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Revitalization model of tapioca industry through environmental awareness reinforcement for minimizing water body contamination

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Abstract. Tapioca industry in Margoyoso District is a household industry which positively contributes to the growth of the region's economy as it is able to absorb 6,61% of productive age population or absorb 3,300 workers. On the other hand, the industry impacts contamination of river water in the form of pollutants dissolved materials and particulates into water bodies so that the quality of water decreases even does not work anymore in accordance with the allocation for irrigation or run off of agriculture. The purpose of this research is to: strengthen environmental awareness; calculate the success of the reinforcement action and minimize water body contamination. The research was conducted in two villages of tapioca industry center in Margoyoso district - Pati Regency Administration Area. The determination coefficient of R Square is 0.802 which indicates a successful effort of 80.2%. Regression equation $Y = 34.097 + 0.608 X$. Industrial entrepreneur's concern increased on 8.45 from total indicator or position to 70.72 so that the gradual effort showed success to minimize water contamination of Suwatu River. The business community of tapioca should build installation of wastewater treatment.

1. Introduction

Human activity in space leads various forms of human reciprocal relationships which affect the environment, and humans are also affected by the environment of their surroundings. Human existence in a space reflects the existence of a carrying capacity of good environment. In this condition, the essence is human has an environmental caring behavior, because humans have directly geographical relationship with the environment where they live. Environment care is a positive behavioral part of the action resulting from an understanding of the environment that reflects the functioning of the constituent elements of the environment. The quality of the environment depends heavily on human cares, although often the awareness rise due to human dependence on the total environment that degraded due to human behavior itself. Considering humans are the dominant environmental component because humans always use the environment by way of processing, taking and developing, not even a little that damage the environment.



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Naturally the environment has the ability to restore its conditions which called environmental carrying capacity, but if the pollutant be accumulated continuously in the environment, it cause accelerate the degradation process at a given period which according to the interaction of environmental components [1]. In a mature level cause environmental degradation that potentially remove one or more species of organisms that had been living normally in the environmental order [2]. Furthermore it can be called environmental degradation caused by human that causes direct or indirect change to its physical and or biological nature which cause the environment does not work anymore in order to support of sustainable development [3].

In the case of brownish-white color with odor smelling in the Suwatu River, Pangkalan River, and Pasokan River that be distribute in the Margoyoso sub-district, indicates a decrease of water quality that affects the priority entrepreneur due to the sewage of tapioca industry is not managing yet before entering the water body. Although 269 units of tapioca industry in this sub district positively contribute to regional economic growth because it is able to absorb 6.61% of productive population or absorb 3,300 labors [4].

Contamination of river in the form of pollutants dissolved materials and particulates mix up to water body which the river water is cloudy, white, and odor [5]. According to Lutfi [6], causing the change of chemical, bacteriological and physical structure of water so that the quality of the water declines and moreover does not work anymore, Effendy [7] as allocation of agriculture irrigation or run off. The contamination is greatly impact for the local community. At the study are there has occurred contaminate at level 2 of 4 criteria by WHO [8], that is causing disturbance to the component of river ecosystem (Figure 1). Substances that precipitate reduce the inclusion of light, will suppress the growth of algae and kill the plant roots. Sludge sediment will cause the current to change and eliminate the species in the bottom. Substances that precipitate can clog the gills and cause fish be suffocate. Severe organic pollutants cause deoxygenation in the absence of bacterial decomposition activity. Contamination due to the influence of sewage from the tapioca industry did not undergo prior processing before it was discharged into water bodies causing toxic substances dissolved and carried into the waters of the Suwatu River which stretched along the village to the east strive the sea (Figure 2).

The existence of tapioca industry has a history that cannot be separated from the culture of local-knowledge of inheritance of hereditary skill to make tapioca flour (in local terms called *tepungpatior kanji*). So that the existence of tapioca industry continues from generation to generation and form community sentiment that combine with daily life as a fundamental occupation. The tapioca industry is a labor-oriented upstream industry (man power oriented industry) located in settlement center location because this type of industry requires many workers to be more effective, and efficient. In addition, the industry is also oriented on raw materials (supply oriented industry) of cassava to reduce transportation cost.

Environmental pollution results in adverse effects on humans, animals, plants affecting the various living systems that are at the core of environmental issues. In the tapioca industry center area, revitalization is needed to minimize contamination through strengthening awareness or increasing the role of tapioca industry owner. According to Leininger [9] caring is a feeling directed towards others, and that is what motivates and gives the power to do actions, and influence lives constructively and positively, by increasing closeness and self-actualization with each other. Furthermore, there are four stages of caring, namely: attachment, assiduity, intimacy and confirmation. Each stage is achieved by fulfilling the needs task well. Concern will be dysfunctional or inhibited, if one or more needs are not be fullfiment. Caring is a behavior, refer to Azzet [10]: actions that always try to prevent damage of river ecosystem and its surroundings, develop efforts to restore river functions can be utilized sustainably. Revitalization to minimize water contamination refers that is not something that is only

oriented to the completion of physical beauty alone, but also must be equipped with improving the economy of society and preservation of existing culture.

