ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 23 No. 3
March 2023
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Afr. J. Food Agric. Nutr. Dev. 2023; 23(3):22670-22693 https://doi.org/10.18697/ajfand.118.21625

COMPOST FERTILIZER BUSINESS SUPPLY CHAIN MANAGEMENT STRATEGY FOR STABILITY OF POTENTIAL ADDED VALUE OF WASTE RAW MATERIALS IN JAMBI PROVINCE, INDONESIA

Novra A[1 2]*, Fatati F[1 2], Devitriano D[2] and S Syarif[2]

Ardi Novra

* Corresponding author email: ardinovra@unja.ac.id

[1]CoE (Center of Excellent) SIFAS (Sustainable Integrated Farming System) Jambi University, Indonesia

[2]Faculty of Animal Science, Jambi University, Indonesia

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 23 No. 3
March 2023
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

ABSTRACT

This article describes strategies and policies for compost development based on the potential value-addition (VA) of waste raw materials and the problems faced in the supply chain. This research, which was conducted in the central area of smallholder oil palm plantations in Jambi province in Indonesia, is important because it is an integral part of the oil palm farmer's household independence efforts in the face of temporary income loss during the oil palm replanting program. In general, this study aims to develop a supply chain management strategy to maintain added value stability by ensuring the availability and price stability of the supply of waste raw materials, and product marketing policies in dealing with a single buyer (monopsony market). The data collected consisted of group historical data, interviews, and participatory observations. The method of analysis was descriptive based on data analysis using a value-added approach in a supply chain management framework. The research results show that: 1) the compost developed is not only able to provide VA but also encourages an increase in the selling value of the waste, 2) varies VA of is waste influenced by the price factor compared to the proportion of its use, 3) the VA is quite sensitive to changes on output price. The problem encountered in the downstream supply chain is the increase in the price of raw material for solid waste in cowsheds due to the gap between demand and supply. The level of availability of raw materials for cowshed solid waste depends on efforts to accelerate livestock population growth, such as through the implementation of sharia-based profit-sharing investments. In the upstream supply chain, the weak bargaining position of compost entrepreneurs due to the monopsony market has caused output prices to drop dramatically. The monopsony market that is faced has resulted in the low bargaining power of the compost business groups in price negotiating. Based on the findings, it can be concluded that government intervention is urgently needed to encourage the development of organic crop cultivation to create a more diversified market demand for compost.

Key words: compost, organic, palm oil, raw material, solid, strategy, waste

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 23 No. 3
March 2023
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

INTRODUCTION

The waste treatment plant complies with regulations for noise, odor and air pollution, as well as groundwater and underground water [1]. The main focus of agricultural waste management is on the problem of controlling odors and feedlot runoff [2], which includes the status of agricultural waste problems and the application of technical and scientific principles to their management. Another focus is how to explain basic principles and processes and management systems (biological processes, ponds and lagoons, aerobic, anaerobic, physical and chemical, and nitrogen control). General agricultural technology improvements induce important welfare gains for the economy in general and rural households in particular [3]. The socio-economic dimensions of farm households in rural populations are technical players who adapt their practices to their constraints and opportunities [4]. The recommended technology is an anaerobic treatment system because all waste is disposed off in one place, and there is no need for another landfill in the future [1]. In certain mills, this is a key factor determining profitability (19% of total revenue), total carbon credits reaching 16% of total revenue, and expanding the waste collection distance from 25 to 50 km [5].

The main reasons for rational agricultural waste management can be viewed both environmentally, and economically. The implementation of strategies in the agricultural sector is intended so that farmers can take full advantage of various economic opportunities for managing agricultural waste, and earn more money [6]. The international regulatory framework on sustainable development encourages the transformation of the role of agriculture, especially circular economy and bioeconomic policies and strategies [7], and systematically helps improve environmental conditions by reducing pollution caused by astronomical agricultural waste disposal [6]. More effective agricultural waste recovery techniques have developed as a result of industrial innovation and high technology so that they can contribute to ensuring resource efficiency, sustainable production and consumption as well as reducing negative environmental impacts [8].

The goal of sustainable agriculture is to balance the economic, environmental and social aspects of agriculture, creating a resilient agricultural system in the long term. Various concepts have been developed and used in research and policy to encourage the application of sustainable practices [9]. For instance, in the livestock sector, especially the beef cattle business, livestock and plant waste management is part of an integrated sustainable farming system. An efficient and environmentally friendly integrated farming system is followed by the development of participatory technology that refers to the local wisdom of the community [10].

Corn-cow integration can minimize environmental pollution through the application of the LEISA (Low External Input Sustainability Agriculture) concept [11]. The LEISA approach is an important part of an integrated system where both solid and liquid animal manure can be utilized to support the provision of organic inputs in crop cultivation. In the integration of oil palm and cattle, plant wastes such as palm fronds and oil palm cake can be used as a source of animal feed [12]. The rice and livestock integration system can increase the use of family labor, reduce the use of inorganic fertilizers and reduce costs which have implications for increasing the income of both types of commodities [13].

Composting is a sustainable technique that converts organic and bio-degradable waste into organic material that can be used as fertilizer for agricultural crops as a soil amendment [14]. The content and quality of such a fertilizer depend on the type of raw material used, the composting process, the conditions of the decomposition process, and nutritional additions [15]. Conversion of food waste and municipal waste into compost and its utilization to increase soil productivity and fertility contributes positively to soil organic matter management and carbon reduction [16]. The challenges faced in the composting process include the long process which takes up to three to four months in small-scale operations, during the composting process there is a chance for soil acidification and odor emissions to occur, heavy metal contamination, and economic uncertainty in the composting facility [17]. The development of more effective and efficient composting methods to address these challenges is needed so that waste management can be more promising and sustainable.

