Leverage Factors at Red Brick Production Centers in Sinar Tanjung Village, Banjar City, West Java Province

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Abstract. The existence of a certain traditional red clay brick production area has helped to boost the community's economy. Although the sporadic existence of production units, in which many were not established based on a research stage with the concept of sustainable development, has consequently generated environmental damage. Land as a non-renewable natural resource has limited carrying capacity and its utilization needs to be regarded carefully for the present and future generations. This study aims to identify leverage factors that can act as an intervention for better environmental management at the red brick production centers in Sinar Tanjung Village, Pataruman District, Banjar City, West Java Province. The present research is based on the concept of sustainable development triangle (economic, ecological, and social dimensions) incorporated with analysis of Rapid Appraisal for Fisheries (Rapfish) -Multi Dimensional Scaling (MDS) from the results of the assessments of 25 red brick production units. It starts with the identification of sustainability issues to be discussed, determination of the analysis unit and attributes, data entry, and Rapfish analysis to determine the area’s sustainability status and leverage factors. The results showed that red brick production centers were not yet sustainable obtaining a value(64.47). Moreover, the leverage factors identified were: profit transfer (economic dimension), level of air pollution (ecological dimension), the trend of changes in the livelihoods of the local communities (social dimension).

Keywords: Red brick, Production, MDS, Rapfish, Sustainable.

1. Introduction
The production of red bricks in a certain designated area is a hereditary livelihood phenomenon, developing sporadically, often without the esteem of industrial ecological concepts that apply natural ecosystem designs into the industrial system. Thus, such production operates in manners that may not be environmentally friendly and sustainable. This poses a dilemma in that this condition also contributed to the improvement of the community's economy. Yudi Prayoga's research (2018) shows that the existence of the red brick industries has made positive impacts on monthly income, allowing it to be stable and increase steadily. Moreover, the establishment of the production unit uses 80% of the people’s capital enables to improve the quality of education for the children of craftsmen, open job opportunities, reduces unemployment, and thus suppressing the poverty rate. There are, however,
negative impacts that cannot be overlooked, such as the emergence of soil dents which large and deep enough to cause standing waters.

A research by Ria Apriyani and Tuti Mutia (2018) showed that the impact that the red brick industry had on land conditions were as follows: reduced soil fertility, decreased soil quality in storing water, damaged irrigation networks in rice fields, and creates air pollution from the combustion process. Nursia and La Hararudu (2016) found that clay brick mining resulted in environmental degradation that was indicated to have a moderate category level of damage, marked by changes in soil topography and the absence of new soils used to replace the soils taken as a material.

However, there are studies that highlight brick manufacturing that simultaneously minimizes disturbance or influence on the environment, such as the research conducted by I Ketut Sudarsana, Ida Ayu Made Budiwati, Yohanes Angga Wijaya (2011). This research provided information that bricks made from rice husk ash and scoria powder that did not undergo firing had a compressive strength of 22.90/\text{kg/cm}^2 and the smallest water infiltration of 44.0 %. The finding proves that it is possible to not use clay and use other alternative materials instead to make bricks or red bricks that do not require burning. Furthermore, Putranto and Wati (2019) had proposed an economic estimate where making red brick originating from foundry and paper wastes without burning process can provide benefits in waste management. These previous research results indicate that the production process of red brick that uses clay has a high influence on how natural resources be managed as it possesses implications towards the human’s environment and thus its survival also. After all, land as a non-renewable natural resource has limitations both in its supporting capacity and carrying capacity. Poor management will undoubtedly affect the survival of future generations. Mundiatun and Daryanto (2015) stated that the failures in environmental management are manifested in the aspects of harmony and balance between humans and the environment, ensuring the interests of the present and future generations, environmental preservation, as well as wise use and control of resources.

