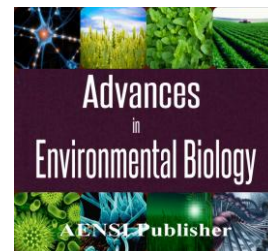




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Potency of Natural Sweetener: Brown Sugar

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ABSTRACT

This research about the substitutes of sugar cane that have the characteristics of a natural, valuable health, and have many functions for the preservation of nature. Brown sugar is a sugar substitute derived from palm plants, such as aren (*Arenga pinnata* (Wurmb) Merrill), coconut (*Cocos nucifera*), siwalan (*Borassus flabellifer* L.). This research aims to investigate the potential of resource, social and economic of brown sugar as a natural sweetener that can substitute sugar cane. The study shows that the aren trees which is the raw material of brown sugar is available in abundance, especially in mainland Southeast Asia, has high adaptability, it also serves as a forestry crop. Furthermore, brown sugar business can be done by people with low education, and in all age groups but predominantly in the range of productive age. Brown sugar is a natural sweetener because of its natural raw materials and the way of processing so valuable health. Economically, brown sugar has proven to be a source of livelihood and feasible to be developed. The implication of this study is about information to explore the potential of resources, social, and economics of brown sugar as a natural sweetener internationally.

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INTRODUCTION

Sugar is a strategic commodity because it has been used worldwide. Sugar is used as an additive in various foods and beverages consumed daily by the world community. According to [1] that sugar consumption was the smallest in Sub-Saharan Africa, at 8 million tons of sugar or 15.2 kg in per capita terms, then comes North America at 11 million tons, Eastern Europe at around 13 million tons, the Middle East and North-Africa at around 15 million tons, and Western Europe at around 18 million tons. All these four regions showed a per capita consumption of at least 32 kg or more. Both the Indian Subcontinent and Latin America are consuming around 27 million tons of sugar a year, but per capita consumption in the Indian Subcontinent was only 16.3 kg while in Latin America it was much greater at 47.2 kg.

Increase in sugar consumption also occurred in the countries with dense populations such as India and Indonesia. [2] said that India's sugar consumption has increased steadily. Per capita sugar consumption has steadily increased from 5.3 kg per annum in the early 1960's to around 18 kg per annum at 2011.

Indonesia is the country with the fourth largest population in the world also has high dependence on sugar. Increased consumption of sugar cane in Indonesia occurred every year but is not followed by the increased production. It is pointed out by the [3] that sugar cane industry in the Indonesia is not able to meet the needs of the national consumption of sugar cane. This situation is shown in the Table 1 below.

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Table 1: Production, Consumption, and Import of Sugar cane in Indonesia, 2005-2013

| Year | Production (Ton) | Import (Ton) | Consumption (Ton) |
|------|------------------|--------------|-------------------|
| 2005 | 2,241,742 | 1,980,487 | 3,057,536 |
| 2006 | 2,307,027 | 1,405,942 | 3,760,000 |
| 2007 | 2,448,143 | 2,972,788 | 3,750,067 |
| 2008 | 2,668,429 | 983,944 | 3,508,000 |
| 2009 | 2,299,503 | 1,373,546 | 4,850,109 |
| 2010 | 2,214,489 | 2,300,089 | 4,289,000 |
| 2011 | 2,228,259 | 2,060,000 | 4,670,770 |
| 2012 | 2,591,687 | 2,350,000 | 5,200,000 |
| 2013 | 2,762,477 | 2,260,000 | 5,516,470 |

Source: [4]

Table 1 showed that production, imports, and consumption of Indonesia on an upward trend generally, despite the downturn in certain years. Average increase in consumption is much greater than the average increase in production as well as imports. Decrease in production occurred in two consecutive years in 2009 and 2010. The highest increase of production occurred in 2012. Decline in imports occurred 4 times. The biggest decline in imports occurred in 2008. While the consumption is drop in last occurred in 2010, and after that sugar consumption continues to rise. Thus, it required a solution to meet the needs of the sugar in addition to sugar imports that can reduce foreign exchange without being followed by public welfare.

All the data about sugar consumption in the world and especially in Indonesia is about sugar cane. The high sugar demand of world community cannot be met by the sugar producers sustainably basis due to the limited resources of sugar beet or sugar cane. Thus, recent years the fulfillment of sugar demands by artificial sweeteners that came from beet plants genetically modified and other half comes from sugar cane [5]. Crops genetically modified (GM) in production by transferring genes from one species to another genetic code. GM foods have not been scientifically proven safe [6]. According to [7] that some countries have banned all GM crops, especially Switzerland and Bulgaria. Throughout Europe there is widespread consumer opposition to GM products. Next, [7] said that several animal studies indicate serious health risks associated with GM food, including infertility, immune problems, accelerated aging, faulty insulin regulation, and changes in major organs and the gastrointestinal system.

It was suitable with [8] who said that artificial sweeteners are regulated by the Food and Drug Administration (FDA) as food additives. Next, he said that all of artificial sweetener must be reviewed and approved by the FDA before being made available for sale. There was consumers want to use many artificial sweetener that did not require FDA approval before sale or consume.