Compost fertilizer development was initiated by the Jambi University community service team in collaboration with Wira Karya Sakti Limited Liability Company (WKS Ltd), an industrial plantation forest company was started in 2016 and currently has a significant impact on the economy of the village of Dataran Kempas. The village is currently known as a compost village, which in 2019 was designated as a superior product for rural areas (in Indonesia it is abbreviated as PRUKADES) by the Ministry of Rural and Underdeveloped Areas of the Republic of Indonesia. Compost production uses 4 (four) types of waste material with the following composition, beef cattle pen solid waste (30%), empty fruit bunches (30%), oil palm mill boiler ash (20%), and chopped oil palm fronds (20%) [18]. Anaerobic fermentation technology uses Probiotic Effective Microorganisms-4 (EM-4) or Trichoderma (if the main buyer requests), while other additives are brown sugar and rock phosphate. Each composting process takes 21 days with a production volume per period of up to 15 tons. The untapped use of agricultural and industrial waste has added value to the economy, both directly and indirectly.

https://doi.org/10.18697/ajfand.118.21625

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 23 No. 3
March 2023
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Indirectly, the use of solid manure can encourage a more intensive cattle rearing system because, to obtain raw material for solid waste, cattle farmers must house their livestock or minimize the release of cattle so that livestock manure is collected and can be sold to compost businesses. On the other hand, compost production also encourages the development of organic crop cultivation (vegetables and horticulture) where compost (environmentally friendly) is used as a substitute for commercial fertilizers (a source of environmental pollution). The level of readiness of households to face the oil palm replanting program has also increased along with the absorption of the people's compost industry which reaches more than 100 workers.

Behind the success story of developing a composting business, it turns out that there are many obstacles both in the input and the output markets. In the input market, due to the scarcity of solid waste supply from cattle sheds and competition in meeting the supply of palm oil mill waste (boiler ash and empty fruit bunches) the input price (cost) for compost production pushed up. On the other hand, the output market with a single buyer (monopsony market) causes low bargaining power of business groups as the determination of selling prices is dominated by buyers. Based on the description above and the importance of encouraging the growth, and development of the people's scale compost industry, it is necessary to have information about the added value obtained for each of the waste raw materials used. It is known that input and output prices have a significant effect on production performance, including added value for waste raw materials used in the composting industry. In general, this study aims to develop a supply chain management strategy to maintain added value stability by ensuring the availability and price stability of the supply of waste raw materials, and product marketing policies in dealing with a single buyer (monopsony market).

MATERIALS AND METHODS

The research was conducted for three months from August to October 2020 with the location of the activity at the Karya Trans Mandiri (KTM) Farmer Group, Dataran Kempas Village, Tebing Tinggi District, Tanjung Jabung Barat Regency, Jambi Province, Indonesia. Research in the form of case studies on the compost fertilizer business, KTM farmer group uses a participatory approach in observing the compost production process, and interviews with key group figures. Sources of information in the interviews were the chairman and secretary of the farmer group, the coordinator for production and marketing, administrative and financial staff, and two male and female workers each. The data collected in the study consisted of primary, and secondary data. Primary data were obtained from interviews relating to the production process and the use of labor (volume and time) for each production period. Secondary data were collected in the form of historical data obtained from cash flow administration recordings, and annual financial reports of farmer groups. The compost production stages use a supply chain management (SCM) approach starting from the process of procuring the main raw material input (downstream supply chain), the production process starting from mixing raw materials, adding additional materials, and the fermentation process (internal supply chain), and post-production, in the form of packaging and sales (upstream supply chain). The calculation of added value for each of the main waste raw materials uses the modified Hayami method with the formulas and stages as in Table 1.

RESULTS AND DISCUSSION

Waste Raw Material Supply Chain

Supply chain management (SCM) is a complete chain management cycle starting from the procurement of raw materials to operational activities and continuing distribution to consumers [19], throughout the supply chain which includes product development, procurement, planning and control, operations, and distribution. There is a flow of material, information, and money [20]. The three main components of SCM are the upstream, internal, and downstream supply chain. The upstream supply chain or the upstream part includes the company's activities with its distributors and their relationship with secondary distributors whose main activity is procurement. The internal supply chain is all in-house processes aimed at transforming inputs from suppliers including the main activities, namely production management, manufacturing and inventory control. The downstream supply chain is all activities that involve the delivery of products to end customers with the main activities of distribution, warehousing, and sales and after-sales services [21]. Based on the three SCM components, in the context of the supply of raw materials for waste in the compost business, it is presented in Figure 1.

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 23 No. 3
March 2023
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

