The Potential Analysis of Sugarcane Litter Management With Mechanization In Sugarcane Plantation Takalar Sugar Factory (PG Takalar) South Sulawesi

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Abstract. Sugarcane plantation of Takalar (PG Takalar) have big potential organic waste alike sugarcane litter. Sugarcane litter is organic waste that could be processed into organic fertilizer in form of compost. The objectives of this study were to determine the potential of sugarcane litter and to determine the machinery requirement for sugarcane litter management in PG Takalar. The result showed that the average availability potential of sugarcane litter in PG Takalar was 19.96% or 20% from each stem of sugarcane. In total, with 4186 ha area of PG Takalar, the potential of sugarcane litter was 32860 ton/year. Nowadays, in PG Takalar, the management of sugarcane litter is done conventionally by burning the litter in the field. It is also found from the study that to manage the sugarcane litter in 4186 ha area, the number of machinery needed to support the mechanization of sugarcane litter management were 48 units of tractor, 13 units of trash rake, 31 units of trailer, 4 units of applicator, 18 units of chopper, 3 units of truck, 3 units of composting turner, and 3 units of loader.

1. Introduction
Takalar PG was built with a grinding capacity of 3000 tons of sugar cane per day and increased to 4000 tons. Plantation land is a former secondary forest and rice field, generally a type of mediterranean and grumosol soil. Climate conditions with an average of 5-6 months for dry months and wet months 5-6 months. Has an area of Cultivation Right (HGU) covering an area of 9967.04 ha spread over 3 (three) districts: Gowa district 1996.86 ha, Takalar district 6550.21 ha and Jeneponto district 1419.97 ha. PG Takalar has plantation land which is at an altitude between 45-125 m above sea level [1].

The performance of PG Takalar from 1989-2011 shows that the area of sugar cane plantations tends to decrease. This results in a decrease in sugar production from year to year. The peak production occurred in 1994, with a land area of 6500 ha capable of producing sugar of 30852 tons, this was caused by the value of sugarcane yield reaching 9.59%. After that sugar production continued to decline to a critical point which only produced 4179.7 tons or only 13.5% of peak production, this occurred in 2009 where the area of land managed was only 2709.1 ha or about 45% of the potential area of land that could be managed. PG Takalar has the highest sugarcane productivity in 1990, which was 58.4 tons/ha and the lowest in 2009 was 27.1 tons/ha.
Waste from sugar cane processing is a potential material for composting which can be used to increase soil organic matter content. During milling, waste from sugar mills includes: 32% of pulp (percent of sugarcane weight), 3.64% of cuttings in sulfitic sugar mills, and 7.5% of carbonated sugar mills, and 0.3% of ash kettle. In sugar cane land litter can be produced 20-25 tons/ha [2].

The waste of PG Takalar sugar cane plantation is in the form of sugarcane litter left on the land. The sugar cane litter has not been used as raw material for mulch or organic fertilizer. After the sugarcane litter dries, the plantation will burn the litter. The wastes at the sugar cane factory were previously less valuable, but at present the sugar factory wastes have a price, for example: pulp or bagasse for paper mills, molasses for flavoring plants, slices, and kettle ash for organic fertilizer. Waste that has not been used is sugarcane litter, plantations tend to burn it in sugarcane areas, because it is more practical, fast, and inexpensive.

Research on the management of sugarcane litter has been carried out by several researchers such as the use of sugarcane litter for mulch and organic fertilizer. Yadav et al [3] conducted a study that used sugar cane litter to maintain the availability of organic materials for the sustainability of ratoon sugarcane crops carried out in India [3]. Cahaya and Nugroho [4] conducted a study that utilizes sugarcane mill solid waste to be processed into compost. Jiuhao [5] conducted a study of the effect of using sugarcane litter as organic mulch on sugar production in the Guangdong area of Guangzhou, China. Bengtson [6] conducted a study on the effect of the management of sugarcane litter used as mulch on soil erosion and crop production in the southern part of Baton Rouge Los Angeles USA. Goenadi [7] conducted a research on the management of sugarcane litter which is used as raw material for compost. Recently, organic fertilizer (compost) has been considered the heart of organic farming systems [10].