Therefore, there is the phenomenon that there is a great need for sugar as a sweetener, but people want a healthy and low-calorie sweetener. It is suitable with [9] who said that sugar is a purified (refined) sugar cane or beet juice after all the vitamins, minerals, proteins, enzymes and other beneficial nutrients discharged. As a result, the sugar does not contain a variety of nutrients and fiber found in other, more complex carbohydrates such as grains, fruits, and vegetables.

There is an alternative sugar. It is called low calorie sweeteners that its ingredients many times sweeter than sugar (sucrose). Examples include acesulfame-K, aspartame, saccharin, stevia and sucralose which are between 150 and 600 times sweeter than sucrose, and neotame which is between 7,000 and 13,000 times sweeter. Low calorie sweeteners are a valuable and safe tool for providing consumers with the opportunity to choose foods and beverages with different calorie levels [10]. According to [10] that in Europe and around the world, low calorie sweeteners, like other food additives, undergo a rigorous assessment process.

Sugar consumers turn to other sources of natural sweetener for health issues. Stevia is a commodity that is booming as natural sweetener. Lately, many people complain about the aftertaste of stevia, and it doesn't melt or cook like sugar does [11]. Therefore, many people in the natural health community have been turning to agave nectar, a low-glycemic sugar made from the bulbous roots of agave plants. [11] continued that agave plants have also been embroiled in controversy about whether it is truly "natural" or even low glycemic.

Next, [12] said that the emphasis on the consumption of natural foods has resulted in the use of palm sugar concentrate as an alternative sweetener. There is brown sugar as the substitute of sugar cane. Brown sugar is a natural sweetener derived from the sap of palm trees, like *aren* (*Arenga pinnata* (Wurmb) Merrill), coconut (*Cocos nucifera*), and *siwalan* (*Borassus flabellifer* L). Productivity of sap from the *aren* (*Arenga pinnata* (Wurmb) Merrill) was the highest among the sap of coconut (*Cocos nucifera*), *siwalan* (*Borassus flabellifer* L). Thus, the study of the natural sweetener will be focused on brown sugar derived from *aren trees*.

Natural sweetener (brown sugar) could be solution of that wants. Besides that, brown sugar is not refined or bleached so it retains its nutrients. Thus the brown sugar as a natural sweetener that have valuable health should be explored to meet the sweetener needs of the community. But, previously it is require a depth study on the potential of brown sugar that can be known whether or not it is thoroughly explored as an alternative natural sweetener.

The aims of this research was to investigate the potential of resource, social and economic of brown sugar as a natural sweetener that can substitute sugar cane. Conceptual framework to achieve the research aims was shown on Figure 1.

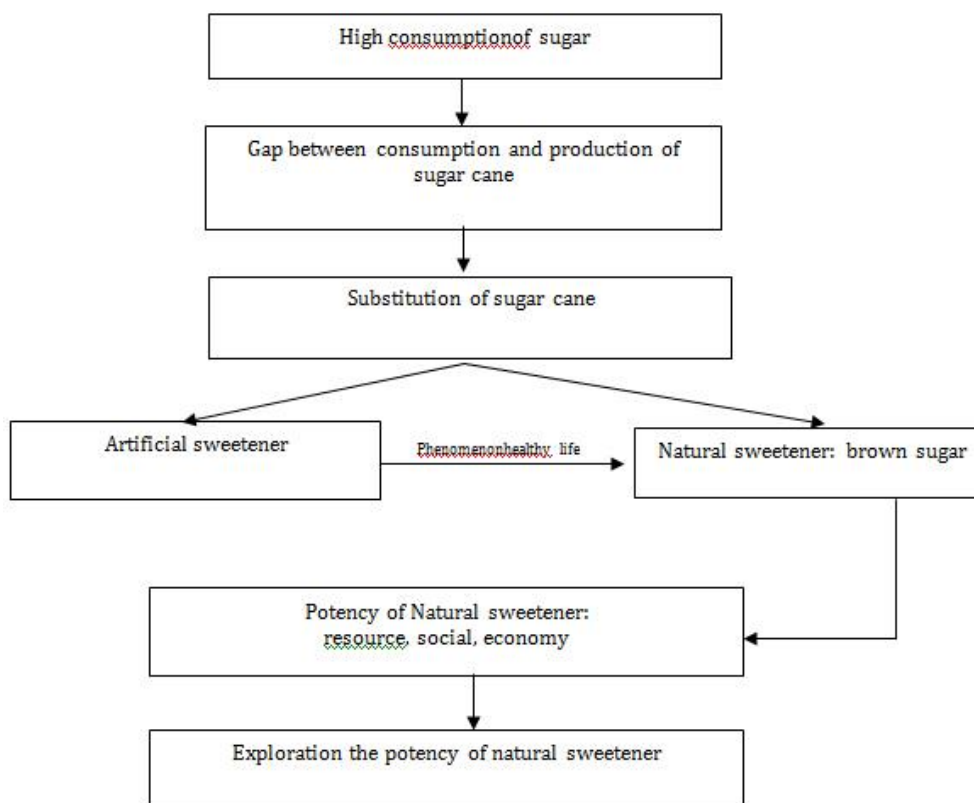


Fig.1: Research Conceptual Framework.

