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To cite this article: Makkarennu *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **681** 012121

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240th ECS Meeting ORLANDO, FL

Orange County Convention Center Oct 10-14, 2021



Abstract submission due: April 9

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Forest resource accounting: Physical accounts and monetary accounts for sugar palm in South Sulawesi, Indonesia

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Abstract: The objective of this research is to analyze a balance sheet giving a profile of what stocks of the sugar palm (*Arenga pinnata*) resource are available at a given point in time and prepare an account of what uses are made of these stocks, what sources they are derived from and how they are added to or transformed over time. This study was conducted at the Bonto Sinala Village, Sinjai District, South Sulawesi. The method used in this research is resource mapping, observation, and interview. The physical accounts and monetary accounts are analyzed by calculating the number of initial reserves in the study year, plus planting then deducting the amount of depletion so that the final amount of reserves will be obtained. The results show that the final reserve of palm sugar seen from the physical balance sheet had a value of 339.360 kg and a monetary balance of IDR 9.048.933.384. The utilization of sugar palm will shrink every year if there is no sustainable management of forest products.

1. Introduction

Forests tend to be overused, which results in damage to the forest itself. Since the commencement of large-scale utilization of forest products in Indonesia, forests have become the main capital in improving the national economy, which has a positive impact [1], especially to support the livelihood of people who lived around the forest [2,3] The use of forests also has a negative impact on where social and environmental problems occur, which will endanger the future. The problem consists of decreasing forest production, the economical quality of the people who live around the forest. Meanwhile, Natural resource reserves are the real wealth of a nation that can increase prosperity. The role of natural resources in development is as a source of raw materials in production activities with the continued development of an economy followed by the development of population and depletion of natural resources [4,5]

Excessive use of natural resources without regard to how to preserve it by itself will increase pressure on the environment, which will affect the adequacy of future community needs. Natural resources, if properly harnessed, can play a significant role in social and economic development [6] [7]. It is one of the capitals that needs to be developed and optimized to support the development of a region [8]. However, the use of natural resources must pay attention to conservation and efforts to preserve its ecosystem functions [4]. Non-timber forest products (NTFPs) generally play a role not only in ecological aspects but also in economic and socio-cultural aspects. NTFPs use fulfills multiple livelihood functions, including directly providing consumptive goods, safety nets during adverse periods, income generation from the sale, and maintaining cultural traditions and knowledge [9,10]. Besides the existence of NTFP production and processing activities, one of the advantages of NTFPs



compared to timber forest products is that their utilization and processing require small to medium capital and can utilize simple to medium technology [11].

Bonto Sinala will be designated as one of the industrial centers of palm sugar in South Sulawesi, the selection of Bonto Sinala as one of the centers of the palm sugar industry with the consideration that besides abundant raw materials, road infrastructure facilities are quite good. This area is capable of producing approximately 400 liters of sugar a day. *Arenga pinnata* is a plant that produces industrial materials because almost all parts of this plant can be utilized and have economic value. Most palm trees are cultivated by farmers and have not been cultivated on a large scale. The main products of sugar palm plants are tapping sap from male flowers, which are made into palm sugar and soft drinks, vinegar, and alcohol [12]. Aren or sugar palm is a multipurpose tree that provides livelihoods for local people [13], with agroforestry is expected to contribute to community-based forest conservation efforts [14].

One of the obstacles to the utilization of palm sugar cultivation is the lack of information regarding the number of initial reserves to the last reserves of the utilization of forest products. Meanwhile, to maintain stability, the utilization of forest products needs to be calculated to find out the number of reserves or potential of natural resources in a region. Accounting forest resources have several policy useful benefits. That is why it is important to maintain such accounts that incorporate all those benefits [15]. The calculation of natural growth should be based on the forest resources available at the initial reserve of the accounting period [16]. One of the benefits of the development forest account is the regular production of coherent information on the stock, changes in stock, and relevant flows of goods and services from environment resources [17].