Understanding sustainable development needs careful attention in order to help overcome problems caused by the red brick production center and how its abounding economic movement had become a bigger priority than the sustenance of its surrounding environment. Beyond doubt, the existence of red brick production centers should consider the value of being environmentally friendly as per the needs of the current generation, and not endanger the opportunities of the future generations. Philip Kristanto (2013) argued that the development of policies on economic, ecological, and social aspects need to be paid attention to in such a way that both can exist synergistically and mutually reinforce one another. Serageldin (1996) in Albert Napiputulu (2013) provided a further explanation in the concept of sustainable development. A sustainable development triangle exists, integration of ecological, economic, and social perspectives or approaches. Therefore, this study focuses more on the search for leverage factor in the red brick production centers based on this concept of sustainable development triangle using analysis Multi Dimensional Scalling (MDS)

2. Research Objectives

The purpose of this study is to find leverage factors of red brick production centers in Sinartanjung Village, Pataruman District, Banjar City, West Java Province based on the concept of sustainable development triangle. It is hoped that these factors can be used as consideration in the intervention within environmental management, in line with the concept of the development of sustainable area as presented below:
3. Method and Analysis

The research on the sustainability of the red brick production centers/area in Sinartanjung Village, Pataruman District, Banjar City, West Java Province was carried out through an assessment of the environmental conditions from economic, ecological and social dimensions. Assessment of the management of red brick production in the area was carried out on 25 red brick production units that were sampled. The assessment encompassed the attribute review stage covering various categories and scoring criteria, identification and determination of sustainability based on a set of consistent criteria, scoring of the area to construct reference values of good-bad and anchor, multi-dimensional scaling for each attribute, uncertainty analysis, and anomaly analysis (leverage factor), determination of the sustainability status of the area and determination of the leverage factors.

The analysis technique used was Rapid Appraisal for Fisheries (RAPFISH) - Multi Dimensional Scaling (MDS) with Microsoft Excel. In this research, several variables were to be determined as attributes that can be used as leverage factors. The determination of attributes or indicators was done in the consideration and relation to the dimensions being looked into. Referring to Akhmad Fauzi (2019), regarding the prerequisites that should be met in the use of the MDS technique to avoid errors in measurement, scoring, and interpretation of results, the attributes should fulfill the principle of rapid appraisal (easy to rank and objective), in which the number of attributes of the economic dimension was 9, attributes of the ecological dimension was 9, and attributes of the social dimension were 8 (no less than 6 attributes). The number of units analyzed was 25, as per the recommendation that the amount should be 2-3 times the number of attributes. The selected attributes would allow for the construction of extremely good and bad scores and a determination for documented scoring basis. The main source of the scores came from Peer-Review Scoring, a score based on a review of scientific documents by determining a threshold; Gray Literature, a score based on the results of previous analyses, published or not; and Expert Judgment, namely the determination of scores made through the agreement of experts, either through Focus Group Discussion (FGD) or other methods such as Delphi (Akhmad Fauzi, 2019). The assessments of the red brick production units were based on observations, interviews, and Focus Group Discussions (FGD) of representative community leaders, the persons in charge of red brick production units, as well as...
their craftsmen monitored by officials from the Banjar City Environmental Service. The Multidimensional Scaling Procedure (MDS) was adapted from Albert Napitupulu (2013) as presented in Figure 2 as follows:

![Multidimensional Scaling Procedure](image)