Figure 1 illustrates the connection between the problem about high consumption of sugar cane as sweetener for daily food and beverage and the effort to find and explore its substitute that have valuable health and big potency in resource, social, and economic. It could be explained that there was a phenomenon of consumers want about natural sweetener.

Methods:

Qualitative and quantitative methods were be used in this research. Potency in resource, and social of brown sugar were be investigated by qualitative method. The data were be collect by survey in South east Sulawesi Province in Indonesia and by study of literature. Require data in this case were distribution and characteristic of aren (*Arenga Pinnata (Wurmb) Merrill*), sap productivity, and its adaptability, demographic of brown sugar producer, and their habit in processing brown sugar.

Potency in economics of brown sugar were be investigated by quantitative method, namely R/C ratio analysis. R/C ratio shows feasible or not the brown sugar business.

$$R/C \text{ ratio} = \frac{R}{C}$$

Where R is revenue of brown sugar producer from brown sugar business (\$/month), and C is total production cost (\$/month). Total production cost contain of fixed and variable cost. Brown sugar business is feasible if R/C ratio >1, and it is not feasible if R/C ratio <1. The result of R/C ratio will be compare with previous studies in order to obtain generalization about economic feasibility of brown sugar business.

RESULTS AND DISCUSSIONS

Brown sugar has great potential as a natural sweetener, substitution of sugar cane for the fulfillment of sweetener consumption of society in the world and Indonesia in particular. The potential assessed in three aspects, namely resources, social, and economic potency.

Resource potency:

Discussion about the resource potency of brown sugar include the assessment distribution of *aren trees* in the world with their advantages and disadvantages as the main source of raw material (sap) on the manufacture of brown sugar. In this case the content of the natural nutrient in the sap and the brown sugar was examined also.

The raw material of brown sugar is derived from the sap of palm plants, such as *aren* (*Arenga pinnata* (Wurmb) Merrill), *coconut* (*Cocos nucifera*), *siwalan* (*Borassus flabellifer* L.). Among the types of palm plant, *aren* (*Arenga pinnata* (Wurmb) Merrill) produce abundant sap. Average sap of *aren* 10-15 liters per tree per day [13]. The other study by [14] said that the average production of sap was highest was produced by *aren* in 10 to 20 years as much 20.83 liters per tree per day while *aren* in 21 to 30 years only produce 7.95 liters per tree per day. Compare with other palm trees, namely; according to [15] that the sap production of *siwalan* (*Borassus flabellifer* L.) is 5-6 liters per tree per day, and [16] said that the sap production of *coconut* (*Cocos nucifera*) is 3-5 liters per tree per day.

Aren grows naturally in the tropical regions. Spread of *aren* region cover: Southeast Asia to Papua east part, Japan (Ryukyu Island), Vietnam (Annam) and east Himalaya [17]. Native to Southeast Asia (Indonesia, Malaysia, Brunei, Singapore, Philippines, Sri Lanka, Thailand, Vietnam Papua New Guinea, Bangladesh, Cambodia, India, Laos, Myanmar,), occurring in tropical rainforest and dry forest [16]. In southern Thailand, *aren* is widely grown in Petchaburi and Songkhla Provinces [12].



Fig. 2: Distribution of native countries of *aren* Source: [18]

Table 2: Palm planted area in Indonesia, 2002

| No | Province | <i>Aren tree</i> area (Ha) |
|-------|---------------------------|----------------------------|
| 1 | Moluccas | 1,000 |
| 2 | South Kalimantan | 1,442 |
| 3 | Banten | 1,448 |
| 4 | Bengkulu | 1,748 |
| 5 | West Sumatra | 1,830 |
| 6 | North Moluccas | 2,000 |
| 7 | Southeast Sulawesi | 3,070 |
| 8 | Central Java | 3,078 |
| 9 | Nangro Aceh Darussalam | 4,081 |
| 10 | North Sumatera | 4,357 |
| 11 | North Sulawesi | 6,000 |
| 12 | South Sulawesi | 7,293 |
| 13 | Papuan | 10,000 |
| 14 | West Java | 13,135 |
| Total | | 60,482 |

Source : [19]

The map above shows countries where the species could growth. But, it did not mean the species could not growth in other countries than those depicted.

Aren has a different name (local name) in each country, namely : Indonesia (*aren, ejow, gomuti, kaong*); Thailand (*tao, chok, kaong*); Vietnam (*doasc, busng basng*); Burma (*taung-ong*); Lao (*Sino-Tibetan*) (*taw tad*);

English (arenga palm, sugar palm, sagwine); French (*palmier areng, palmier à sucre*); German (*Zuckerpalme*); Italian (*palma dello zucchero, palma arenga*); Spanish (*palma azucarera*), Holand (suiker palm), [18].

Indonesia has a large resource potential of *aren* trees. *Aren* trees found in most parts of Indonesia. [19] said that in Indonesia, there are 14 provinces from 34 provinces that have the abundance of *aren tree*. It is shown in Table 2.