The physical balance can describe changes in the number of natural resources, which include the value of changes in initial reserves, planting, depletion, and final reserves in units of weight and volume while the monetary balance to calculate revenues from natural resources in Rupiah units, to obtain information on utilization value, balance sheet needed to provide information about the value of the use of natural and environmental resources so that their use is more efficient and efficient [18]. From the changes that occur, both with increasing and decreasing can be used as the basis for determining development policy; therefore, researchers need to calculate the amount of utilization of forest products. In this paper, we calculate the physical balance and monetary balance to determine the number of palm trees available, used, and remaining so that the sustainability of palm trees is maintained.

2. Methodology

2.1. Study Site

This research was carried out in Bonto Sinala Village, Sinjai Borong Subdistrict, Sinjai Regency, South Sulawesi Province. Bonto Sinala Village was chosen as the location of the study because the villagers had carried out activities to utilize forest products in the form of palm sugar both for trading and daily consumption. Bonto Sinala Village is a village in the western end of Sinjai Regency, which borders directly with the Bulukumba Regency, which is the village resulting from the expansion of Biji Nangka Village, Sinjai Borong District, Sinjai Regency. Bonto Sinala Village has an area of 390 Ha. The population of Bonto Sinala Village is 1,496 people, consisting of 742 men and 754 women with 415 households. While the number of low-income families is 202 households, with a percentage of 24.31% of the number of families in Bonto Sinala Village. Palm sugar is one of the products of non-timber forest products that have been known by the broader community in South Sulawesi, especially in Bonto Sinala Village, Sinjai Regency as a maker of palm sugar using traditional methods

2.2. Methodology

The data collected consists of primary data and secondary data, where primary data consists of the number of trees owned by farmers. The number of trees being harvested, the number of trees that have not been harvested, palm juice per day production, sugar production per day, sugar prices, labor needed, and equipment needed to make sugar. Primary data were collected through preliminary observations, interviews with questionnaires. The number of respondents is 22 people who are farmers who are landowners and palm sugar makers in the Bonto Sinala Village. Secondary data consists of general information about the place of research. Also, other information obtained through literature study reports on research results relating to research

2.3. Data Analysis

This research was analyzed by using physical balance and monetary balance. The initial reserve for the year of the study is added to the amount of planting, then reduced by the amount of depletion so that the final reserve will be obtained. Formulation of the final reserve can be seen below (Suparmoko, 2006):

$$\begin{array}{rcl}
 \text{a. Initial reserve} & \dots\dots & \\
 \text{Additions to stock} & \dots\dots & + \\
 \text{Total a} = & \frac{\dots\dots\dots}{\dots\dots\dots} & \\
 \text{b. Depletion} & \dots\dots & - \\
 \text{Final reserve} = & \frac{\dots\dots\dots}{\dots\dots\dots} &
 \end{array}$$

Notes:

1. Initial reserves are the number of sugar palm trees owned by farmers
2. Additions of the growing number of sugar palm trees at this time as stocks are expected to be harvested in the future
3. Depletion is shrinkage or the amount of resources taken in one year.

The monetary balance of forest products utilized by the community is calculated from the amount of initial reserves, additions, and depletion, which are converted into the unity of Indonesian Rupiah/IDR (1USD = 14,932.90 IDR on 2 May 2020). The amount of the initial rupiah value added by adding will be reduced by depletion so that the final reserve will be obtained. The monetary balance can show the true value of the resource's final reserves. If there is a difference in the initial price of the year with the year-end price (Revaluation), it is best to make adjustments to the value that can be discussed by the community and related parties. But the value of the year-end reserve will always be the same as the reserve value at the beginning of the following year.

