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# Sago Palm Production and Income Analysis in Northern Mindanao, Philippines*

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**Abstract** The sago palm is known for its ability to accumulate starch in its stem and can grow in peat and mineral soils. However in the Philippines, the sago palm is mainly utilized as roofing material as a source of income. A study was conducted in Alubijid, Misamis Oriental, Mindanao, Philippines, to evaluate data on biomass, plant population density and to conduct income analysis derived from sago thatch production. Studies have shown that sago palm biomass resulted to measurements of leaf parameters since there was no trunk formation due to the cutting of 3 leaves every three months to produce the thatch and to remain 3–4 leaves per palm. The population density of palms per hectare was extremely high ranging from 3025 to 4600 palms. This further supports the fact that sago growing areas in Alubijid were flooded throughout the year and that farmers need to grow more palms to harvest more leaves thus controlling newly grown suckers has not been practiced. Recently, the prevailing market price of sago roofing material per 100 pieces is US $6.24. Based on the population density, sago farmers can roughly gain an annual net income of US $3,591.71 per hectare, which is higher compared with the net income of a local farmer.

**Key words:** sago palm, Alubijid, sago thatch, population density, net income, family labor and hired labor.

# フィリピン・北ミンダナオにおけるサゴヤシ生産および サゴヤシ栽培農家の収入解析

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**要約**　サゴヤシは泥炭土壌および無機質土壌のどちらにも生育し，幹に澱粉を集積する能力があることはよく知られている．しかし，フィリピン・ミンダナオでは，サゴヤシは農家の収入源となる屋根葺き材として主に利用されている．フィリピン・ミンダナオ・ミサミスオリエンタール・アルビヒットにおいて，サゴヤシバイオマス，生育密度などに関するデータを収集し，屋根葺き材生産に関する農家の収入を解析する研究を行った．アルビヒットでは，サゴヤシ葉から屋根葺き材をつくるために，3カ月ごとに1本のサゴヤシから3葉を収穫し，3ないし4葉を残す作業を繰り返しており，サゴヤシには幹の形成がみられず，結果的に，サゴヤシバイオマスはサゴヤシ葉の重量を計測することによって達成された．アルビヒットのサゴヤシ生育密度は極めて高く，ヘクタール当たり3025～4600であった．これは，アルビヒットが年間を通じて湛水条件下にあること，サゴヤシ栽培農家が新たに生育してくる吸枝を制御せず，より多くの葉を生産している意欲の表れであると判断される．ミンダナオにおける最近のサゴヤシ屋根葺き材(100枚)の市場価格は，6.24米ドルである．サゴヤシの生育密度から計算すると，サゴヤシ栽培農家のサゴヤシに関する収入は，ヘクタール当たり3,591.71米ドルで，周辺農家の純収入と比較して高いといえる．

キーワード　アルビヒット，家族労働と雇い労働，純収入，生育密度，屋根葺き材

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## Introduction

The sago palm (*Metroxylon sagu*) belonging to the family Palmae grows in peat and mineral soils. It is known to accumulate more than 200 kg of starch in its stem. It originated from Moluccas of Indonesia to Papua New Guinea. The sago palm grows between 10° south and 10° north latitudes and up to an elevation of 700 m above sea level. According to Flach (1976), good ecological conditions for sago palm includes minimum temperature of 15°C, full sunshine, regularly flooded but not permanent flooding, floodwater with appreciable nutrient content and slightly brackish, mineral clayey soils with 20% organic matter content and a pH of 4 and above (Flach, 1976).

In the Philippines, the sago palm is widely distributed in some municipalities in Southern and Northern Mindanao. However, there are no available information on the distribution of sago palms throughout the country (Tomboc, et. al., 1990) and there are only few reports on sago palm (Okazaki, 1998). In the late 14th century, it was reported as a major agricultural product in South Mindanao, Sulawesi and Maluku Islands. Recently, in the Philippines, the sago palm is considered as a minor importance in the economy, and starch production was rarely observed in the sago palm cultivated areas of Northern Mindanao since there are no sago processing plants and no commercial plantations established. Although the sago palm was not purposely cultivated, most sago palm farmers preserve the sago palm to collect the leaves for roofing materials and to extract starch traditionally for household consumption (Josue and Okazaki, 1998). In the Philippines, the sago palm farmer grows and cultivates sago palm and their source of income is mainly derived from the sago palm. Although the farmer cultivates his main crop which means that 70–90% of his income is derived from it, or 90% of his total land area is cultivated with his main crop, the farmer also considers the integration of other crops or cultivation of vegetables as well as raising farm animals, such as small-scale poultry or small-scale piggery, in his backyard for additional sources of income or for self-sustenance. This study was conducted to evaluate data on biomass, plant population density and to conduct income analysis derived from sago thatch production.