2. Methods

The research was conducted at tapioca industry center in administration area of Margoyoso sub district - Pati Regency. The population of this research is tapioca industry entrepreneur with a number of 269 [4]. The sample proportion is 25% or 68 people. The independent variable is the reinforcement of awareness, and the dependent variable is water body contamination minimizing as **socialization and empowerment**. Data collection is done by observation, interview, documentation, and measurement of river water quality. Field data are used as a basis for revitalization to strengthen the concerns of industrial owners through socialization and empowerment. Data analysis was done by simple regression and product moment correlation that calculated using SPSS for windows 23 support. Spatial analysis use ArcGis 10.1 software resulted in location distribution map of tapioca industry.

3. Results and discussion

The existence of tapioca industry in Margoyoso District - Pati Regency, associate to the location of cassava producers and agglomerate site of agroindustry area that supports the availability of food. Build an integrated system involving human resources, cassava as agricultural products, science and technology tapioca industry, money and market information. The sustainability of this industry is accelerating along with the need of food sufficiency, but it is undeniable that this industry continues to produce waste, such as those affecting water body in the form of liquid waste or sewage. This type and character waste is water (effluent) according to Suprapti [11] cassava skin; Water used cassava peeled washing; Water used wet flour wash, water deposited deposition *aci* (first deposition); and former water of salt solution. The volume of wastewater reaches 12-15 times the volume of cassava processed, with spread extensive impact that is up to the pond area (Figure 1). These conditions need to be balancing by industry owners not only economically oriented but must be paid attention to ecological orientation. The realization of revitalization to minimize water body contamination is described as follows.

The tapioca industry in Margoyoso sub-district is 269 entrepreneurship units that spread in four villages namely Sidomukti Village, NgemplakKidul Village, Tanjungrejo Village, and Waturoyo Village with different proportions.

Table 1. Industry Unit of Tapioca in Di Margoyoso Sub-District [4]

| No. | Village | Unit | Percentage (%) |
|-----|----------------|------|----------------|
| 1 | Sidomukti | 67 | 24.91 |
| 2 | Tanjungrejo | 10 | 3.72 |
| 3 | Ngemplak Kidul | 171 | 63.57 |
| 4 | Waturoyo | 21 | 7.80 |
| | Total | 269 | 100.00 |

Based on published data by BPS [4] it is able to absorb the labors of more than 3,300 people. This condition indicates the number of labor of tapioca industry related to the product and waste produced. Mapping of absolute location distribution is obtained through field activities using GPS be processed in ArcGis 10.1 software can be seen in Figure 1.

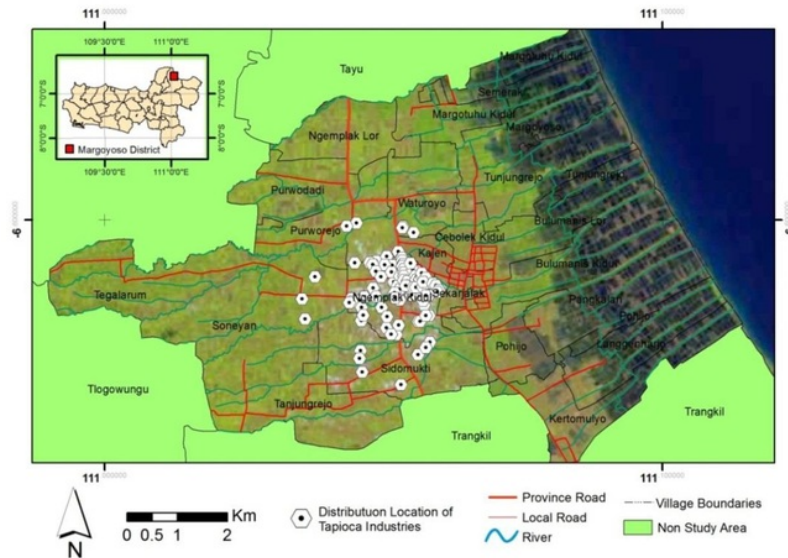


Figure 1. Location distribution map of tapioca industry

Spatial analysis Figure 1 shows that tapioca industry is located near densely populated settlements, besides in this subdistrict there is a river that empties into Java Sea which become dump waste of tapioca such as Bango, Suwatu, Pangkalan, and Pasokan. In this river, tapioca industry entrepreneurs flow their liquid waste/sewage. Indonesian Water Association [12] argues that if effluent is discharged directly into a waters, it consequently disturbs the entire ecological balance and may even lead to the death of fish and other aquatic biota. This opinion reinforces the alerts of Lismanto and Muntoha [14] at least there are two villages affected by the waste, namely Pangkalan Village and Margoyoso Village. Pond farmers in the village complain because milkfish (*chanoschanos*) of about 6,500 that weighted about half ons, dying because the tidal water inundation mixed with tapioca industrial wastewater in local terms is called *lendir* or *elot*.