According to Suparmoko (2006) to calculate monetary balance using the method :

$$\begin{array}{rcl}
 \text{a. Initial reserve} & \text{IDR } \dots\dots & \\
 \text{Additions} & \text{IDR } \dots\dots & + \\
 \text{Total a} = & \frac{\dots\dots\dots}{\dots\dots\dots} & \\
 \text{Revaluasi} & \text{IDR } \dots\dots & + \\
 \text{b. Depletion} & \text{IDR } \dots\dots & \\
 \text{Final reserve} = & \frac{\dots\dots\dots}{\dots\dots\dots} &
 \end{array}$$

Information

1. Initial reserves are the number of trees owned by farmers. Initial reserves are expressed in units of money.
 2. Additions of the growing number of sugar palm trees at this time as stocks that are expected to be harvested in the future
 3. Revaluation is a change in prices at the end and beginning of the year
 4. Depletion is shrinkage or the amount of resources taken in one year.
- To get the value of forest depletion is obtained by multiplying the production volume of each type of forest resource utilized by the community with its unit rent or unit price.

$$D_x = (Q_x) (U_x)$$

Where:

D_x = Depletion value

U_x = Unit rent

Q_x = Volume of forest resources taken.

Calculating the amount of depletion requires unit rent calculations where unit rent is the economic rent value per unit, which uses the cost of taking per unit, including the value of earnings per unit that is acceptable to the taker from the market price of forest resource products.

Price per unit	IDR	
Production cost per unit (Materials, labor, rent, dsb)	IDR	
	—————	(-)
Gross profit per unit	IDR	
Decent profit, per unit (interest rest x production cost per unit)	IDR	
	—————	(-)
Rent forest products unit	IDR	

3. Results and Discussion

3.1. Physical Balance of Palm Sugar

The physical balance sheet is the state of the initial stock and the final stock of resources accompanied by the changes stated with the appropriate physical units. These changes can be in the form of additions and subtractions. Additional reserves can occur due to natural planting and growth. Changes can occur due to exploration. Physical balance describes changes in the quantity of each type of natural resource, which includes changes in the initial reserves, planting, depletion, and final reserves. The physical balance in the form of palm juice used by the community in Bonto Sinala Village was analyzed using liter units.

3.1.1. Initial Reserves of Palm Sugar

The initial reserve shows the number of resources owned by farmers, the number of initial reserves of palm sap owned by farmers in 2018 presented in Table 1.

Table 1. Total Initial Reserves of Palm Sugar 2018

Respondents	Initial Reserves 2018		
	Trees	Nira (liter)	Palm Sugar(kg)
1	20	65700	7300
2	10	18250	7300
3	3	18615	4106.3
4	25	91250	9125
5	10	62050	10950
6	5	9125	1825
7	8	19466.7	2920
8	15	54750	6843.8
9	5	18250	5475
10	15	22995	4380
11	30	219000	32850

12	6	10950	2190
13	100	182500	36500
14	30	78214.3	18771.4
15	20	36500	7300
16	10	31025	9125
17	20	124100	29200
18	20	60833.3	12166.7
19	20	41366.7	7300
20	22	120450	28105
21	10	9125	1368.8
22	15	54750	8942.5
Total	419	1349266	254044

Table 1 shows that the initial reserves of sugar palm trees which produce sap as raw material for the production of palm sugar used by the community as many as 419 trees. The amount of palm sugar production of 25,404 kg is obtained from each respondent who is active in producing palm sugar.

3.1.2. Additions of Palm Sugar Resources

Additions of sugar palm trees can increase sustainability in the production of palm sugar because of the availability of raw materials so that utilization can continue. The addition of the initial amount of palm sugar can be seen in Table 2.

Table 2. Additions to the number of reserves beginning in 2018

Respondents	Trees	Palm Juice (Liter)	Sugar (Kg)
1	20	65700	7300
2	0	0	0
3	10	62050	13687.5
4	0	0	0
5	10	62050	10950
6	5	9125	1825
7	0	0	0
8	5	18250	2281.3
9	5	18250	5475
10	10	15330	2920
11	7	51100	7665
12	0	0	0
13	5	9125	1825
14	10	26071.4	6257.1
15	5	9125	1825
16	0	0	0
17	20	124100	29200
18	3	9125	1825

19	20	41366.7	7300
20	10	54750	12775
21	10	9125	1368.8
22	15	54750	8942.5
Total	170	639393.1	123422

Table 2 shows that there are some people who do not plant or add sugar palm trees. If this continues, it will have an impact on reserves early next year. The addition of resources is needed for the sustainability of resources that will be utilized by palm sugar. The more additions, the more reserves for the following year will be utilized.