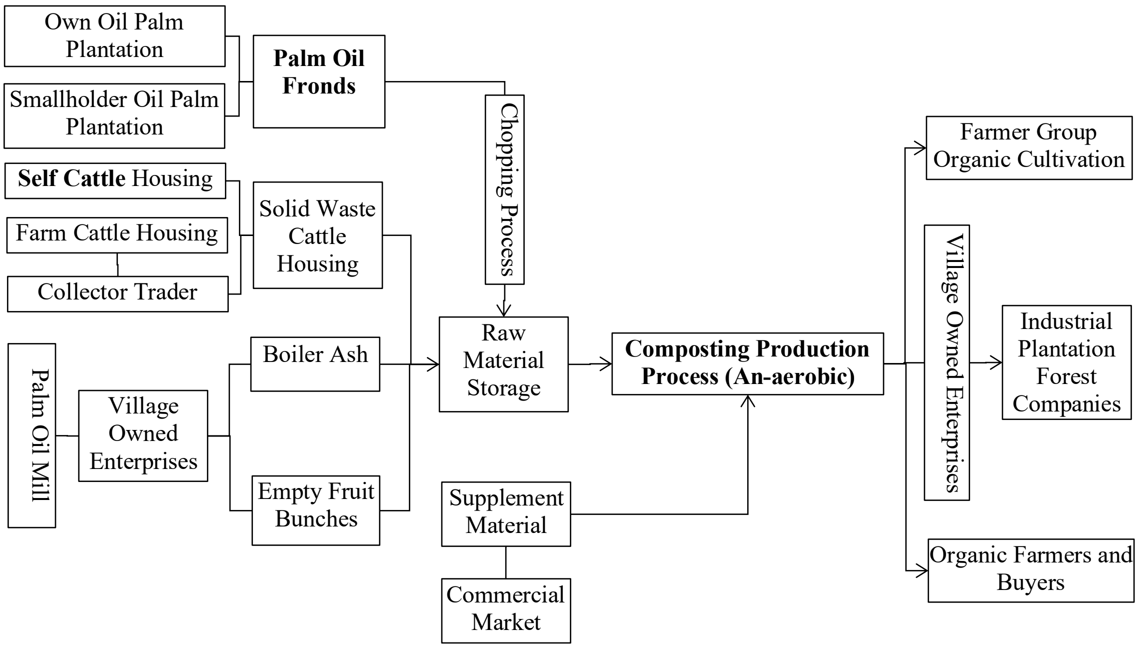

Figure 1: Supply Chain Compost Industry

The supply chain for each raw material of waste varies, generally coming from external groups of compost business actors. The supply of stable solid waste besides coming from the cattle business itself also comes from collector traders who are the main supplier partners. These traders obtain stable supplies of solid waste from farmers in the village of Dataran Kempas and surrounding villages as well as from the collection of solid waste from cattle sheds in other districts. The huge demand for solid waste has led to market expansion to meet the needs of the compost industry. Apart from being able to provide added value to the cattle farmers, this supply provision indirectly encourages the transformation of the maintenance system from extensive to intensive (indirect impact). Another raw material for waste that also comes from the environment itself is palm frond waste, but most of it still comes from external groups of compost fertilizer businesses, namely smallholder oil palm plantations in the village. Before being used, the palm fronds are chopped using a chopper machine. The other two main raw materials, namely boiler ash, and empty fruit bunches are waste products from the processing of the palm oil mill. The procurement of these two types of compost raw materials is carried out through the services of Village Owned Enterprises or VOE (in Indonesia it is abbreviated as BUMDes).

The flow of material in the downstream components of the supply chain illustrates that many parties will enjoy the value chain from the input market including cattle farmers, oil palm farmers, collectors and village-owned enterprises. The values obtained are not only economic but also contain social benefit values such as

https://doi.org/10.18697/ajfand.118.21625

changes in farming behavior and oil palm farming. The oil palm plantation area will look clean from the piles of palm fronds that have been arranged to pile up between the plants. The process of decomposition of oil palm fronds to become a source of plant nutrients and return to plantations can be accelerated through the development of a compost fertilizer business. Furthermore, the four main raw materials for waste are stored before being used for the compost production process using anaerobic technology. Microorganisms used in EM4 (Effective Microorganism-4) is a mixed culture of live microorganisms which is very beneficial for soil fertility and is beneficial for plant growth.

The fermentation process starts with the collection and preparation of the main raw materials (4 types of waste according to their respective proportions). The waste raw material is prepared in layers with a height of each layer of 20 cm (total layer height of 80 cm) and then additional materials are sprinkled in the form of urea, rice bran and rock phosphate before stirring; mix the raw materials and additives, then water evenly with a liquid microorganism that has been mixed with water and sugar in a concentration of 1: 10. Then the compost raw material is covered with a tarpaulin so that the anaerobic fermentation process can take place properly. The process of making this compost can be conducted in an open space, and then observing and re-stirring it every week or two during the fermentation process. On the 21st day, the compost can be harvested and packaged at the packaging and fertilizer storage hut. Compost is packed in sacks of volume 40 kg/sack and then closed with stitches and ready to be marketed. Every 15 tons of raw material waste will produce a compost weight of around 11-12 tons depending on the moisture content of the raw material (an average of 11.70 tons or experiencing shrinkage of about 15%).

Cost-Benefit Analysis

Production costs refer to all the value of goods and services issued by business actors for the production of a product such as labor, raw materials, inventories, consumables and general overhead [22]. The cost of raw materials refers to the cost of components that go into the final product produced and pricing of raw materials is one way to encourage the efficient use of natural resources [23]. For a more realistic estimation of the impact of higher prices on resource use, information is needed at the very least about the share of their costs in the total production costs and the expected price sensitivity or elasticity. This may help policy makers when formulating policy on efficiency improvements concerning the use of natural resources. This also applies to the production of compost with the main raw material in the form of waste as presented in Table 2.

One of the three costs included in the producer's cost of goods sold (COGS) in addition to labor and amortization costs is the cost of primary raw materials. The proportion of waste raw material costs in the composting industry reached 51.01%, while for the same industry in the Netherlands in 2010 it was between 5 - 50% [23]. The direct use of natural resources in the food, chemical and base metal industrial sectors is relatively large and will be even greater if added to the indirect use. The next expenditure that has a fairly large proportion is labor costs because the production process relies more on labor-intensive than capital-intensive because of the increased time spent on weed management and monitoring [24]. The largest waste raw material expenditure is used for the procurement of solid waste for cattle pens as presented in Table 3.

The cost-share for each waste raw material varies, which is influenced not only by the proportion of use but also by the price to obtain the waste itself. The share of the cost of procuring solid waste for cattle housing is the highest (24.68%) because, in addition to the high proportion of its use, it is also very expensive. Another cost component in the production of compost, which has the second-largest share after waste raw materials is labor costs, which is around 26.34%. The high cost of labor is because the production process is still manual and labor-intensive. On the one hand, it has the potential to reduce the level of efficiency, but on the other hand, this is by the needs of the local community who are facing the community oil palm replanting program. Job opportunities arising from the compost processing business are a choice in dealing with "temporary loss income" during the replanting program until the oil palm plants return to an economical level of production. The loss of income, even though temporary, is one of the consequences of the replanting program due to the cessation of production so that the household income of oil palm farmers will be lost until the replanting plants can produce again, which is estimated to be 3 - 4 years [25].

