Effectiveness and Efficiency as a Tool of Measurement of Waste Bank’s Performance

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Abstract. The objectives of the study are to measure the efficiency and effectiveness of waste bank as an informal institution in waste reduction. The research was conducted in five waste banks located in Batu District, Batu City. Survey concerning waste bank performance was conducted for about 5 months. The questionnaires were distributed during the survey for effectiveness assessment, while in-depth interview was conducted on waste bank staffs for attaining waste bank characteristics. Overall Equipment Effectiveness (OEE) and Elasticity index were used to measure the waste banks’ effectiveness and efficiency respectively. The waste bank performance was determined by these two parameters. The results showed that all waste banks have low effectiveness indicated by the value of OEE lower than 60%. Meanwhile, the elasticity index varied among the waste banks from 0.57 to 2.74 representing low or high efficiency. Thus, the waste banks’ performance in Batu District was either low or moderate depending on the combination of the two above parameters.

Keywords: Waste-Bank Performance, Effectiveness, Efficiency.

1. Introduction

Local government is the main authority in dealing with solid waste management effectively and efficiently from the residents [1]. The Local Authorities have to emphasize more on waste reduce household waste [2]. One of the informal waste sectors that are able to reduce waste is waste bank. Waste bank is a collective waste management focusing on waste separation and recycle aiming to increase waste value and to involve community. It is one of the efforts to reduce domestic waste. Some previous studies showed that it may attract public involvement for its promising profit and its ability to reduce waste transporting to the landfill [3, 4]. Waste management through waste bank can reduce the negative impact of landfill for its methane emission to the atmosphere and infiltration of leachates into the soil. However, most existing waste bank lack the capability to operate the business professionally in order to optimize the profit for the members. This had an effect seeing the low performance of the waste bank. [5] Explained that performance is the achievement of an organization based on its responsibility that is carried out efficiently and effectively.

Furthermore, [6] defined waste bank’s efficiency as a ratio of marginal product value to average waste production, while waste bank’s effectiveness is a measurement representing the target achievement set by the waste bank indicated by OEE value. The same approach was also used by [7]. Waste bank’s efficiency and effectiveness was used to measure waste bank’s performance according
Waste bank’s performance may also be measured using the ratio between waste volume treated in WB with total volume of municipal solid waste [9].

2. Methods

Analysis of Overall Equipment Effectiveness (OEE) and elasticity index are used to measure waste bank’s effectiveness and efficiency respectively. The independent variables required for both measurements are presented in Table 1.

Table 1. Variables used in the measurement

| No. | Variables          | Reference |
|-----|--------------------|-----------|
| 1.  | Income             | [6]       |
| 2.  | Number of active members |       |
| 3.  | Availability       |           |
| 4.  | Quality            |           |
| 5.  | Performance        | [7]       |

Effectiveness is measured based on the OEE value showed in Table 2. The value indicates that the higher the OEE value is, the better the effectiveness of waste bank will be.

Table 2. Reference for OEE Value indicating Effectiveness

| OEE Value | Remarks                                | Effectiveness |
|-----------|----------------------------------------|---------------|
| If OEE= 100% | Outstanding. WB generates significant impact to programs, rapid performance, no downtime. | High          |
| If 85% ≤ OEE <100% | Good. The scope of service is national wide.                  | Moderate      |
| If 60% ≤ OEE <85% | Moderate. WB’s performance is average but there are spaces for improvements. | Moderate      |
| If 40% ≤ OEE <60% | Marginal. WB has low score but it can be improved easily through direct measurements. | Low           |
| If OEE< 40%  | Low. WB has very low score and requires much efforts to improve it.                       |               |

Source: [6]

Efficiency is measured as elasticity index calculated on monthly basis. The value is compared with indicators value presented in Table 3.

Table 3. Elasticity index of waste bank

| Elasticity index | Remarks                                                                 | Efficiency |
|------------------|-------------------------------------------------------------------------|------------|
| > 1              | More members of WB will increase the profit for its capability to generate more outputs | High       |
| = 1              | Average productivity of members are maximum that the condition can be maintained to maintain the sustainability of the program | Moderate   |
| < 1              | Members are required to be more empowered to sustain or to improve the average productivity towards the program | Low        |

Source: (Kristina, 2014)

Combining the value of effectiveness and efficiency generates WB’s performance which are categorized into 9 groups presented in Table 4 [9].
Table 4. Matrix for measurement of waste bank’s performance

| Effectiveness | High Efficiency | Moderate Efficiency | Low Efficiency |
|---------------|----------------|--------------------|---------------|
| High Effectiveness | High Performance | High Performance | Moderate Performance |
| Moderate Effectiveness | High Performance | Moderate Performance | Low Performance |
| Low Effectiveness | Moderate Performance | Low Performance | Low Performance |

Source: Sudibyakto & Priatmodjo (2016)

3. Result and Discussion

3.1. Waste bank’s efficiency

WB’s efficiency is reflected by its monthly elasticity calculated using income and number of active members. The result of the calculation is showed in Table 5.