Related to these conditions the owner of the industry has not been able to enable it to manage the sewage or liquid waste or independently. The unjustified action is that each industry brings a waste outlet to the nearest river.



Figure 2. Conectivity of Tapioca Sewage Outlet to the Nearest River [8]

Consideration of proximity of location with regard to the management of sewage or liquid waste deliberately flowed into the river, it is done to minimize pollution so as not to seep into the wells of the population. The nature of tapioca liquid waste contains vegetable organic substances that quickly decompose if left inundated in the open. Some of the rivers that become dumping liquid waste tapioca include: Bango, Suwatu, Pangkalan, and Paskan empties into the Java Sea by passing ponds owned by residents in the village below.

Revitalization as a model to raise the commitment of industrial owners not only produce tapioca flour products, but also as conservation or nature conservation for acting care that puts back the importance of minimizing water body contamination. Restoration step of the vitality of the industry owner's ability by not neglecting the rescue of water bodies (rivers and ponds) contaminated with slime waste. This research is relatively effective through the following strategies.

Environmental strengthening actions include the participation of tapioca industry entrepreneurs with the creation of storage facilities to precipitate waste as did by pond owners (Figure 3). Slurry of tapioca waste is a waste containing vegetable elements that are easy to decompose. Tapioca waste has concentrations of Biological Oxygen Demand (BOD) is 5 and Chemical Oxygen Demand (COD) is high. This causes the dissolved oxygen content in the water to be low, even completely discharged. As a result oxygen as a source of life for aquatic creatures cannot be fulfilled so that the creature will die [15, 16]. This condition is in line with the opinion of Soeriaatmaja [16] describes contamination due to tapioca waste in open water can cause a change that is polluted.

In the assessment of river water bodies in this location include increased toxic compounds in water and odor carriers that spread out from the aquatic ecosystem itself as well as increasing the degree of acidity expressed by low pH damage the balance of open water ecosystems [17].

The success of the strengthening action, indicated by decreasing the degree of acidity and decreased oxygen demand for microbial decomposition of organic compounds and oxygen demand for chemical processes in water.

Suspended solid in relatively high water, ranging from 3105 mg/L indicates that the precipitation process is not perfect yet. Results of secondary data tracking from Balitbang [18] compared with 5 parameters of laboratory test results showed a decrease, only 1 pH parameter has met the full as stated in Regulation of the Minister of Environment of Republic Indonesia No. 5/2014 [19], ie BOD₅ = 150 mg/ L; COD = 300 mg/ L. Total suspended solids = 100 mg/ L; HCN (cyanide) = 0.3 mg/ L; PH = 6.0 - 9.0 is supported by appendix XIII section A concerning the fruit and/ or vegetable processing Industry performing one type of activity.

Measures to minimize contamination show a decrease (Table 2), has been done by the industry for the separation of starch in the process after the first deposition of about 24 hours, the water is discharged as wastewater and wet tapioca flour which is ready to be harvested, followed by second deposition in the no/ not yet connected to the river. The revitalization test through the strengthening of environmental awareness to minimize water body contamination using product moment correlation which calculated using SPSS 23 for windows shows the significance level of 0.904 with determination coefficient of R Square is 0.802, so it indicates the success of effort equal to 80.2%. The presence or absence of differences between the awareness-raising variables by minimizing water body contamination obtained regression equation $Y = 34.097 + 0.608 X$, the constant of 34.097 states that if there is no value of awareness raising then the contamination value of 34.097 while the regression coefficient X of 0.608 states that each addition of 1 value Reinforcement awareness then the value of water body contamination decreased by 0.608. The importance of revitalization is intended to care for the preservation of the environment by minimizing water body contamination.



Figure 3. The waters of the mixed waste tapioca in the pond area of Pangkalan Village [14]

Table 2. Tapioca Waste Contain

| Parameter | Source | | | |
|-------------------------------|--------|---|------------------------|---------|
| | Aina | | Banowati, <i>et al</i> | |
| BOD5 (mg/L) | 2000 | - | 5000 | 3105.76 |
| COD (mg/L) | 4000 | - | 30000 | 7678.15 |
| Total suspended solids (mg/L) | 1500 | - | 5000 | 3900.05 |
| HCN (mg/L) | 0 | - | 15 | 0.64 |
| pH | 4.0 | - | 6.5 | 6.8 |

The factors affecting the quality of tapioca industrial liquid waste are: large volumes, the contents of pollutants that rapidly decompose after 6 hours, and the frequency of waste disposal is continuous as the tapioca production process. Combined, some related industrial owners create a sewage settling basin before disposal, but most immediately dispose of sewage through ditches/ sewer sanitation that flows into the river. In the domestic scale industry (domestic) this sediment is also used for producing tapioca flour although poor quality is used for feed stock.

4. Conclusion

The increasing ability and development of tapioca industry, the endeavor of environmental management is needed not only be done after the production process but also management is directed by making changes in the production process. The suggestions of the field finding is to emerge the making communal Installation of wastewater treatment by the entrepreneurs in the holding area in order to avoid further impact.

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