## Materials and Methods

### 1. *Study site*

The study site is located in Northern Mindanao in the Municipality of Alubijid, Province of Misamis Oriental (Fig. 1), approximately, at 8°34′ latitude and 124°29′ longitude. The area is classified as tropical monsoon (Am) climate. Three sample plots within the farmer's backyard measuring 20 m × 20 m were taken for this study. The area is located within 1 hectare of alluvial soil with shallow peat horizon and grown with 8-year old sago palms. Furthermore, the whole area was entirely burned down 8 years ago.

### 2. *Sago palm biomass*

The sago palm biomass was measured by randomly choosing 10 palms per plot regardless of age, height and size in 2000. Randomly chosen palms were cut at the base of the palm using a diesel-operated chain saw. Sago palm leaves were cut and measured individually. Individual leaves were measured from the base of the petiole to the tip of the longest leaflet. Furthermore, individual petioles were cut from the whole leaf, measured in terms of length and weighed individually. Moreover, the number of leaflets/leaf were counted, measured and weighed. The total weight was taken by adding the weight of the leaflets and the weight of the petioles, respectively.

### 3. *Plant population density*

The number of palms in a plot (20 m × 20 m) were counted. The population density of sago palms per hectare was computed based on the number of palms in a single plot.

### 4. *Statistical analysis*

The statistical analysis of data performed was the One-way ANOVA for 3 groups of independent samples while Paired T-test was performed for samples with matched data.