**Figure 2.** Multidimensional Scaling Procedure.

### 4. Results and Discussion

Sinartanjung Village, Pataruman District, Banjar City, West Java Province is one of the villages/sub-districts with 50 traditional red brick production units, the largest in Banjar City. Annually it produces no less than 8,350,000 red bricks, involving a workforce of 109 people, a production area of 7,087 m². The village area of 691.16 hectares is divided into 84.8 ha of rice fields, 199.26 ha as dry land, 399.15 ha of plantation land, and 7.95 ha of public facilities. The area based on sub-villages (hamlets) consist of Pananjung 185.64 Ha, Pananjung Barat 62.2 5 Ha, Pananjung Timur 82.15 Ha, and Sinargalih 361,12 Ha. The area is located at 25 m above sea level, the rainfall is 2,000 mm with 8 rainy months, an average daily temperature of 32⁰C, total population of 4,164 people (male = 2.064 people, female = 2.100 people), 1,529 households, and a population density of 602/km. Furthermore, the number of individuals in the area in the primary education level (SD-SLTP) is 2,265, secondary education level is 557, and higher education (D1 =2, D2 = 13) is 15 individuals. Clean water for the population is sourced from: 931 units of dug wells, 23 units of pump wells, 2 springs in good condition, and 1 river that passes through the area. There are 1,054 houses, 865 of which are permanent and 189 are semipermanent (made from bamboo and woods). Based on the type of flooring used in the houses, 1034 houses use ceramic/cement and 20 houses that use wooden floor/soil. Employments include farmers at 160 people, 291 people are self-employed, 451 people are casual daily laborers, 90 are traders, 200 are private employees, 28 are retirees, 60 are civil servants, and 5 people in the military. The village has a state budget of IDR 4,362,768,800. - in which is sourced from the City state budget as much as IDR 112,711,000, District/City Government Assistance as much as IDR 70,000,000, Provincial Government Assistance as much as IDR 115,000,000. - Central government assistance as much as IDR 980,195,000. -, the Village’s income as much as IDR 286,108,800. -, the Village small and medium enterprises as much as IDR 222,200,000. -, Village Fund Allocation as much as IDR 2,573,554,000. -, sponsors from companies in the village as much as IDR 3,000,000. The budget is used for public expenditure costs/development expenditure is IDR 3.419,110, and personnel/employee expenditure is IDR. 729,964,000. - (Profile of Sinartanjung Village, Pataruman District, Banjar City Year 2018).
4.1. Attribute review

The attributes for each dimension were determined based on their relevance/relationship with the three dimensions to avoid any mistakes. The numbers of attributes were determined set to be more than six according to the required rules. The economic dimension consisted of: 1) Availability of raw materials at the production centers, 2) Trend of selling price of red bricks, 3) Marketing of products from the production centers, 4) Transfer of profits from the red brick production centers to the surrounding community, 5) Contribution of income of red brick production centers to the village budget (last 5 years), 6) Contribution of the existence of red brick production centers in improving the quality of life and welfare of local communities, 7) Social welfare funds based on regulations allocated from the income of red brick production centers for the community around, 8) Environmental improvement funds allocated from the income of the red brick production center for the surrounding environment, and 9) The average income of workers in the red brick production centers in reference with the city minimum wage (UMK).

The ecological dimension consisted of: 1) The level of land use for the existence of red brick production centers, 2) Utilization of chemicals in brick production activities, 3) Availability of water resources for the needs of red brick production centers, 4) Level of water pollution due to brick production activities, 5) Level of soil pollution due to brick production activities, 6) Air pollution due to brick production activities, 7) Noise level due to the production of red bricks, 8) Percentage of green open space/RTH to land used by red brick production centers, and 9) Quality of community housing around the red brick production centers.

The Social Dimension consisted of: 1) The influence of company existence on the local social and cultural values, 2) The response of the local community to the existence of red brick production centers, 3) The trend of change in livelihoods of the local community due to the existence of red brick production centers, 4) The ratio of labor to the presence of red brick production centers, 5) Average education level of the local community as influenced by the existence of red brick production centers, 6) Health status of the local community with the presence of red brick production centers, 7) The frequency of conflicts that arise in the local communities on the existence of red brick production centers, and 8) Community participation in environmental management as influenced by the existence of red brick production centers adapted from Albert Napitupulu (2013). Identification and determination of sustainability based on a set of criteria.