With the results of the estimation that there are centers of smallholder oil palm plantations, it is estimated that the temporary income loss rate will reach 53.21% with the proportion of affected palm oil households reaching 57.31% [26]. It is hoped that the sale of compost as a mainstay product cannot only reduce some of the cost of feed but cattle can be seen as an investment (savings) business that is not affected by inflation, can create jobs and become an integral part of the farming system and the life of rural communities [27]. Labor-intensive industries contribute greatly to the socio-economic aspects, namely a) having large forward and backward linkages, b) as a means of regional economic equality, c) as a social safety net, d) generating export foreign exchange and e) being the driving force for other economic sectors [28]. In the waste fermentation process for the production of organic fertilizer, an average weight reduction of 15% occurs which is influenced by the water content of the raw materials and the effectiveness of the microorganisms used. The effect of liquids containing solutes will help microorganisms absorb nutrients. Based on this level of weight loss, the average compost output value produced for each production period is shown in Table 4.

At the output price level of IDR 1.170 / kg, the total revenue after deducting the fees to be paid to VOE is greater than the costs incurred. This indicates that the profit or net income from the compost business is positive (profitable). The Benefit-Cost (BC) Ratio of 1.74 shows that for every IDR spent on compost production, IDR 1.74 will be earned or a profit margin of around IDR 74/kg. The profit rate of the compost business reaches 42.6%, indicating the potential profit that will be received by groups of farmers who run organic fertilizer businesses for each processing period. The financial performance of the compost group business was not significantly different from the results of the financial analysis of the organic fertilizer management unit in Bondowoso Regency with a profit level of 54.35% and an RC ratio of 1.84 [29]. Compost producers must increase the market value of compost and its competitiveness against mineral fertilizers [30] because its market share is still very low, which is less than 10% of the total fertilizer consumption. Appropriate composting methods are increasingly varied, including for animal waste, where one of the advantages is the opportunity to recycle the final compost product in agriculture or horticulture. High concentrations of compost organic matter have been used for many years as a soil amendment [31]. In general, some of the advantages of compost are eradicating pathogens and weed seeds, and improving the handling characteristics of manure by reducing its volume and weight [32].

Comparative Added Value of Waste

Value chain activities will drive performance improvements related to agriculture in input-output management, synergy, and value chain integrity, the performance of each value chain actor runs effectively so that consumers experience the best service with the product received, while producers get increased competitiveness and profitability [33]. Value chain analysis is a strategy used to better understand its competitive advantage [34]. Competitiveness in achieving optimal trade performance is influenced by an effective value chain [35], and the key to competitiveness is the ability to generate added value for the industry. The value chain is the totality of activities required to bring goods or services from the design location through the various phases of production (physical transformation and input of various service providers), delivery to the final consumer, and recycling after use. The function of value chain analysis is to identify the stages of the value

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 23 No. 3
March 2023
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

chain where the industry can increase added value for customers and improve cost efficiency. Analysis of the added value of waste is very important as is the previous financial and economic analysis because each waste raw material used has a different contribution. Value-added analysis shows the individual role of each waste raw material used in the compost-making process. The added value for both output and share of income from direct labor is presented in Annex 1 and Table 5.

The nominal added value between the types of waste raw materials varies from the lowest, namely solid waste of cattle sheds to the highest, namely boiler ash from the oil palm processing industry. The comparison of the proportion of use and price between the four waste raw materials indicates that the nominal value added tends to be more influenced by the price factor for the waste raw material. The use of cage solid waste and empty fruit bunches is both 30%, but a more expensive cage solid waste price (IDR 500/kg) provides lower added value compared to other waste raw materials. This indicates that the price factor of waste raw materials (input) needs to be considered in the development of the compost fertilizer industry.

The demand for solid waste raw materials is increasing in line with the increasing production capacity of compost by several business groups (7 groups of business actors in 3 adjacent villages). The average production capacity of each business group, which is around 1,000 tons, requires at least 21,000 tons/month. On the other side of the supply side, the growth of the cattle population and the beef cattle raising system which is still on a small scale with a maintenance system that is not yet intensive causes its availability to become increasingly scarce. The gap between supply and demand has pushed up the price of raw materials for solid waste in cattle sheds. For other types of waste, it is still more available even though there is still competition between groups. The existence of VOE as a supplier of boiler ash and empty fruit bunches for the palm oil processing industry has successfully overcome the price fluctuation of the two types of waste raw materials. Another raw material in the form of palm oil frond waste is still available in abundance in the village area of the center of the oil palm plantation, although its use requires a chopping process.

Furthermore, the comparison between the added value and the relative profit margin between the four types of waste raw materials is presented in Figure 2.

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 23 No. 3
March 2023
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