3.1.3. Depletion of Palm Sugar Resources

Depletion is shrinkage that occurs in an object that is natural. Depletion value is reflected in how many natural resources are taken. In other words, depletion is the decrease in the quantity of the stock of a natural resource over an accounting period that is due to the extraction of the natural resource by economic units occurring at a level greater than that of regeneration [17]. The depletion value can be seen in table 3.

Table 3. Depletion of Palm Sugar Resources

Respondents	Depletion		
	Trees	Nira (liter)	Sugar (kg)
1	1	3285	365
2	1	1825	730
3	2	12410	2737.5
4	1	3650	365
5	1	6205	1095
6	3	5475	1095
7	3	7300	1095
8	2	7300	912.5
9	1	3650	1095
10	10	15330	2920
11	1	7300	1095
12	1	1825	365
13	5	9125	1825
14	7	18250	4380
15	3	5475	1095
16	2	6205	1825
17	5	31025	7300
18	3	9125	1825

19	3	6205	1095
20	2	10950	2555
21	4	3650	547.5
22	3	10950	1788.5
Total	64	186515	38106

Table 3 shows the amount of depletion that occurred at 38,106 kg. In 1(one) palm tree can produce different amounts of sap. This is caused by the age factor possessed by the tree being harvested. Apart from age, there are also other factors that influence the production of sap in each tree. Trees that are newly-tapped will get a large amount of sap, whereas if the tree has been tapped for a long time, the resulting sap will be reduced. The physical characteristics revealed by the palm tree when the bunch is in the lower stem, this indicates that the production of sap in the palm tree is not good, or it can be said that the tree cannot produce.

Palm sugar farmers harvest every day in the morning and in the evening and making palm sugar also almost every day. The harvested sap is then cooked on that day so that the sugar making process takes place every day. Palm sugar produced by each farmer is different, one palm tree can produce palm sugar weighing 365 kg per year, and those that can produce palm sugar weighing 7300 kg per year for one palm tree. This is caused by the poor quality of the sap so that the sap cannot crystallize. According to Radam et al. (2015) [19], the difference in the high and low productivity of palm sugar is caused by differences in the total cooking time of sugar. In producing sugar, the farmers usually leave the sap, which is being cooked so that the fire goes out; this can affect the weight of the production of palm sugar. In addition to the processing productivity of palm sugar is influenced by the quantity and quality of the cooked sap and the skill of the palm sugar maker.

3.1.4 . Final Reserve of Palm Sugar Resources

Physical balance describes the change in the quantity of each type of natural resource, which includes changes in the initial reserves, growth, depletion, and final reserves. The final in one-year reserve volume will be the same as the reserve at the beginning of the following year. The initial reserve in 2018 was 254,044 kg, with an addition of 123,422 kg and depletion with a value of 38,106 kg, which left out the final reserve of 339,360 kg. This condition shows that the final reserve of palm sugar every year continues to decrease if there is no effort to plant palm trees, then there will be the scarcity of palm sugar resources.

3.2. Palm Sugar Balance Sheet

The monetary balance can show the true value of the final reserve. The monetary balance of utilized palm sap resources is calculated from the number of initial reserves, planting, and depletion in currency units. If there is a difference in the price of the beginning of the year and the end of the year (revaluation), it is better to make adjustments to the values that can be discussed by the community with the parties concerned. The initial reserve amount added by planting and revaluation is then reduced by depletion so that the final reserve is obtained.