The sustainability of the red brick production area through the perspective of economy means that there must be a condition that can result in economic growth, capital maintenance, efficient use of resources, and investment. Ecologically, sustainability implies maintaining ecosystem integrity, environmental carrying capacity, and conserving natural resources including biodiversity. Meanwhile, socially, sustainability is interpreted as a condition that can create equitable development results, social cohesion, social mobility, community participation, community empowerment, social identity, and institutional development. The sustainability criteria for the area are stated as follows: a score <50 means unsustainable, a score of 50-75 means it is not yet sustainable and a score> 75 means sustainability (Mersyah 2005, CSD (2001) and Kavanagh (2001) in Albert Napitupulu (2013).

4.2. Scoring

Assessment of the sustainability of the area using the MDS technique relies heavily on the scoring approach of each attribute. The critical point lies in the attribute chosen to be ranked on each dimension, hence, consensus regarding the attribute valuation is a crucial point. The accuracy of the data held, the capabilities of the participants involved in the FGD as well as the person in charge/brick craftsmen who were interviewed are the determining factors that need careful must receive careful attention to produce a decisive agreement or decision. Incomplete knowledge or analysis of the red brick production centers, misunderstandings regarding the attributes and scores, and data retrieval errors can all be avoided to achieve a decisive selection of attributes. The attribute rating scale for each dimension as a view or perception data was presented as 0-10 and the area sustainability category score was 0-100.
4.3. Leverage factor analysis
Principally, leverage factors detect the dominant attributes, known as obtaining the results of the assessments of all attributes. They reflect how much the leverage factor attributes contribute to the final value, which would later be looked into as a consideration for better environmental management. Leverage values range from 2% to 6% of the Root Mean Square change (Akhmad Fauzi, 2019). The results of the assessments of each attribute on each dimension are based on the Sustainable Development Triangle as presented in tables 1, 2, 3:

| Attribute | Scale | Run RAPFISH VALUE | Result |
|-----------|-------|-------------------|--------|
| Availability of raw materials | 9.50 | | |
| Production commodity price trends | 1.16 | | |
| Product marketing | 4.08 | | |
| Profit transfer | 1.44 | | |
| Contribution to Village Own Source Revenue (last 5 years) | 4.4 | | |
| Contribution to the improvement of the quality of life and welfare of local communities | 1.44 | 1,435.636 | 57.42 | The area is not yet sustainable (score is in the 50-75 score range) |
| Social welfare funding based on the existing regulation | 1.52 | | |
| Environmental improvement funds | 0.4 | | |
| The average income of workers in the red brick production center compared to the minimum wage (UMK) | 1.24 | | |

*Processed from research data in 2019*

The total value of the assessments of the nine attributes of economic dimensions in 25 red brick production units based on the Run Rapfish analysis was 1,435.64, and hence the sustainability status of the red brick production centres based on the economic dimension obtained a value of 57.42 (average value). After being conferred with the criteria for sustainable areas, the results indicated that the area was in the unsustainable category. Rapfish Ordination as a data distribution tracking is presented in Figure 3 as follows:
Figure 3. Rapfish Ordination of the Economic Dimension. Source: A 2019 study processed with Rapfish application version 3.0 (Run Rapfish).

Figure 4. Leverage Factors in the Economic Dimension.

The leverage factor of the economic dimension lies in the attribute of the profit transfer. The leverage of attributes is shown in Figure 4.