Table 2 showed that West Java as the highest *aren tree* area, while the Southeast Sulawesi has the fifth largest area plantation among the fourteen provinces in 2002 (3,070 Ha). However, there has not been definite data about *aren tree* area until now. This is because *aren* has not been cultivated specifically but only grows wild. *Aren* trees are also found in several other areas that are not mentioned in the table, but with a smaller population distribution, such as: East Java, East Kalimantan, Yogyakarta, Gorontalo, West Sulawesi, South Sulawesi, North Sulawesi, and Central Sulawesi.

Breadth distribution of *aren trees* was caused its height adaptability. [20], [21], [22] said that *aren tree* has well adapts to a variety of agro climate, ranging from lowlands to 1,400m. [23] also reported that the *aren trees* grows from sea level to an altitude of 1,300 m above sea level, but this plant is more like a place with a height of 500-1,200 m [24]. *Aren trees* will give satisfactory results when it is cultivated in places with an altitude of 500-700 m above sea level [23]. Soil conditions are adequate nest or excess water can pass, such as loose soil, volcanic soil on the slopes, and the soil is sandy land around the banks of the river is ideal for growing of *aren trees*. The best environmental temperature 25°C with an average annual rainfall of 1,200 mm on average.

In addition, to the excellence of its adaptation power so as to ensure the availability of raw material for brown sugar on a large scale, *aren trees* also has a very good conservation benefits. [21] said that *aren trees* has a high tolerance in a mixed cropping pattern including the fast growing woody plants as well as have a lot of roots and dense canopy is suitable to be developed as well on marginal lands. In addition, [25] said that the *aren trees* produces biomass above-ground and in the soil that are very large so it plays an important role in the CO₂ cycle.

In line with what was said by [17] about some advantage of *aren trees*, namely: a) it has high adaptability to various soil and agro climate condition, even though no intensively cultivation. b) it has high hydrological function (relatively fast growing and has dense root and crown) making it suitable for plant conservation, c) it has high tolerance in mixed cropping pattern including timber plants. It was reported by [26] that *aren trees* constitute an important resource at the local level that has a great potential as a component in agro-forestry systems.

Another advantage is that the *aren trees* can thrive even without fertilization. This as the result of research by [27] where the non-fertilizer application gave a better net benefit than the three fertilizer formulations for the sugar palm (*aren trees*) growth. Therefore, [28] recommend that the sugar palm could be planted in community forests in northern Thailand using plenty of water, with a proper tillage practice, and without costly fertilizer. This condition is also supporting the naturalness of brown sugar made from sap of *aren trees* (sugar plant).

One indicator that brown sugar is a natural sweetener is raw materials derived from *aren tree* that grow naturally without the use of artificial fertilizers and pesticides. No pest and diseases have been reported [28]. Next, [28] said that brown sugar does not use artificial colorants and aroma enhancer. Moreover, brown sugar is a nutrient-rich, low-glycemic crystalline sweetener that looks, tastes, dissolves and melts almost exactly like sugar, but it's completely natural, unrefined and it has a far superior taste [11].

Actually brown sugar has been known and used by some countries since some years ago. This is shown by the variation of the local names which vary by country and even in some regions within a country. Indonesia, Malaysia, Philippines, Thailand, India, Brazil, Mexico, and Venezuela has developed to produce palm sugar. There is some local name of brown sugar in some country [29] as follow: Indonesian: *gula kelapa, gula aren, gula merah, gula Jawa*; Malaysia: *gula anau, gula Melaka* (coconut palm), *gula kabung* (arenga pinnata palm/sugar palm); Philippines: *Pakaskas*; Thailand: *nam tan pip* (น้ำตาลปีบ; pronounced [ná:m.tā:n.pí:p]) or *nam tan puek* (น้ำตาลปีค; pronounced [ná:m.tā:n.pù:k]); Vietnam: *đường thốt nốt*; Sri Lanka: *jaggery, kitul-hakuru, tal-hakuru, pol pani*; Laos: *nam tan pip* (ນ້ຳຕານປິບ; pronounced [nám.tā:n.píp]); Bangladesh/Bengal: *gur* (cane sugar), *taal patali* (solid palm sugar), *khejur gur* (date palm sugar); Cambodia: *skor tnot*; Burma: *jaggery, htanyet* (pronounced: [tʰəneʔ]); Telugu: *nalla bellam, thaati bellam* (Palm Jaggery); India: *kerala, karippati* atau *karipotti*, Kannada: *bella*.

[19] also reported that brown sugar is produced by country who has tropic climate, namely Indonesia, Thailand, Vietnam, India, Korea Selatan, China, Bolivia, and Brazil. Indonesia as one of develop country that produce brown sugar have big potency as exporter country of brown sugar. Develop country as a producer country as well as a potential market of brown sugar. It is suitable with [30] who said that emerging markets have become an important economic pole, and rising interest in investment opportunities in these markets has spread among investors.

Brown sugar was a widely used health food in ancient India. Even now in many Indian Villages it is being widely used. This is especially significant for women's health [31]. Next, [31] reported that traditionally that

brown sugar has lots of medicinal qualities. It is widely used in Indian medical sciences like *Siddha* and *Ayurveda*. It is known to be effective against cold and lung related ailments.