Table 5. Value of waste bank’s efficiency

| Waste Bank       | Elasticity Index | Remarks | Efficiency |
|------------------|------------------|---------|------------|
| Kartini Mandiri  | 0.57             | E < 1   | Low        |
| Saras Asri       | 1.13             | E > 1   | High       |
| Cahaya           | 0.96             | E < 1   | Low        |
| RW 03 Krajan     | 2.74             | E > 1   | High       |
| Kampung Damai    | 1.20             | E > 1   | High       |

According to Table 5, Kartini Mandiri and Cahaya waste bank have value of E lower than one (E<1), indicating that its members should be more empowered to maintain or to increase their average productivity in WB’s programs. Low efficiency is caused by low income and instable number of members. For example, low elasticity of Kartini Mandiri was caused by significant decrease of member’s marginal product. The calculation showed that the addition of one active member will decrease waste value of Rp 64,700 and Rp 64,500 in the 15th and 19th round respectively. Member’s marginal product decrease leads to elasticity index to -4.26 and -4.16 in respective round. Therefore, member empowerment is necessary to increase the average productivity leading to higher efficiency. Meanwhile, Saras Asri, RW 03 Krajan, and Kampung Damai have value of E higher than one (E > 1). In this case, addition of members will profit from WB because it contributed to more output as the average productivity rose. High efficiency of the three WBs was mainly caused by steadily increasing income and number of members every round.

3.2. Waste bank’s Effectiveness

Waste bank used the Overall Equipment Effectiveness (OEE) formula to measure WB’s effectiveness that described targeted achievement of WB based on quantity, quality, and time [6]. Three parameters, availability (A), performance (P), dan quality (Q) were calculated to generate the OEE value. Table 6 presents the result of each parameters as well the OEE value. According to Table 2, the effectiveness parameter was predetermined.
Table 6. Determination of WB’s effectiveness based on OEE value

| Waste Bank          | A   | P   | Q   | OEE | Effectiveness |
|---------------------|-----|-----|-----|-----|---------------|
| Kartini Mandiri     | 92% | 78% | 33% | 24% | Low           |
| Saras Asri          | 88% | 68% | 50% | 29% | Low           |
| Cahaya              | 67% | 59% | 33% | 39% | Low           |
| RW 03 Krajan        | 100%| 55% | 100%| 55% | Low           |
| Kampung Damai       | 33% | 65% | 50% | 24% | Low           |

Table 6 indicates that all WBs are categorized into WB with low effectiveness since the value of OEE is lower than 60% comprising of low and marginal group.

3.3. Waste bank’s Performance

Referring Table 5, Table 6, and Table 7 as well, WB’s performance was measured and the result is presented in Table 7. WB in Batu district has various value of elasticity index and OEE. However, the measurement of WB performance based on these values come to the result of two main group of WBs based on its performance i.e. low and moderate. The average WB’s performance is moderate.

Table 7. Matrix of WB’s Performance in Batu District

| Waste Bank          | Elasticity | Efficiency | OEE  | Effectiveness | Performance |
|---------------------|------------|------------|------|---------------|-------------|
| Kartini Mandiri     | 0.57       | Low        | 24%  | Low           | Low         |
| Saras Asri          | 1.13       | High       | 29%  | Low           | Moderate    |
| Cahaya              | 0.96       | Low        | 39%  | Low           | Low         |
| RW 03 Krajan        | 2.74       | High       | 55%  | Low           | Moderate    |
| Kampung Damai       | 1.20       | High       | 24%  | Low           | Moderate    |
| Mean                | 1.32       | High       | 34%  | Low           | Moderate    |

4. Conclusion

Performance of the five WBs in Batu District was measured and the three of them have high efficiency (Sarah Asri, RW 3 Krajan, Kampung Damai) and two WBs have low efficiency (Kartini Mandiri and Cahaya). However, all WBs have low effectiveness which were caused by low availability (the actual time compared to the planned operational time), low performance (capability of WB staffs), and low quality (number of implemented programs over the planned programs). Meanwhile, high efficiency was caused by steady income and stable number of members. In conclusion, WBs in Batu district have moderate performance with high efficiency and low effectiveness.

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