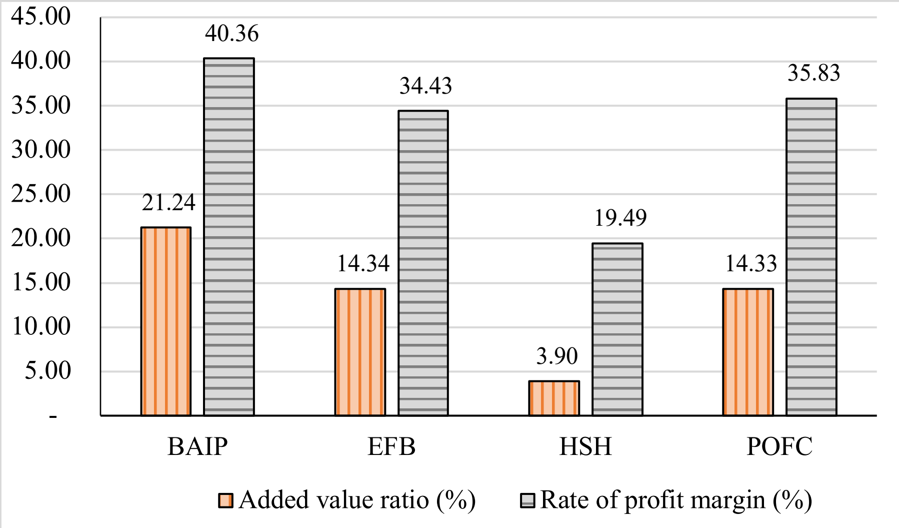

Figure 2: Added value ratio and rate of profit margin

Figure 2 shows that the variations in added value and a profit margin between various waste raw materials go hand in hand, where the higher the added value, the higher the profit margin received by the compost fertilizer business actor. Referring to the comparison of nominal values, it can be stated that the relative value tends to be influenced by the price of waste rather than by the level of use in compost production. The use of biomass waste as raw material for biofertilizers will not only produce low-cost fertilizers but will also change the view that such waste has no price. One of the factors that need to be considered in the development of compost fertilizer is the control of the input price of waste raw materials, especially concerning the level of availability and the level of competition and dependence on input markets. The availability of the type of waste that needs to be considered is the solid waste of cattle sheds because it requires costs for collection from beef cattle farmers who are still dominant, semi-intensive, and scattered while expanding to other areas including other districts will cause an increase in transportation costs. The independence of the procurement of solid waste raw materials for cattle pens must be pursued by accelerating the growth of the livestock population and encouraging a more intensive maintenance system. The mutualism symbiosis relationship between the compost fertilizer industry which has created the selling value of solid waste from the cow coop, basically will motivate cattle farmers to transform into intensive maintenance. Intensive maintenance of cattle will make it easier to collect a larger volume of stable waste for sale and become one of the additional sources of income or an alternative to cattle farming.
Problems encountered and policies

The perspective of commercializing the production of biofertilizers requires useful information on the economic viability and potential environmental impacts, including the life-cycle assessment of organic fertilizer production [37]. Furthermore, the environmental assessments of biofertilizers, as well as the economic potential of biowaste conversion into biofertilizers were discussed elaborately [38]. This work will provide a comprehensive insight into the current progress in organic fertilizer production from biomass waste. Concerning the compost processing business based on the use of waste in the study area, it turns out that there are still several obstacles. The input market constraints discussed earlier are related to the management of the raw material supply of waste, especially solid waste from cattle sheds. The gap between supply and demand has pushed up the price of stable solid waste and has an impact on production costs and potential added value. The level of availability of raw materials for cowshed solid waste depends on efforts to accelerate livestock population growth. The strategic step that has been taken to meet the needs independently is through increasing the scale of the group cattle business but it is constrained by the factor of availability of capital. The innovation made by the group is to attract investment from capital owners in the business of fattening cattle. Jambi Province, like Indonesia, with a Muslim majority, requires cattle for religious activities, especially Eid al-Adha. This market opportunity is used to develop a sharia-based profit-sharing investment model known as Cheap Qurban Sharia Investment (CSQI). This program can encourage the utilization of the potential of ummah funds for farmers' economic empowerment, business opportunities for entrepreneurs, and Islamic institutions and indirectly help stabilize commodity prices for beef cattle without reducing the actual value of Qurban [39].

In the downstream supply chain area, the problem faced by this rural industry is that the target market for compost products has not been diversified. Compost users or consumers who use it are still limited to one company that has been a partner in the Desa Makmur Peduli Api (DMPA) program. In the early years of the collaboration and being the target of the corporate social responsibility (CSR) program with a limited number of production and groups of players in the composting industry, there was indeed a guaranteed output market. Over time, with the increasing number of new rural compost industry groups, the company has more and more alternative supplier choices. The monopsony market faced by compost business groups has resulted in their low bargaining power, especially concerning the fixing of the selling price. So far, more than 90% of the compost produced has been purchased by a single buyer, namely Wira Karya Sakti Ltd, Industrial Plantation Forest company. Since mid-2021, through a long negotiation process, there has been an agreement on lower product prices (down from IDR 1,170 to 970). This will certainly cause changes in economic performance and for that, an estimate of the amount of change in added value is carried out assuming there is no change in input prices (Annex 2 and Table 6).

The monopsony market causes the bargaining power of the compost business to be weak so that the price set tends to be low, this will have an impact on the decrease in added value. The average rate of reduction in added value reached 56.86% (nominal) or 47.86% (relative) due to the change (decrease) in the price of compost from IDR 1,170 to 970 and even more than 85% of the raw material for cattle housing solid waste. In the case of changes in output prices, several lessons can be taken, including 1) the potential added value received by the compost fertilizer business group is very sensitive to changes in output prices, 2) diversification of the target market is needed to open alternative markets for compost marketing, and 3) for this, government regulation through various policy interventions, either directly or indirectly, is needed. Specifically, for point 2, the diversification of the target market is not only limited to finding new consumers or buyers but can also be done by encouraging the use of some compost products for the cultivation of organic plants by group member households and their surroundings. The application of organic cultivation of food, vegetables and horticulture can be integrated with the empowerment program for households affected by the smallholder oil palm replanting program.

For example, the use of space between oil palm plants for the cultivation of various types of seasonal crops such as food, vegetables and horticulture. This farming system, which is better known as intercropping, can be an alternative source of income as a substitute for temporarily lost income due to the cessation of oil palm production during the replanting process. Learning from the development of plants between the rubber replanting program, land cover that is still open can be a fairly effective source of substitute income. The results of research by Novra et al [26] showed that the substitution power of food crops among replanted crops reached around 49.27% of the potential loss of temporary income (IDR 1.85 million) and the highest was in maize (55.83%).

This alternative source of income is not only aimed at strengthening the economic resilience of replanting program households but also encouraging the maintenance of replanting young oil palm plants to be more intensive and environmentally friendly. The maintenance of replanting oil palm directly can use compost as a substitute for chemical fertilizers (commercial) which have been commonly used, and the remaining compost that is not absorbed by the intercropping plants becomes a source of nutrients for oil palm plants. This means that patterns like this are not only able to be a solution to the problems of monopsony in the marketing of compost but also to encourage the efficiency of land resources and the use of compost itself as well as encourage an environmentally friendly agricultural system or sustainable agriculture. If this organic cultivation can be encouraged through various creative regulations from policymakers (government), then the solution to the problem in the output market can be effective. The problem of marketing compost products includes diversifying the target market to optimize the potential market uptake of compost. An integrated organic cultivation system that is cheaper and environmentally friendly will develop so that the level of achievement of the three goals of sustainable agricultural development, namely social, economic, and ecological, will be closer.