3.2.1. Initial Reserve of Palm Sugar

The initial reserve shows the number of resources owned by farmers, the number of initial reserves of palm sap owned by farmers in 2018 can be seen in Table 4.

Table 4. Total Initial Reserves of Palm Sugar in 2018

Respondents	Seeling price (IDR)	Sugar Production (Kg)	Total (IDR)
1	14	7300	102.200.000
2	15	7300	109.500.000
3	12	4106,3	49.275.600
4	14	9125	127.750.000
5	15	10950	164.250.000
6	13.5	1825	24.637.500
7	14	2920	40.880.000
8	15	6843,8	102.657.000
9	14	5475	76.650.000
10	15	4380	65.700.000
11	13	32850	427.050.000
12	12	2190	26.280.000
13	15	36500	547.500.000
14	15	18771,4	281.571.000
15	13.5	7300	98.550.000
16	15	9125	136.875.000
17	15	29200	438.000.000
18	13	12166,7	158.167.100
19	13	7300	94.900.000
20	15	28105	421.575.000
21	15	1368,8	20.532.000
22	14	8942,5	125195
	Total	254044	3.639.695.200

Table 4 shows the initial reserves of sugar palm trees, which produce sap as the raw material for making palm sugar that is utilized by the community in Bonto Sinala Village. The initial amount of palm sugar is 254,044 kg, which is multiplied by the selling price so that the amount is IDR. 3.639.695.200 this value is obtained from each respondent who is active in producing palm sugar.

3.2.2. Additions of Palm Sugar Resources

Additions of sugar palm trees can increase sustainability in the production of palm sugar because of the availability of raw materials so that utilization can continue. The addition of the initial amount of palm sugar can be seen in table 5.

Table 5. Addition of Palm Sugar Resources in 2018

Respondents	Sugar Production (Kg)	Seeling price (IDR)	Total (IDR)
1	7300	14	102.200.000
2	0	15	0
3	13687.5	12	164.250.000
4	0	14	0
5	10950	15	164.250.000
6	1825	13.5	24.637.500
7	0	14	0
8	2281.3	15	34.219.500
9	5475	14	76.650.000
10	2920	15	43.800.000
11	7665	13	99.645.000
12	0	12	0
13	1825	15	27.375.000
14	6257.1	15	93.856.500
15	1825	13.5	24.637.500
16	0	15	0
17	29200	15	438.000.000
18	1825	13	23.725.000
19	7300	13	94.900.000
20	12775	15	191.625.000
21	1368.8	15	20.532.000
22	8942.5	14	125.195.000
Total			1.749.498.000

Table 5 shows the amount of the addition of palm sugar juice resources of IDR. 1.749.498,000. The value of 0 (rupiah) is caused by the community, not planting or adding sugar palm trees. If this continues, it will have an impact on reserves early the following year. The addition of resources is needed for the sustainability of resources that will be utilized by farmers producing palm sugar. The more additions, the more reserves for the following year will be utilized.

3.2.3. Palm Sugar Resource Depletion

Depletion is shrinkage or the amount of resources taken in one year, to get the value of forest depletion obtained by multiplying the production volume of each type of forest resource used by the community with unit rent. Unit rent is an assessment level that is calculated to get a depletion value. The way to calculate unit rent is to subtract the cost of taking per unit from the price of natural resources, including the value of earnings per unit that is worthy of being received by investors. A decent profit value is the same as the loan interest rate in the bank as an alternative cost. Proper profit is obtained from the return on investment services used by the community as a determinant of the potential value that may be collected by the government as the resource owner in the forest, and each unit has a rent value of 12% of the production cost per unit. The calculation of palm sugar rent units can be seen in Table 6.