This study aims to determine the potential and requirements of equipments and machines in the management of sugarcane litter in PG Takalar.

2. Materials and Methods

The tools used in this study are: 4 wheel tractor and a set of sugar cane litter technology consisting of trash rake, trailer, litter, hoe, chopper and shovel. The material used in this study is sugarcane sugar cane 4 (R4) TK 386.

2.1. Method of collecting data

The method applied in this study is a quantitative method with primary data collection techniques carried out through direct measurements in the field. While secondary data was obtained from the Research and Development section of PG Takalar and from various parties concerning research problems through literature.

2.2. Analysis of Potential Sugar Cane Litter

Analysis of the potential of sugarcane litter in Takalar PG was carried out by collecting primary data in the form of weight sugarcane litter (sugar cane leaves and shoots). Data was obtained by measuring directly in the field by weighing the sugarcane harvested. Then cut the shoots and weigh again so that you can know the weight of the shoots or litter. Secondary data was obtained from the Risbang section of PG Takalar. The weight of sugarcane litter (sugar cane leaves and shoots) can be calculated with the following equation:

\[
BST = BTTT - BTTP \tag{1}
\]

Where: \( BST \) = Weight of sugarcane litter (kg), \( BTTT \) = total weight of sugarcane (kg) \( BTTP \) = sugarcane weight without shoots (kg).

The potential of sugarcane litter (sugar cane leaves and shoots) is calculated by equation:
PST = % BST * BTTT \hspace{1cm} (2)

Where:
PST = potential of sugarcane litter (kg), BTTT = total weight of sugarcane (kg)
% BST = Weight percentage of sugarcane litter (%).

2.3. Mechanization Analysis of Sugar Cane Litter Management

The analysis begins by identifying the equipment and machines found at the research location. This is useful in the process of selecting equipments and machines used in sugarcane litter management activities. The equation used in determining the number of equipments and machines requirement is:

\[
Ut = \frac{Ls - Lg}{Ka}
\]

Where:
Ut = The number of equipments and machines requirement (unit)
Ls = Targets to be worked on or achieved (ha/year, kg/year)
Lg = Target that is served or achieved (ha/year, kg/year)
Ka = Machine work capacity per unit (ha/year/unit, kg/year/unit)

3. Results and Discussion

3.1. Availability analysis of Sugar Cane Litter in PG Takalar

Sugar cane is a very large source of biomass. Biomass in sugar cane is spread in shoots, stems, leaves, and roots. If the production of milled sugarcane per ha reaches 100 tons/ha and all litter is burned and shoots are transported, the sugar cane will contribute soil organic matter in the form of roots which is left around 16.2 tons \[8\].

The composition of sugarcane biomass is based on the results of research conducted by King \textit{et al} \[8\], sugarcane litter in the form of shoots has a potential of 15% and leaves 21%. This is a great potential that can be used as a source of organic fertilizer raw material.

The results of measuring the potential availability of sugarcane litter at PG Takalar indicate that the average potential of sugarcane litter owned by PG Takalar is 19.96% or about 20% of the weight of sugarcane plants. This is consistent with the results of research conducted in India by Yadav \textit{et al} in Yadav \[3\] which states that the amount of sugarcane litter left on land after harvesting sugarcane reaches 10-20\% of the weight of sugarcane. The measurement of the potential of sugarcane litter is carried out on sugarcane litter derived from sugar cane which has only been harvested or cut down a few times. The litter consists of shoots of sugar cane and sugar cane leaves, both yellow and green.