Brown sugar potential as a sugar cane substitute is not only caused by the same function as a sweetener, but also because of its nature, unique flavor and aroma, as well as its nutritional content. Compared to sugar cane, brown sugar content has calcium, phosphorus, and iron higher, also contains thiamine and riboflavin [32]. It is showed by Table 3.

Other health benefits of brown sugar has been reported by [33] that smaller calories contained in a brown sugar than sugar cane. Palm sugar or brown sugar has a glycemic index value that is lower by 35 while the sugar cane has a glycemic index of 58. Brown sugar still has the main benefit such as environmentally friendly. It is because brown sugar is made from palm sap that is free from pesticide. [34] also reported about comparison between palm sugar (brown sugar) and sugar cane. It is shown on Table 4.

Table 3: Comparison of macro and micro minerals in brown sugar and sugar cane

| Mineral | Brown Sugar | Sugar cane |
|--|-------------|------------|
| Micro Mineral mg/L (ppm) in dry matter | | |
| Manganese (Mn) | 1.30 | 0.00 |
| Baron (B) | 0.30 | 0.00 |
| Zinc (Zn) | 21.90 | 1.20 |
| Iron (Fe) | 2.30 | 1.20 |
| Copper (Cu) | 2.30 | 0.60 |
| Macro Mineral mg/L (ppm) in dry matter | | |
| Nitrogen (N) | 2.02 | 0.00 |
| Phosphorus (P) | 790.00 | 0.70 |
| Potassium (K) | 10.30 | 25.00 |
| Calcium (K) | 60.00 | 60.00 |
| Magnesium (Mg) | 290.00 | 10.00 |
| Sodium (Na) | 450.00 | 10.00 |
| Chlorin (Cl) | 4.70 | 100.00 |
| Sulfur (S) | 260.00 | 20.00 |

Source: [33]

However [35] said that brown sugar processing is still traditional business and only done by a household. In contrast to the processing of sugar cane, it is produced by large-scale industries. Similarly in Province of Southeast Sulawesi of Indonesia, Brown sugar processing business is generally characterized by a very simple technology and rely solely on family labor or even just doing one or two people. Supply of brown sugar fluctuates widely in these conditions.

Table 4: Comparison Palm Sugar with Sugar cane.

| No | Palm sugar | Sugar cane |
|----|---|--|
| 1 | Free from Chemicals, bleaches, preservatives and GMO. | Bleached using harmful chemicals and bleaches, the traces of which are very much present in the Sugar. |
| No | Palm sugar | Sugar cane |
| 2 | Highly Nutritious, contains about 24 nutrients including Vitamins, Minerals and Protein. | Contains hardly any nutrients. |
| 3 | All nutrients are natural and not fortified or artificially added. | Contains hardly any nutrients. |
| 4 | Contains Vitamin B12, which is very rare to find in Plant Sources. Consumption of 15 gram of Palmyra Palm Sugar daily takes care of daily Vitamin B12 requirement of an adult. | Contains hardly any nutrients. |
| 5 | Traditionally in India women are suggested to consume palm sugar as a first thing after giving birth to a child and immediately after Puberty, because of its high nutritional content. | Contains hardly any nutrients. |
| 6 | Contains Low Glycemic Index. The Glycemic index is only 40. Replacing cane sugar with palm sugar is a big step for diabetics, heart patients, cancer patients and obese people. Normal people by replacing Palm Sugar with sugar cane, the risk of diabetics, obesity and heart ailments are reduced. | Contains High Glycemic Index. The GI of cane sugar is more than 92. This makes it harmful for Diabetic patients, heart patients, cancer patients and Obese people. |
| 7 | Safe for infants to have Palm Sugar as it is free from chemicals and bleaches. | Because of presence of harmful chemical, unsafe for infants to consume. |
| 8 | Consumption of Palm sugar does not make children hyperactive. | Consumption of cane sugar makes children hyperactive. |
| No | Palm sugar | Sugar cane |
| 9 | Palm sugar is certified organic. | Most of the cane sugars available in the market are not organic. |
| 10 | Palm sugar is free from flocculent, surfactants, viscosity modifiers | The process of making cane sugar crystals includes these process |
| 11 | Adds unique exotic flavor apart from sweetening the | Merely sweetens the dish. |

| | | |
|----|---|--|
| | dish. | |
| 12 | Contains medicinal properties. Used in many Ayurveda medicines and in varieties of indigenous medicines of India. By itself it is considered as a medicine for cough cold and breathe related problems. | Does not known to have any medicinal properties. |
| 13 | Palm trees are dry land flora. They consume very less water. Consuming Palm Sugar is ecofriendly way of living. An acre used for Palmyra tree cultivation can give more than one and half times of Palm Sugar yield than that of cane sugar. In today's population pressure over land this is very significant. | Sugar cane consumes lots of water. To get 1 kg of cane sugar, the water consumed is much higher than that of Palm Sugar. |
| 14 | Palm sugar consumption brings in equality in economy as this supports unprivileged palm tree tappers life. Since palm sugar comes with minimal processing, the proportion of money spent on processing is less and proportion paid to the farmers is more. | Proportion of money which goes to palm tree tappers out of every sale price paid by the customer is high than that of cane sugar. Large share of the money paid by the end customer goes to big sugar mill owners and to meet out huge processing expenditure. |
| 15 | Palm Sugar is the Traditional staple sweetener of India. This is the cause of health of Indians for many centuries. | Introduced and popularized to Indians by the British. Cane Sugar is one of the cause of current health problems of majority of Indians through prolific Diabetes, Anemia and Malnutrition. |