Table 6. Calculation of Unit Rent

Respondents	Production cost Per Unit (IDR)	Gross profit per unit (IDR)	Decent profit (IDR)	Unit Rent (IDR)
1	4.214	9.786	506	9.28
2	2.107	12.893	124	12.769
3	562	11.438	33	11.405
4	4.214	9.786	247	9.539
5	1.405	13.595	82	13.513
6	1.405	12.095	82	12.013
7	1.405	12.595	82	12.513
8	1.686	13.314	99	13.216
9	1.405	12.595	82	12.513
10	527	14.473	31	14.442
11	1.405	11.595	82	11.513
12	4.214	7.786	247	7.539
13	843	14.157	49	14.108
14	351	14.649	21	14.628
15	1.405	12.095	82	12.013
16	843	14.157	49	14.108
17	211	14.789	12	14.777
18	843	12.157	49	12.108
19	1.405	11.595	82	11.513
20	602	14.398	35	14.363
21	2.809	12.191	165	12.026
22	860	13.14	50	13.09

Table 6 shows the calculation of unit rent, with the known rent units of each farmer making palm sugar, it can be calculated the value of palm sugar depletion by multiplying the Volume of natural resource extraction with unit rent. The calculation of depletion value can be seen in Table 7.

Table 7. Calculation of Depletion Value of Palm Sugar

Respondents	A resource used	Rent unit (IDR)	Depletion value (IDR)
1	365	9.28	3.387.328
2	730	12.64	9.227.328
3	2737,5	11.371	31.127.328
4	365	9.28	3.387.328
5	1095	13.427	14.702.328
6	1095	11.927	13.059.828
7	1095	12.427	13.607.328

8	912,5	13.112	11.964.828
9	1095	12.427	13.607.328
10	2920	14.41	42.077.328
11	1095	11.427	12.512.328
12	365	7.28	2.657.328
13	1825	14.056	25.652.328
14	4380	14.607	63.977.328
15	1095	11.927	13.059.828
16	1825	14.056	25.652.328
17	7300	14.764	107.777.328
18	1825	12.056	22.002.328
19	1095	11.427	12.512.328
20	2555	14.326	36,602.33
21	547,5	11.854	6.489.828
22	1788,5	13.037	23.316.328
		Total	508.360.216

Table 7 shows that the calculation value of depletion by using unit rent, where depletion is calculated to find out how much the value of palm sugar is extracted each year by the rupiah unit in 2018. Depletion that occurs is 508,360,216 IDR.

3.2.4. Revaluation of Palm Sugar

On the utilization of forest products carried out by people in Bonto Sinala, if there is an initial price different (revaluation), it is best to adjust the values that can be discussed by the community together with related parties. The amount of revaluation of palm sugar presented in Tabel 8

Tabel 8. The amount revaluation of palm sugar

Character	Revaluation (IDR)
Initial Reserve	2.545.098.700
Additions stock	1.241.795.700
Harvested	381.206.000
Amount of revaluation of palm sugar	4.168.100.400

Table 8 shows that the amount of revaluation of palm sugar that occurred in 2018, revaluation amount is obtained by summing the initial reserves, additions, and sugar palm trees that have been harvested so that they get a value of 4.168.100.400 IDR.

3.2.5. Final Reserve of Palm Sugar

Monetary balance usually conveys the true value of the resource's closing stock. Initial reserves palm sugar amounting to 3,639,695,200 IDR and added with additions stock 1,749,498,000 IDR with total 5,389,193,200 IDR then added with value revaluation 4,168,100,400 IDR. This value deducted by a depletion value of 508.360.216 IDR, so the final total reserve value IDR 9.048.933.384. The depletion value taken is the value of using unit rent without using workers wages. This is because farmers who produce palm sugar in the study area do not use other workers to make palm sugar, so they do not incur costs to pay workers wages.

4. Conclusion

The utilization of palm sugar will experience shrinkage that will continue to occur every year. If there is no sustainable management of forest products, it will result in increasing depreciation every year and will suffer losses the following year. Sugar palm resources accounting has a significant role in ensuring the availability of palm trees as a source of raw materials in making palm sugar. With the availability of palm sugar raw materials, the production process continues to meet market needs and become a source of income for the community.

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