CONCLUSION

Based on the results and discussion, it can be concluded that the added value obtained for each raw material for composting waste varies and is relatively high. The stability of this added value needs to be maintained through supply chain management in both the input market (upstream SC) and the output market (downstream SC). The strategy for the upstream SC component is to increase the independence of the input supply of solid waste raw materials by increasing the group cattle population and maintaining the production of chopped palm fronds. In the downstream SC component, in order to reduce dependence on a single buyer, diversification of the target product market is a strategic option that can be developed, including encouraging the use of compost in organic agricultural cultivation. This strategy will work more effectively if it is supported by policy interventions by the local government such as an appeal or even an obligation for plantation companies to use compost in plant maintenance, oil palm replanting programs, and intercropping of seasonal crops.

ACKNOWLEDGEMENTS

The research is funded from internal sources of non-tax State Revenue of Jambi University through a superior applied research scheme with a contract number: 499 / UN21.18 / PG / SPK / 2020 dated April 20, 2020. Thanks to the Karya Trans Mandiri farmer group as a fertilizer business actor. Compost and Village-Owned Enterprises, Dataran Kempas Village Tebing Tinggi sub-district, Tanjung Jabung Barat Regency, Jambi Province, Indonesia, as well as final program students of the Faculty of Animal Husbandry, Jambi University who acted as field observers.

Table 1: Formulas and Stages of Calculation of Value Added of the Hayami Modification Method

No	Variable	Formula
Input, Output, and Prices		
1	Compost volume (kg)	(1)
2	Waste materials volume (kg)	(2)
3	Direct labor (WPD)	(3)
4	Conversion factor	(4) = (1)/(2)
5	Coefficient of direct labor (WPD/kg)	(5) = (3)/(2)
6	Compost Price (IDR/kg)	(6)
7	Wage of labor (IDR/HOK)	(7)
Revenue and profitability		
8	Price of waste material (IDR/kg)	(8)
9	Price of the other's input (IDR/kg)	(9)
10	Compost value (IDR)	(4) x (6)
11	a. Compost value added (IDR)	(11a) = (10) - (8) - (9)
	b. Compost value-added ratio (%)	(11b) = ((11a)/(10)) x (8)
12	a. Direct labor income (IDR/kg)	(12a) = (5) x (7)
	b. Share direct labor	(12b) = ((12a)/11a) x 100
13	a. Profit (IDR/kg)	(13a) = (11a)-(12a)
	b. Profitability rate (%)	(14a) = ((13a)/(10)) x 100

Source; Sudiyono (2002)

Table 2: Compost production cost structure (Capacity 15 tons/period)

No	Input	Cost (IDR)	Proportion (%)
1	Boiler ash	5,700,000	6.25
2	Empty fruit bunches	10,800,000	11.85
3	Housing solid waste	22,500,000	24.68
4	Palm Oil Fronds chopper	7,500,000	8.23
5	Supplement material	7,575,000	8.31
6	Worker	23,832,237	26.14
7	Packing sack	5,950,000	6.53
8	Investment depreciation	4,112,000	4.51
9	VOE output fee	3,187,500	3.50
Total cost		**91,156,737**	**100.00**

Source: Data processing (2020)

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 23 No. 3
March 2023
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Table 3: The structure of the cost of raw materials for waste in compost production

No	Waste material	Using (kg)	Price (IDR)	Cost (IDR)	Proportion (%)
1	Boiler ash	30,000	190.00	5,700,000	12.26
2	Empty fruit bunches	45,000	240.00	10,800,000	23.23
3	Housing solid waste	45,000	500.00	22,500,000	48.39
4	Palm oil fronds chopper	30,000	250.00	7,500,000	16.13
	Total	**15.000**		**46,500,000**	**100,00**

Source: Data processing (2020)

Table 4: The benefit-cost ratio of the compost production business

No	Variable	Unit	Formula	Value
1	Total weight raw material	Kg	A	150,000
2	Weight loss level	%	B	15
3	Weigh loss production	Kg	C = (AxB)/100	22,500
4	Real production	Kg	D = B - C	127,500
6	Output price	IDR/kg	E	1,170
7	Value of compost	IDR	F = D x E	149,175,000
8	Fee of VBA	IDR	G	3,187,500
9	Net value production	IDR	H = F - G	145,987,500
10	Total Cost	IDR	I	83,857,237
12	Net revenue	IDR	J = H - I	62,130,263
13	Benefit - Cost Ratio	-	K = H / I	1.74
14	Profitability rate	%	L = (J/H) x 100	42,56

Source: Data processing (2020)

Table 5: Nominal added value, direct labor income, and margin profit of the compost fertilizer production

No	Variable	Waste typed			
		BAIP	EFB	HSH	POFC
1	Price of raw material (IDR/kg)	190.00	240.00	500.00	250.00
2	Price the others input (IDR/kg)	403.13	412.14	300.71	388.13
3	Output value (IDR/kg)	994.50	994.50	994.50	994.50
4	Added value (IDR/kg)	401.38	342.36	193.79	356.38
5	Direct labor income (IDR)	794.41	529.61	529.61	794.41
6	Profit margin (IDR/kg)	804.50	754.50	494.50	744.50

Note: BAI = Boiler Ash Palm Oil Processing, EFB = Empty Fruit Bunches, CHSW = Cattle Housing Solid Waste, POFC = Palm Oil Fronds Chopper
Source: Data processing (2020)

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 23 No. 3 March 2023 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Table 6: The results of the estimation of the impact of changes in input prices on the added value of each waste raw material

No	Type of waste	Nominal			Relatives		
		IDR 1.170	IDR 970	Change (%)	IDR 1.170	IDR 970	Change (%)
1	BAIP	401.38	231.38	42.35	21.24	14.77	30.47
2	EFB	342.36	172.36	49.66	14.34	8.71	39.28
3	HSH	193.79	23.79	87.73	3.90	0.58	85.19
4	POFC	356.38	186.38	47.70	14.33	9.04	36.92
Average		323.47	153.47	56.86	13.45	8.27	47.96

Source: Data processing (2020)

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 23 No. 3 March 2023 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

REFERENCES

1. **Cohen E and GY Din** Agricultural waste management: Case study of a waste treatment plant for animal manure. *SSRN Electronic Journal,* 2010.