Source: [36]

The fluctuating of brown sugar supply can weaken the Southeast Sulawesi potential market of brown sugar. Meanwhile, the certainty supply is requirement for good trade of brown sugar mainly for export purpose. Understanding of risk analysis is also important in this case. This is as proposed by [36] that is not everyone knows the inherent risks involved in investing or how to strike a correct balance between risk taking and making a profit. Next [37] said that Business risk is fundamental to the long term success of a company and the achievement of its goals.

Social potency:

Discussion about the social potency of brown sugar include the assessment of the social aspect of the brown sugar processing. These include: how to acquire knowledge about the processing of brown sugar, and the characteristics of brown sugar producers (age, education).

Many social activities became a cultural community around brown sugar producers. Knowledge about creating and managing of brown sugar business are not obtained through a training or special education. Knowledge in managing brown sugar business is obtained based on personal experience and participate in helping a neighbor or family relatives. There is some of brown sugar producer who obtain their knowledge from generation to generation in his family. That is one of the social potential of brown sugar. There is an easily transmitted knowledge of brown sugar processing that only based on emotional relationship between one to another person. It could be used to expand the spread of brown sugar business in many *aren trees* center.

Brown sugar business became source of livelihood for many people in the central areas of the *aren trees* In Indonesia. Thus the characteristics of brown sugar producers needs to be studied as one of the potential development of brown sugar business.

Brown sugar processing business consist of two types of activities, namely tapping and cocking the sap. These activities are still carried out without involving labor rent (labor outside the family). This is because a very small scale of that business. Brown sugar producers only tap averages 7 of *aren trees* every day. Small number of workers as well because they can maximize their energy in that business. This is because their average age in the range of productive age. It is shown in Table 5.

Table 5: Characteristic of brown sugar producers by age in the South East Sulawesi, 2014

| No | Location (district) | Age | | | | | |
|----|---------------------|----------------------------|-------|---------------------------|-------|------------|--------|
| | | Productive (15 - 54 years) | | Non productive (>54years) | | Total | |
| | | ∑ (people) | % | ∑ (people) | % | ∑ (people) | % |
| 1 | Kolaka | 113.00 | 77.40 | 33.00 | 22.60 | 146.00 | 100.00 |
| 2 | Bombana | 140.00 | 70.00 | 60.00 | 30.00 | 200.00 | 100.00 |
| 3 | Muna | 13.00 | 65.00 | 7.00 | 35.00 | 20.00 | 100.00 |

Source: [38]

Table 5 showed the characteristic of brown sugar producers by age in the South East Sulawesi, contained in three districts, namely Kolaka, Bombana and Muna. Table 5 showed that there is no old less than 15 years of brown sugar producers, and only 30% at most of brown sugar producers over the age of 54 years.

The research by [39] also showed the dominance of people on productive age range who produce brown sugar. It is shown in Table 6.

Table 6: Characteristic of brown sugar producers by age in the Rejang Lebong District Bengkulu Province, 2013

| Age (year) | Quantity (%) |
|------------|--------------|
| 25-40 | 40.69 |
| 41 – 55 | 45.36 |
| 55-80 | 13.95 |

Source: [39]

Brown sugar processing business is dominated by processing the productive age. It indicates that the business of processing of brown sugar can be used as a potential jobs for people in the productive age who do not have jobs. This case as well as a solution for unemployment in Indonesia. The number of unemployed in Indonesia 2014 at 7.15 million people or 5.70% of the total labor force in Indonesia [40].

The level of education is usually a requirement to get a job, but not in the brown sugar business. It can be seen in Table 7.

Table 7: Characteristic of brown sugar producers by education in the South East Sulawesi, 2014

| No | Formal education | Location (District) | | | | | |
|----|--------------------------|---------------------|--------|-------------------|--------|-------------------|--------|
| | | Kolaka | | Bombana | | Muna | |
| | | Σ (people) | % | Σ (people) | % | Σ (people) | % |
| 1 | No school | 10.00 | 6.85 | 15.00 | 7.50 | 3.00 | 15.00 |
| 2 | Elementary School (SD) | 70.00 | 47.95 | 97.00 | 48.50 | 13.00 | 65.00 |
| 3 | Junior High School (SMP) | 58.00 | 39.73 | 63.00 | 31.50 | 4.00 | 20.00 |
| 4 | Senior High School (SMA) | 8.00 | 5.48 | 25.00 | 12.50 | 0.00 | 0.00 |
| 5 | University | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Total | 146.00 | 100.00 | 200.00 | 100.00 | 20.00 | 100.00 |

Source: [38]

Table 7 showed the characteristic of brown sugar producers by education in the South East Sulawesi, (District of Kolaka, Bombana, dan Muna). Brown sugar business is done by those who have only 9 years of basic education (elementary school, middle), mostly. It can be explained that the no school certificate and no special skills required to run this business.