Table 2. Assessment Results of Attributes of The Ecological Dimension.

| Attribute                                      | Scale | Run RAPFISH VALUE | Result                          |
|------------------------------------------------|-------|-------------------|---------------------------------|
| Land use rate                                  | 0.52  |                   |                                 |
| Use of chemicals                               | 9.16  |                   |                                 |
| Availability of water resources                | 1.52  |                   |                                 |
| Water pollution level                          | 1.36  | 1,280.60          | Area is not yet sustainable     |
| Soil pollution level                           | 1.60  |                   | (score is in the 50-75)         |
| Noise level                                    | 8.24  | 1,280.60          | 51.22                           |
| Air pollution level                            | 0.48  |                   |                                 |
| Percentage of green open space / RTH           | 0.56  |                   |                                 |
| The quality of housing in the surrounding community | 0.92  |                   |                                 |

Processed from research data in 2019

The total value of the results of the assessment of 9 attributes of the ecological dimensions of 25 red brick production units based on the Run Rapfish analysis was 1,280.60. Thus, the sustainability status of the production centres on the ecological dimension was valued at 51.22 (average value). When conferred with the sustainable area criteria, the result implies that the area was sustainable. Rapfish Ordination as a data
distribution tracking is presented in Figure 5. The leverage factor of the ecological dimension lies in the attribute of Air pollution level. The leverage of attributes is presented in Figure 6.

Figure 5. Rapfish Ordination of the Ecological Dimension. Source: A 2019 study processed with the Rapfish application version 3.0 (Run Rapfish).

Figure 6. Leverage Factors of the Ecological Dimension.

| Attribute                                      | Scale | Run RAPFISH VALUE | Result            |
|------------------------------------------------|-------|-------------------|-------------------|
| Influence on local social and cultural values  | 3.16  |                   |                   |
| Local communities’ response                    | 7.48  |                   |                   |
| Trends in changes in local people’s livelihoods| 1.36  |                   |                   |
| Labor ratio                                    | 2.12  |                   |                   |
| Average education level of the local community | 1.84  |                   |                   |
| Local community health status                  | 2.96  |                   | Sustainable Area  |
| Frequency of conflicts within the local communities | 7.68  |                   | (Score>75)        |
| Community participation in environmental management | 1.44  |                   |                   |

Processed from research data in 2019

The total value of results of the assessments of 8 social dimension attributes in 25 red brick production units based on Run Rapfish analysis was 2,199.36. The production of red brick based on social dimensions was valued at 84.77 (average value), when conferred with sustainable area criteria, the area...
was classified as sustainable. Rapfish Ordination as a data distribution tracking material is presented in Figure 7:

![Rapfish Ordination](image)

Figure 7. Rapfish Ordination of the Social Dimension. Source: *Research results in 2019 processed with the Rapfish application version 3.0 (Run Rapfish)*

The leverage factor of the social dimension lies in the attribute of the changes in livelihood trends of local communities. The leverage of attributes is presented in Figure 8 as follows:

![Leverage of Attributes](image)

Figure 8. Leverage Factors of the Social Dimension.

The total value of the analysis of the sustainability of the red brick production area based on the concept of sustainable development triangle (economic, ecological and social) was 193.41, inferring an average of 64.47. If compared with the sustainability criteria the area can be categorized as unsustainable. The leverage factors were the attributes of social welfare funds based on the existing regulations from the economic dimension, air pollution levels from the ecological dimensions as well as changes in trends of livelihoods of local communities from the social dimension.
5. Conclusion
The research objective was achieved as the sustainability and leverage factors at the red brick production centers in Sinartanjung Village, Pataruman Subdistrict, Banjar City, West Java were successfully identified based on the Sustainable Development Triangle analysis. The area, at a value of 64.47, can be classified as unsustainable, whereas the leverage factors that can be taken into consideration when action on an intervention to achieve better environmental management and used as a framework to formulate strategies or policies to establish a sustainable development of an area are as follows: a. Leverage factor from the economic dimension. An effort that must be made by the red brick production units is to increase profit transfer, meet the needs of the craftsmen and the community around the production units; b. Leverage factor from the ecological dimension. The level of air pollution should be suppressed to a minimum, so as not to not cause health problems and help foster a sense of comfort in the community around the production centres; c. Leverage factor from the social dimension. Production units should strive to intensify the trend of changes in the livelihoods of local communities, gradually improve the standard of community economic life without disturbing the stability of local social and cultural values.

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