2. **Loehr R** Agricultural waste management: Problems, processes, and approaches. First Edition eBook 1974. ISBN: 9780323145060. *Elsevier Academic Press.*

3. **Arndt C and F Tarp** Agricultural Technology, Risk, and Gender: A CGE Analysis of Mozambique. *World Development,* 2020; **28 (7):** I307–I326.

4. **Cheyns E and S Rafflegeau** Family agriculture and the sustainable development issue: possible approaches from the African oil palm sector. The example of Ivory Coast and Cameroon. *OCL Journal* 2005; **12 (2):** 111-120.

5. **Yin GY and G Cohen** Agricultural Waste Management: Case Study of a Waste Treatment Plant for Animal Manure. *Journal of Environmental Protection*, 2013; **4:** 435-445.

6. **Sindhu N, Seharawat P and JS Malik** Strategies of Agricultural Waste Management for better employment and Environment. *International Journal of Current Research.* 2015; **7 (12):** 24604-24608.

7. **Duque AM, Luis JB, Francisco JC and CF Francisco** Agricultural waste: Review of the evolution, approaches and perspectives on alternative uses. *Global Ecology and Conservation Journal*. 2020. **22** (June-e00902): 1 - 23.

8. **David CR, Sutherland WJ, Barnes AP, Borthwick F, Foulkes C, Hall C, Moorby JM, Nicholas-Davies P, Twining S and LV Dicks** Integrated farm management for sustainable agriculture: Lessons for knowledge exchange and policy. *Land Use Policy.* 2019; **81:** 834-842.

9. **Ansar M and F Fathurrahman** Sustainable integrated farming system: A solution for national food security and sovereignty, *IOP Conference Series Earth and Environmental Science.* 2018; **157(1):** 012061.

10. **Elly FH, Lomboan A, Kaunang CL, Rundengan M, Poli Z and S Syarifuddin** Development potential of integrated farming system (Local cattle-food crops). *Animal Production Journal.* 2019; *21(3):* 143-147.

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 23 No. 3 March 2023 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

11. **Novra A and S Suparjo** Collective action model: Facing temporary loss income while the rubber replanting program. *IOP Conf. Series: Earth and Environmental Science.* 2020; **518** (2020) 012059.

12. **Mukhlis MN, Nofialdi and M Mahdi** The integrated farming system of crop and livestock: A review of rice and cattle integration farming. **International Journal of Sciences: Basic and Applied Research (IJSBAR).** 2018; **42(3):** 68-82

13. **Wolka K and B Melaku** Exploring selected plant nutrient in compost prepared from food waste and cattle manure and their effect on soil properties and maize yield at Wondo Genet, Ethiopia. *Environ. Syst. Res.* 2015; **4:** 1–7.

14. **Chew KW, Chia SR, Yen HW, Nomanbhay S, Ho YC and PL Show** Transformation of biomass waste into sustainable organic fertilizers. *Sustainability Review.* 2019; **11:** 1-19.

15. **Razza F, D'Avino L, L'Abate G and GL Lazzeri** The role of compost in bio-waste management and circular economy. In Designing Sustainable Technologies, Products and Policies; Springer: Berlin, Germany, 2018. 133–143.

16. **Li Y, Jin Y, Borrion YA and AH Li** Current status of food waste generation and management in China. Bioresour. *Technol*. 2019; **273:** 654–665.

17. **Novra A, Suparjo S, Latief A and S Syarif** Economic recovery for smallholder oil palm plantations affected by land and forest fires. *Abdimas Mahakam Journal*, 2020; **4(1):** 1-7.

18. **Purwanto HG** Isu-isu strategis manajemen operasi: Manajemen rantai pasok (SCM). Available: https://sites.google.com/site/operasiproduksi/manajemen-rantai-pasokan, 2017. *Accessed July 2019.*

19. **Pujawan IN and S Mahendrawathi** Supply chain management, Second edition, Guna Widya Publication, Surabaya, 2010.

20. **Turban E and L Volonino** Information technology for management transforming organizations in the Digital Economy. 7th Edition. ASIA: John Wiley and Sons. 2010.

21. **Kenton W** The evolution of accounting and accounting terminology: Production cost. Investopedia. 2021. Last Update: April, 27th 2021.

22. **Wilting H and A Hanemaaijer** Share of raw material costs in total production costs. PBL Netherlands Environmental Assessment Agency Publication 2014. Number: 1506.

23. **SARE.** Economics of organic production: Transitioning to organic production. SARE (Sustainable Agriculture Research and Education). Outreach. 2003.

24. **Novra A, Fatati F and A Adriani** Preparing households for the oil palm replanting program: Is an empowerment program needed? *Journal of Southwest Jiaotong University*, 2021; **56 (3):** 179-195.

25. **Novra A** Membangun industri peternakan sapi potong rakyat: Sustainable integrated farming system (SIFAS) approach, Faculty of Animal Science Jambi University Publication. 2020.

26. **Massinai R, Sudira P, Mawardi M and DH Darwanto** The concept development of agroindustry based on integrated farming system at tidal swamp land areas). Chapter I: (Conceptual Thinking). *Agritech Journal*. 2013; **33(1):** 121-129.

27. **Aditya M** in Harry Industri Padat Karya Berorientasi Ekspor Dorong Pertumbuhan Ekonomi Nasional. Pasardana.id. Penasihat Investasi Institusi Terdaftar: Available: https://pasardana.id/news/2018/5/7/industri-padat-karya- berorientasi-ekspor-dorong-pertumbuhan-ekonomi-nasional/#. 2018. *Accessed April 2020.*

28. **Fitasari F, Hapsari TD and EB Kuntadi** Efisiensi biaya produksi pupuk organik pada Unit Pengelola Pupuk Organik (UPPO) Tani Mandiri I B di Desa Lombok Kulon Kecamatan Wonosari Kabupaten Bondowoso, *Jurnal Agribisnis Indonesia* 2017; **5(1):** 11-26.