The research by [3] also showed the dominance of people on primary education who produce brown sugar. It is shown in Table 8.

Table 8: Characteristic of brown sugar producers by education in the Rejang Lebong District Bengkulu Province, 2013

| Education level | Quantity (%) |
|--------------------------|--------------|
| Elementary School (SD) | 30.25 |
| Junior High School (SMP) | 66.27 |
| Senior High School (SMA) | 3.48 |
| Total | 100.00 |

Source: [39]

These data in accordance with [40] who reported that in February 2014, Unemployment Rate (TPT) for senior high school education in the highest position in the amount of 9.10 percent, followed by junior high School by 7.44 percent, while the TPT lowest for the primary education level down in the amount of 3.69 percent.

Skill about how to process brown sugar that have been mastered though by less educated population is a potential for the development of brown sugar business in terms of business scale, and it can more easily in the development of quality and product differentiation, also. It is because they have learned the basic skills in the business a long time ago.

Economic potency:

Economic potential is explored by analyzing the financial feasibility of the business of brown sugar processing. Brown sugar business was done in traditional way at household industry. In this condition, brown sugar business was highly depend on forest natural resources where *aren trees* grow. Therefore many inputs that were not counted as costs. However, it is need to be assessed all costs incurred by brown sugar producers for the existence and development of brown sugar business in the future.

The feasible was be showed by the value of R/C ratio. R is revenue and C is cost. Therefore we will describe about costs and revenue of brown sugar business, firstly. There are two kinds of cost namely fixed and variable cost. It were shown on Table 9 and 10 as below. Brown sugar processing was done every day, actually. It mean that fixed and variable cost expenses every day.

Some types of equipment (the source of fixed costs) are used in the processing of brown sugar (in Table 9), described as follows:

- Container are used to hold sap when tapping on a palm tree. There are two or three bunches that could be tapped and one jerry for one bunch.

- Bamboo ladder are used to help brown sugar producer to climb *anaren trees* for tapping. One of bamboo ladder for one *aren trees*.
- Machete is used to slice as thin as possible so that the bunch can spend abundant sap.
- Skillet is used to cook the sap until thickened and ready to be molded into brown sugar.
- Kitchen was a special kitchen for brown sugar processing. This is outdoor or on the farm where the *aren trees* grows.
- Brown sugar mold is used to print saps that has been cooked and thickened.
- Spoon stirrer is used to stir the sap while cooking process so as not to scorch.

Table 9: Fixed costs (FC) of brown sugar business

| No | Equipment | Depreciation cost (\$/month) | % |
|----|------------------|------------------------------|--------|
| 1 | Container | 0.07 | 4.26 |
| 2 | Bamboo ladder | 0.36 | 21.32 |
| 3 | Machete | 0.09 | 5.33 |
| 4 | Skillet | 0.36 | 21.32 |
| 5 | Kitchen | 0.71 | 42.64 |
| 6 | Brown sugar mold | 0.06 | 3.84 |
| 7 | Spoon stirrer | 0.02 | 1.28 |
| | Total | 1.68 | 100.00 |

Source: primary data

Table 9 showed various kinds of fixed cost of brown sugar business that came from the use of all the equipment for one *arentree* in a month. Fixed cost was be accounted by depreciation cost. The biggest depreciation cost came from kitchen building (42.64%), while spoon stirrer was the smallest depreciation cost (1.28%). There were the same depreciation cost for bamboo leader and skillet, namely 21.32% from total depreciation cost.

Various kinds of variable cost less than fixed cost. There were four variable cost at Table 10 as bellow.

Table 10: Variable costs (VC) of brown sugar business

| No | Equipment | Variable cost (\$/month) | % |
|----|-----------|--------------------------|--------|
| 1 | Sap | 78.26 | 27.44 |
| 2 | Lime | 0.43 | 0.15 |
| 3 | Wood fire | 43.48 | 15.24 |
| 4 | Labor | 163.04 | 57.16 |
| | Total | 285.22 | 100.00 |

Source: primary data

Most of brown sugar producers obtained sap from *aren trees* that grows wild in his plantation. Even so the sap should be counted as variable costs for development of brown sugar business in the future, and so for wood fire and labor. An *aren tree* could produce minimal 10 litters and maximal 50 litters of sap per day, where 1 kg of brown sugar was produced from 4.4 litters of sap. Therefore, an *aren tree* produced 6.82 kg of brown sugar by price \$1.45 per kg. Lime purchased by brown sugar producers and used to inhibit the acidification process sap. This is the smallest variable cost.

Table 10 showed that labor cost was the highest variable cost. It could be explained that brown sugar processing needs a long time, about 10 hours. After ten hours of which brown sugar has been molded, the work of a brown sugar producers is not finished, actually. He have to cook the sap that was tapped in the afternoon until the next morning with a small flame. It is done to prevent the sap became acid so it still can be mixed with morning sap and then processed into brown sugar. This continuous cooking process of sap resulting in high demand for fuel.