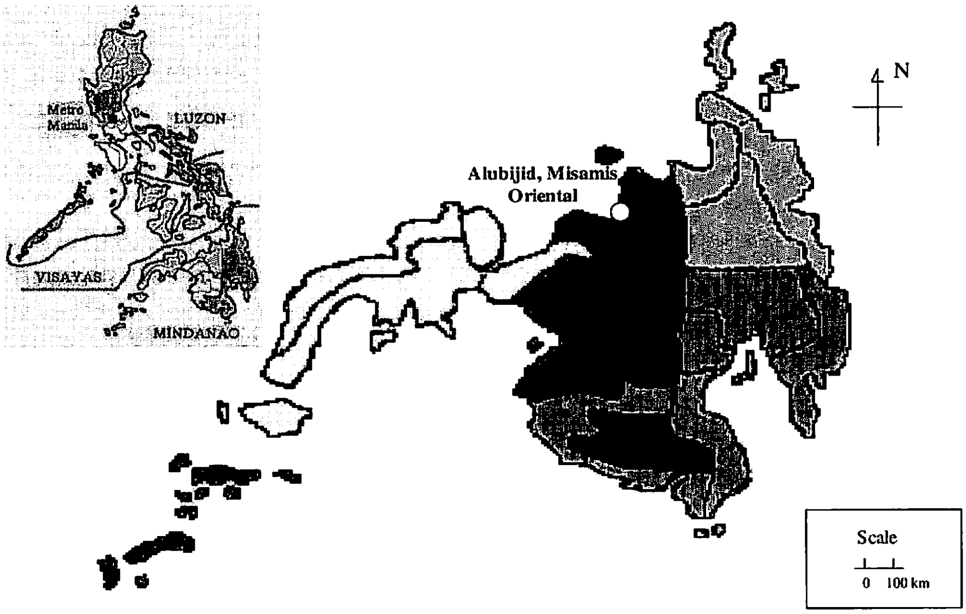


**Fig. 1** The study site location in Alubijid, Misamis Oriental, Mindanao, Philippines

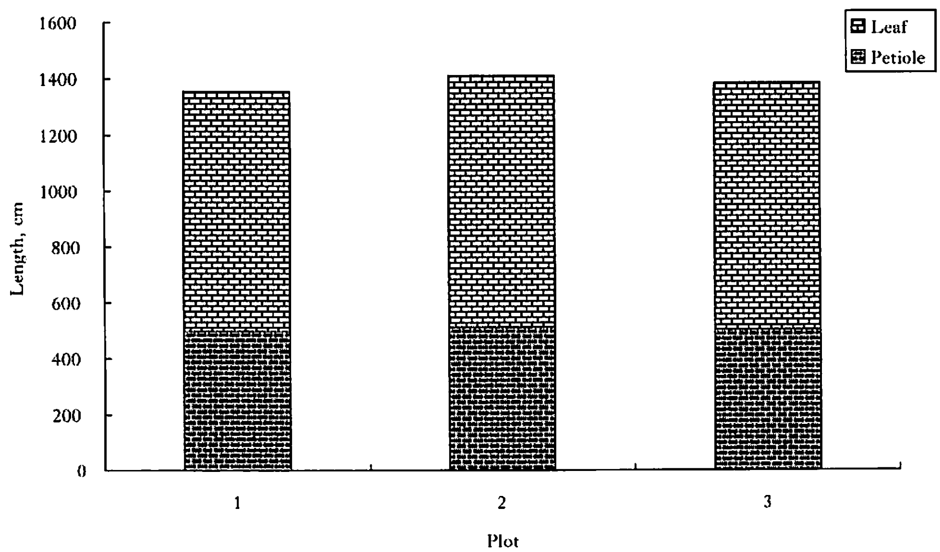


**Fig. 2** The mean leaf and petiole length (cm) of sago palms per plot in Alubijid

*5. Income analysis*

Income analysis was estimated based on farmer interview and prevailing prices such as market price of roofing material per 100 pieces, hired labor and family labor cost, and cost of materials for thatch production.

## Results and Discussion

*1. Sago palm biomass*

The sago palm biomass is a measure of the amount of starch accumulated by the palm in its stem. However, in the case of Alubijid where no trunk formation has occurred, measuring the sago palm biomass is insignificant. The sago palm biomass yielded only to leaf measurement parameters. Figure 2 shows the mean leaf and petiole length of sago palms. One-way ANOVA for petiole and leaf length of sago palms per plot showed no significant difference among the means per plot. Mean petiole length of sago palms per plot ranged from 497.4 to 511.5 cm with a total mean of 503.1 cm and the mean leaf length per plot ranged from 882.5 to 899.3 cm showing no significant difference. The total mean leaf length is 878.6 cm. The total length of petiole and leaf ranges from 1365.4 to 1452.5 cm.

On the other hand, paired t-test result of the relationship of petiole and leaf length showed an extremely statistically significant difference with a significance (P) value of 0.01%. The t value and the total degrees of freedom (df) obtained were 32.6 and 2, respectively.

**Table 1** The average number of leaflets per leaf of sago palms per plot in Alubijid

| | Plot | | |
|---|---|---|---|
| | *I* | *II* | *III* |
| Average number of leaflets | 84.6$^{ns}$ | 86.0$^{ns}$ | 82.5$^{ns}$ |
| Standard deviation | 9.8 | 8.0 | 7.0 |
| Coefficient of variation | 0.1 | 0.1 | 0.1 |

ns: not significant
P = 0.1
*Total df* (groups) = 2

Since this paper focuses on the income generated from the sago leaf, it is therefore necessary to consider the number of leaflets and the length of leaves. Table 1 shows the average number of leaflets per leaf of sago palms per plot in Alubijid. Statistically, the average number of leaflets showed no significant differences among the means. Means ranged from 82.5 to 84.6 while statistical level of significance obtained was 15%. Figure 3 shows the number of leaflets per leaf and the corresponding leaf length of sago