29. **Council of Agriculture.** Yearly Report of Taiwan's Agriculture. Available: http://eng.coa.gov.tw/list.php?catid=8821 *Accessed: November 3th, 2016.*

30. **Tiquia-Arashiro SM, Richard TL and MS Honeyman** Carbon, nutrient, and mass loss during composting. Nutrient Cycling in Agroecosystems. 2002; **62:** 15–24.

31. **Epstein E** The science of composting. Lancaster, Pennsylvania, USA: Technomic Publishing Company. 1997.

32. **Maswadi M** Rantai Nilai Bauran Pemasaran dan Daya Saing Lidah Buaya di Pontianak. 2017. PhD thesis, Universitas Sebelas Maret.

33. **Demont M, Fiamohe R and AT Kinkpe** Comparative advantage in demand and the development of rice value chains in West Africa. *World Development.* 2017; **96:** 578-590.

34. **Nurimansyah N and WS Ciptono** Analisis rantai nilai (value chain) industri pakaian jadi di Indonesia. Thesis Magister Management, Gadjah Mada University, 2012.

35. **Askarany D and AWF Smith** Cost-benefit analyses of organic waste composting systems through the lens of time-driven activity-based costing, *Journal of Applied Management and Advanced Research*, 2014; **12 (2):** 59-79.

36. **Chen YT** Cost Analysis of Food Waste Composting in Taiwan, *Sustainability Article.* 2016; **8(1210):** 2-19.

37. **Acevedo MD, Belmonte LJ, Cortés-García F and F Camacho-Ferre** Agricultural waste: review of the evolution, approaches, and perspectives on alternative uses. Global Ecology and Conservation. 2020. **22** (June 2020, e00902).

38. **Novra A, Adriani A, Octavia A and D Depison** Cheap Qurban Syariah Investment (CQSI) Program, Empowerment and Price Stabilization. *Journal of Development Economic* 2020; **18(2):** 103-122.

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 23 No. 3
March 2023
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Appendix 1:
Analysis of the added value of waste raw materials for farmer groups in the compost fertilizer business (P = IDR 1.170)

No	Variable	Formula	Waste typed			
			BAIP	EFB	HSH	POFC
Input, Output, and Price						
1	Output (kg)	1	25,500	38,250	38,250	25,500
2	Waste raw material (kg)	2	30,000	45,000	45,000	30,000
3	Direct labor (WD)	3	298	298	298	298
4	Conversion factor	(4) = (1)/(2)	0.85	0.85	0.85	0.85
5	Coefficient of direct labor (WD/kg)	(5) = (3)/(2)	0.01	0.01	0.01	0.01
6	Price of Output (IDR)	6	1,170	1,170	1,170	1,170
7	Wage of direct labor (IDR/WD)	7	80,000	80,000	80,000	80,000
Revenue and margin profit						
8	Price of waste raw material (IDR/kg)	8	190	240	500	250
9	Price of the others waste (IDR/kg)	9	403.13	412.14	300.71	388.13
10	Output value (IDR)	(4) x (6)	994.50	994.50	994.50	994.50
11	a. Added value (IDR)	(11a) = (10) - (8) - (9)	401.38	342.36	193.79	356.38
	b. Added value ratio (%)	(11b) = ((11a)/(10)) x (8)	0.21	0.14	0.04	0.14
12	a. Direct labor revenue (IDR)	(12a) = (5) x (7)	794.41	529.61	529.61	794.41
	b. Share of direct labor	(12b) = ((12a)/11a) x 100	197.92	154.69	273.29	222.91
13	a. Profit margin (IDR)	(13a) = (11)-(8)	401.38	342.36	193.79	356.38
	b. Rate of profit margin (%)	(13b) = ((13a)/(10)) x 100	40.36	34.43	19.49	35.83

Note: BAI = Boiler Ash Palm Oil Processing, EFB = Empty Fruit Bunches, CHSW = Cattle Housing Solid Waste, POFC = Palm Oil Fronds Chopper

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 23 No. 3
March 2023
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Appendix 2:
Analysis of the added value of waste raw materials for farmer groups in compost fertilizer business (P = IDR 970)

No	Variable	Formula	Waste typed			
			BAIP	EFB	HSH	POFC
Input, Output, and Price						
1	Output (kg)	1	25,500	38,250	38,250	25,500
2	Waste raw material (kg)	2	30,000	45,000	45,000	30,000
3	Direct labor (WD)	3	298	298	298	298
4	Conversion factor	(4) = (1)/(2)	0.85	0.85	0.85	0.85
5	Direct labor coefficient (WD/kg)	(5) = (3)/(2)	0.01	0.01	0.01	0.01
6	Price of Output (IDR)	6	1,170	1,170	1,170	1,170
7	The wage of direct labor (IDR/WD)	7	80,000	80,000	80,000	80,000
Revenue and margin profit						
8	Price of waste raw material (IDR/kg)	8	190	240	500	250
9	Price of the others waste (IDR/kg)	9	403.13	412.14	300.71	388.13
10	Output value (IDR)	(4) x (6)	824.50	824.50	824.50	824.50
11	a. Added value (IDR)	(11a) = (10) - (8) - (9)	231.38	172.36	23.79	186.38
	b. Added value ratio (%)	(11b) = ((11a)/(10)) x (8)	0.15	0.09	0.01	0.09
12	a. Direct labor revenue (IDR)	(12a) = (5) x (7)	794.41	529.61	529.61	794.41
	b. Share of direct labor	(12b) = ((12a)/11a) x 100	343.34	307.27	2,226.57	426.24
13	a. Profit margin (IDR)	(13a) = (11)-(8)	231.38	172.36	23.79	186.38
	b. Rate of profit margin (%)	(13b) = ((13a)/(10)) x 100	28.06	20.90	2.88	22.60

Note: BAI = Boiler Ash Palm Oil Processing, EFB = Empty Fruit Bunches, CHSW = Cattle Housing Solid Waste, POFC = Palm Oil Fronds Chopper