Base on all information above, now we can analysis the feasibility of brown sugar business like Table 11 below.

Table 11: R/C ratio of brown sugar business in the Province of Southeast Sulawesi, Indonesia, 2014

| Brown sugar Production (kg) | Price (\$/kg) | FC (\$) | VC (\$) | TC (\$) | R (\$) | R/C |
|-----------------------------|---------------|---------|---------|---------|--------|------|
| 204.55 | 1.45 | 1.68 | 285.22 | 286.89 | 296.44 | 1.03 |

Source: primary data

Table11 showed the difference between revenue (R) and cost (C), where $R > C$. Therefore the value of R/C ratio bigger than one (R/C ratio >1). It mean that brown sugar business is feasible, so it can exist and develop for the future business. However, the small value feasibility is not disputed by brown sugar producers because of the circulation of brown sugar is very fast. Brown sugar produced every day is always sold out, and even when there is some orders for the next day.

The feasibility of very small numbers even close to one, which means the breakeven point ($R=C$). This happens because of the very large dependence against the nature of brown sugar producers in processing brown sugar. As a result, many production inputs are not counted as expenses so that they cannot take into account how the price of brown sugar per kg that they deserve or that can cover the expenses for production inputs as well as providing a profit. In this condition, regardless of the price of brown sugar in the level of trader will still be accepted by brown sugar producers. It is also caused by brown sugar business that is very small scale so that these businesses bear higher costs. It can be overcome by expanding the production scale so that the production cost becomes more efficient. The feasibility can be improved by increasing the sap raw material acquisition to more than 30 liters per tree. This can be done by intensive cultivation of *aren trees* and improve the skills in tapping activities.

Some researchers have examined the business feasibility of brown sugar in various regions in Indonesia such as follow:

[41] showed R/C ratio = 1,12 for brown sugar business in the Dukuh Village, Ngadiluwih Sub District, Kediri District, East Java Province, [42] showed R/C ratio = 1,63 for brown sugar business in the Tuhaha Village, Saparua Sub District, Maluku Tengah District, Maluku Province, [43] showed R/C ratio = 3,06 for brown sugar business in the Mungka Sub District, Lima Puluh Koto Kota District, West Sumatera Province, [44] showed R/C ratio = 1,32 for brown sugar business in the Makian Village, Bacan Selatan Sub District, Halmahera Selatan Province, [45] showed R/C ratio = 1,56 and 1,65 respectively for the wet and dry seasons for brown sugar business in the Rejang Lebong District, Bengkulu Province, [46] showed R/C ratio = 1,5 for brown sugar business in the Bekoso Village, Pasir Belengkong Sub District, Paser District, East Kalimantan Province, [47] showed R/C ratio = 1.26 for brown sugar business in the Kulon Progo District Yogyakarta Province, and [48] showed R/C ratio = 1.86 for brown sugar business in the Cikuya Village, Culamega Sub District, Tasikmalaya District, West Java Province, [49] showed R/C ratio = 2.12 for brown sugar business in the Tulo'a Village Bulango Utara Sub District, Bolango District, Gorontalo Province.

All of these studies indicate that the brown sugar business in various regions in Indonesia is financially feasible. It shows the economic potential of brown sugar business. Therefore brown sugar business can also be carried out in various regions in Indonesia and in other countries in Southeast Asia, also. This business can also be scaled up so that it can supply more natural sweetener needs of the world community.

Conclusion:

This paper is a qualitative and quantitative analysis. Some things are studied in this paper is on the various potentials of brown sugar as a natural sweetener in terms of resource, social, and economic potential.

First, potential resources in the form of a broad distribution of *aren trees* as a source of raw material of brown sugar in mainland Southeast Asia and there is abundant population in the Province of Southeast Sulawesi, Indonesia, the high productivity of sap of *aren trees*, length productive age of *aren trees*, high adaptability to various climatic and soil conditions coupled with the additional benefits of plant conservation. Resource potential is also indicated by the naturalness of *aren trees* that are free of artificial fertilizers and pesticides, the excellence nutrient content of *aren* sap and brown sugar, and the uniqueness aroma of brown sugar, also.

Second, social potential in the form of easily transfer skills to produce brown sugar through the emotional closeness of the relationship between the brown sugar producers. Social potential is also shown in the form of easily recognized and run of brown sugar business by people who only have primary education, so that the business as employment for the population in the productive age. And third, economic potential is indicated by the feasibility value of the brown sugar business.

The implication of this study is about information to explore the potential of resources, social, and economics of brown sugar as a natural sweetener internationally.

Contribution of this study to the knowledge is a belief that the community needs for health valuable natural sweetener is feasible, both on a local scale in the Province of Southeast Sulawesi, a national scale in the Country of Indonesia, as well as on a world scale. This is because (a) the availability of *aren trees* as a source of raw materials brown sugar (natural sweetener) which also has a variety of advantages abundant in mainland Southeast Asia, and particularly in the state of Indonesia, (b) availability of abundant human resources that have been very familiar with the processing of brown sugar, and (c) the feasibility of brown sugar business which has been analyzed in this study and also by previous researchers.

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