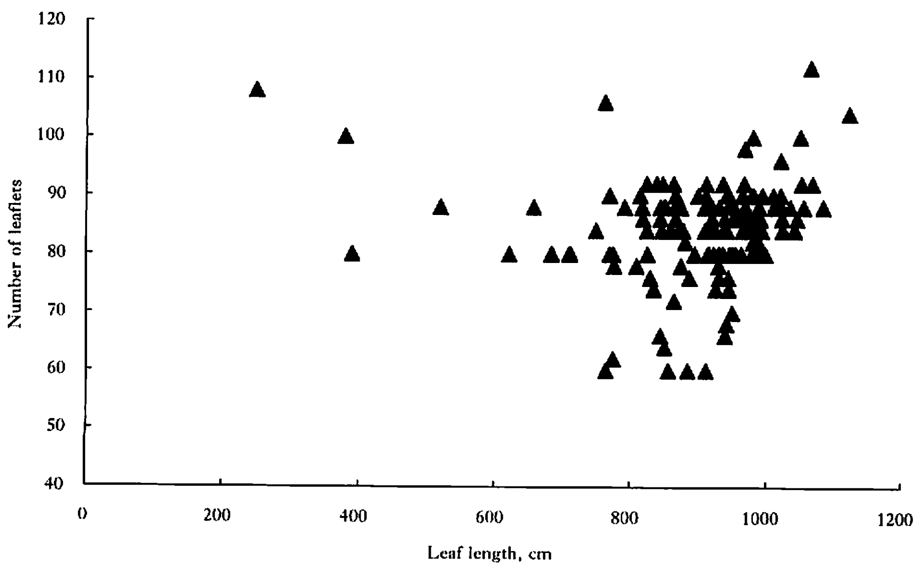


**Fig. 3** The number of leaflets and its corresponding leaf length of the sago palms in Alubijid

palms in Alubijid. However in this figure, there are some exceptions. Paired t-test resulted to an extremely statistically significant at 0.01% level of significance. T-value obtained was 81.0 while the degrees of freedom (df) was 302. The highest number of leaflets obtained was 120 while 60 is the lowest. Moreover, length of leaflets varied from 90 to 145 cm. Length of leaves ranged from 250 to 1122 cm.

Measuring sago palm biomass in Alubijid generally showed that the sago palms in Alubijid were mainly composed of sago leaves which indicates that there was no trunk formation in 8 years after the fire. The sago palms in Alubijid have showed less change in trunk growth and formation or delayed growth stage. The causal factors could be waterlogged condition throughout the year without the possibility of drainage and farmers' practice of cutting three leaves every three months to produce the roofing thatch material. With this cultural management of sago palms in Alubijid, the number of leaves remaining in palms range from 3–5 leaves (Celiz, et. al, 2001).

### *II. Plant population density*

The plant population density of palms per hectare in the different study sites is shown in Table 2. The data obtained from Malaysia (Yamaguchi, 1998) and Indonesia (Okazaki, 1999) were used as reference values to show comparison among palms with the same number of years after planting. In this table, although the number of years after planting or palms of the same age is relatively the same, the term "the same growth stage" was strictly impossible. The term "palms of the same age" was used to show a comparison among sago palms in the different sites at the same growth year, for example, 7 years after planting; however, the term "same growth stage" was strictly not used because although these sago palms in the different sites have the same number of years after planting, they do not possess the same growth stage. Trunk formation of sago palms start at 3–4 years after planting. The sago palms in Alubijid were developed after whole the area was totally burned, thus their palm age were quite clear. The sago palms in Alubijid are now on their eighth year but still no trunk formation has occurred. The probable causes are waterlogged condition, high population density and intensive management.

**Table 2** The population density of sago palms with the same number of years after planting per hectare in the different study sites

| Alubijid, Philippines | | | | Sarawak, Malaysia | Tobimeita, Indonesia |
|---|---|---|---|---|---|
| Year | | | | | |
| 1998 | 1999 | 2000 | 2001 | | |
| 3475 | 4125 | 3242 | 4150 | 611 | 945 |

The evaluation of growth parameters of sago palms per plot in Alubijid, after the area was totally burned out, were conducted annually for 4 years from 1998 to 2001. The growth parameters include palm height, diameter at ground level and the number of leaves per palm. In each plot these parameters were collected, assessed in each palm within the plot. Spray paint marks were left on each palm to avoid repetitions. The number of data gathered in a plot indicates the plant population density. In the Philippines, farmers collect the leaves for roofing materials. On the other hand, farmers collect starch from sago trunk in Malaysia and Indonesia.

