region river water is used directly or accommodated in reservoirs, then distributed its utilization, for agriculture. Rice fields consume water between 800-1000 mm/season or between 6-8 mm/day. Local rain and runoff from the rain catchment area are sufficient to meet water, and even excessive needs which are usually wasted in the rainy season. Some rainwater seeps into the soil and is stored as groundwater. Runoff and groundwater are potential enough to be used in critical situations. River water and reservoir water are distributed through irrigation networks regularly and need high discipline in applying water management rules, especially in technical irrigation systems. The aim of increasing the efficiency of the irrigation system is to inhibit the decrease in the volume of water in the reservoir and to regulate the limited flow of river water to expand the planting area in the dry season. SPMAA Islamic Boarding School.

**2. Build Embung**

This field reservoir (embung) is made close to farmers' rice fields, to collect excess rainwater in the rainy season. High rainfall intensity in a short period during the rainy season is accommodated in paddy fields. Water runoff is wasted. Ponds in the 4-5% area of ​​rice fields or reservoirs will supply runoff water, can be used to moisturize the soil during the dry season if rainfall does not adequately meet the needs of plants. The area of ​​embung catchment with the size and capacity of water depends on the runoff coefficient, and this determines the planting area that can be irrigated efficiently. Water in this field reservoir can be utilized in the dry season so that it reduces the lack of water for plants. This embung technology has been carried out in Lamongan.

**3. Using Ground Water**

More than 15% of fresh water is stored as groundwater. To a certain extent, this groundwater can be used to meet water needs in the dry season. If the user is not excessive, the use of groundwater is entirely rational, because rain always occurs and is generally excessive in the rainy season. The problem of reducing groundwater in the dry season can be replenished in the rainy season. This is a change in the surface of the freshwater In the dry season it falls and rises again in the rainy season. Excessive use of groundwater can have adverse consequences, especially in areas near the coast which cause the possibility of seawater intrusion.

**4. Pompanization**

Pompanization is one of the effective ways to support the continued crop production system of food crops. This pumping business is considered to benefit farmers through increasing productivity and cropping intensity and absorbing labor. Pompanization is also needed to lift water from steep and deep rivers.

**5. Adjusting the Cropping Pattern**

The risk of drought can be reduced by adjusting the cropping pattern with periods of surplus and water deficit. According to Wisnubroto and Attaqy (1992), setting a good cropping pattern should be able to predict the occurrence of drought, so that the effort that can be done is:

**a. Rice-paddy-fallow cropping pattern**

For paddy fields with the rice-paddy-rice pattern, the second paddy can be replaced with secondary crops or fixed-paddy rice with a shift overlapping pattern. When the first rice was more or less 20 days before the harvest, the second rice was distributed to the nursery. Immediately after the first rice was harvested, the soil was immediately prepared for the second rice plant. Thus if the rainy season stops early 20-30 days, the second rice plant does not experience water shortages.

**b. Rice-palawija-palawija cropping pattern**

 For paddy fields, rice-palawija-palawija cropping, the second crop is better removed, so there is no loss in the form of production facilities and labor.

**c. Annual plants**.

 For young plants, mulch is given enough to reduce evaporation from the ground.

In agriculture, male santris are taught to grow rice, vegetables, and rosella plants. They were taught starting from how to plant, fertilize, weed the grass, and the final stage of harvesting. The land used island belonging to the SPMAA boarding school in the pesantren environment. This land is used to grow rice and vegetables in the dry season, while during the rainy season the land is used as a fishery/pond. The products of the santri plants are of course used as daily necessities for all santri in the pesantren environment. In agriculture, the female center is almost the same as skills education for male santri, which is taught how to grow rice, vegetables, spices, and medicinal plants. The results can be used for the needs of the santri themselves. The needs of food and natural medicines for all residents of the majority of SPMAA Islamic boarding schools come from the activities of the center whose results can be utilized. The purpose of the life skill is that santri can have expertise in a field that can later become a provision if the santri has graduated.

**6. Drilling artificial** wells to areas or points of drought area, socializing to the community to make rain-fed wells in their respective homes and assisting people who experience drought by distributing water to areas that experience drought.

**7. Making bio pore holes,** both carried out in Islamic boarding schools and with the surrounding community to collaborate in making bio pore holes.

**4. Conclusion**

This study concludes that the SPMAA Islamic Boarding School undertakes disaster management efforts, namely the disaster management model for pesantren-based drought hazards. First, the SPMAA Islamic Boarding School is one of the eco-pesantren models in Indonesia. Second, geographically located in drought-prone areas. Third, the drought disaster management strategy carried out by the Lamongan SPMAA boarding school implements operational strategies, while the operational strategies were undertaken as follows; (1) Building Reservoirs, (2) Building Embankments, (3) Using Ground Water, (4) Building Ait soil, (5) pumping, (6) adjusting Soil Patterns, (7) drilling wells made, (8) Making Making Biopori hole.

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