Potential of sugarcane litter of ratoon plants found in PG Takalar in 1994-2011. The average potential of sugarcane litter in PG Takalar is 9.60 tons/ha. The highest potential of sugarcane litter in PG Takalar was in 1998 which was 13.97 tons/ha, while the lowest was 6.79 tons/ha in 2009. The calculation results show that the potential of sugarcane litter is strongly influenced by the productivity of sugarcane. Sugar cane productivity is directly proportional to the potential of sugarcane litter. In addition, the potential of sugarcane litter is also influenced by the type of sugarcane varieties and the composition of plants found on the plantation. For example, the P3GI succeeded in creating varieties that had advantages in terms of yield potential and were able to produce sugarcane up to 119 tons/ha, namely varieties PS 881, while superior varieties planted in PG Takalar were ROC 10 with productivity reaching 87.6 tons/ha.

The potential availability of sugarcane litter for sugar cane plantations on the island of Java based on the results of the study by Toharisman \[2\] averaged 20-25 tons/ha. There is a striking difference between the potential of sugarcane litter between PG Takalar in South Sulawesi and sugarcane plantatations in Java, this is due to the method or system of sugar cane cultivation. Sugar cane
cultivation system will affect the productivity of sugarcane. For PG Takalar, sugar cane plants are cultivated on dry land with HGUs that cover thousands of hectares so that it is very difficult in the cultivation process, while most sugarcane plantations on Java use a sugar cane cultivation system or a reynoso system and are managed by farmers. Local farmers with narrow land, making it easy to maintain and maintain plants. Thus sugar cane farmers in Java can produce plants that grow optimally with maximum production. In addition to the intensive maintenance of sugar cane in the reynoso system, it is also caused by the provision of more controlled irrigation water. The reynoso sugar cane cultivation system uses paddy fields as a planting medium equipped with good irrigation channels and drainage so that the water needs of the plants are more adequate and can be controlled. It is different from the sugar cane cultivation system on dry land which does not have good irrigation and drainage channels and makes rainwater the main water source so that it will experience water shortages during the dry season. Lack of water in the shoot formation phase and vegetative growth phase will have an impact on productivity of broad unity reaching 40% [9].

The results of research carried out by processing sugarcane litter into compost and mixed with organic matter of cow dung as much as 25% of the weight of sugarcane litter, the weight of the mixture will shrink by about 56% so that its potential to become compost is 44% of the weight of the base material. From the 2011 production data, the PG Takalar has a potential of compost as much as 18073 tons.

3.2. Analysis of Tool and Machine Requirements for Sugar Cane Management
The role of mechanization is very much needed in the management system of sugarcane litter on sugarcane plantation in dry land. The intended mechanization is the use of equipment technology that can support the management of sugarcane litter. The technology is needed starting from the process of collecting sugarcane litter to compost applications in the field. Management of sugarcane litter into compost will require several mechanical tools and machines and composting sites such as; tractors, trash rakes, trailers, sugarcane litter counters, compost turners, loaders, and compost applicators.

South Sulawesi does not yet have a large-scale organic waste management unit that has large capacity processing equipment. Organic waste management units are generally only household scale industries that are not equipped with adequate equipment and have a small work capacity. Including in the PG Takalar who did not have the equipment to process organic waste into compost adequately. PG Takalar only has a place, tractor, trash rake and trailer even though in the management of sugarcane litter, PG Takalar requires several stages of activities and equipment. The equipment is used to process sugarcane litter into compost so that it can be used back to sugar cane plantations.

Based on 2011 harvest season land area of 4186 ha, the total number of tractors needed to support mechanization in the management of sugarcane litter is carried out in each rayon, so there are 3 units of cane litter management, 48 tractors, trash rake needed 13 units, trailer 31 units and applicator 4 units. Whereas composting activities require 18 units of choppers, 3 units of trucks, 3 composting turners, and 3 units of loaders.

4. Conclusion
The results showed that PG Takalar had an average potential availability of sugarcane litter about 19.96% (20%) of each stem of sugarcane plant. The management of sugarcane litter in PG Takalar is done conventionally by burning the sugar cane litter on plantation land. The number of equipments and machinery needed to support mechanization in the management of sugarcane litter with a land area of 4186 ha is a tractor of 48 units, trash rake is 13 units, trailer is 31 units, applicator is 4 units, chopper is 18 units, composting turner is 3 units, truck 3 units and 3 unit loaders.

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