Results show that population density in Alubijid is extremely high. In four years time, population density ranged from 3242 to 4150 palms per hectare. The results indicate the need of cultivating more sago palms and a higher leaf and leaflet yield to produce more roofing material, which is an additional source of income. Table 2 also denotes the management differences of sago palms in the different sites. In sago starch producing countries such as in Malaysia and Indonesia, sago palm population density has to be minimized by controlling the growth of suckers and the distance of planting has to be maintained in order to maximize starch accumulation in the sago stem (Yamaguchi, 1998). While in the Philippines, farmers need to grow more palms to harvest more leaves and allow sago seedlings to proliferate to increase yield and income thus population density is extremely high.

### *III. Thatch production and income analysis*

The harvesting and production cost, projected gross

**Table 3** Income analysis table of thatch production cost and projected income derived from sago palm roofing material

| | |
|---|---|
| 1. PROJECTED GROSS INCOME PER HECTARE PER YEAR | US S 8.32 × 123.04 = US S 4,094.96 |
| Total mean population density per hectare | 3 241.67 palms per hectare |
| Harvesting rate per hectare | 3 leaves/palm/ 3months |
| Potential number of leaves that can be harvested | 9 725 leaves/ha/ 3 months |
| Average number of leaflets/leaf | 84.35 with 10% unutilizable |
| Average width size of leaflet | 5 cm |
| Approximate number of leaflets per thatch | 60 leaflets |
| Possible number of roofing materials produced per hectare | 12 304.57 sheets |
| 1 bundle of roofing material | 100 sheets |
| Retail price of 100 sheets of roofing materials | US $ 8.32 |
| 2. HARVESTING COST PER HECTARE PER YEAR | US S 17.27 × 4 = US $ 434.92 |
| Harvesting per hectare: 15 man-days | |
| Labor 75% Family labor (cost per day, US $ 1.04) | |
| 11 man-days | US $ 11.44 |
| 25% Hired labor (cost per day, US S 1.46) | |
| 4 man-days | US $ 5.83 |
| Total cost at harvesting | US $ 17.27 |
| 3. PRODUCTION COST PER HECTARE AND PER YEAR | US $ 108.73 × 4 = US $ 434.92 |
| I. Materials needed: Bamboo sticks | US $ 20.80 |
| Straw | US $ 10.40 |
| II. Labor: 80% Family labor (cost per day, US $ 0.62) | |
| 98.44 bundles | US $ 61.03 |
| 20% Hired labor (cost per day, US $ 1.04) | |
| 24.61 bundles | US $ 16.50 |
| Total cost of production | US S 108.73 |
| TOTAL COST OF PRODUCTION PER YEAR | (2 + 3) = US S 126.00 × 4 = US S 504.00 |
| PROJECTED NET INCOME PER HECTARE PER YEAR | [1 − (2 + 3)] = US S 897.93 × 4 = US $ 3,591.72 |

and net income of roofing material derived from sago palm is shown in Table 3. With the data on plant population density and with the farmers' practice of cutting 3 leaves at harvest, the potential number of thatch that can be produced can be easily determined. Generally, a single thatch has a length of 1.5 m. It is sold in a hundred pieces per bundle at US S 8.32. During thatch making, approximately 10% of the leaflets are not included, young leaflets at the top most part and bottom most part. Most leaflets used in the thatch making have an average width of 5 cm, a single thatch consists of strips of leaflets, each single strip consists of 2 sago leaflets. It is approximated that each thatch can consume about 60 leaflets. With the total mean population density per hectare of 3 241.7 palms and at harvesting rate of 3 leaves per palm in 3 months, the total number of leaves that can be harvested is 9 725 leaves per hectare. As the average number of leaflets in a single leaf was mentioned, the mean total number of leaflets per leaf is 84.4 leaflets with 10% unutilizable. It can be deduced that the 123 bundles of roofing material can be produced per hectare in a 3-month period.

Generally, 75–80% of the harvesting and production activities accounts for family labor while 20–25% is hired labor, since family labor is cheaper compared to hired labor. Most farmers do not allocate an amount for family labor instead, they charge it as free labor. Labor costs are in a per man-day basis. Harvesting cost accounts for US $ 17.27 while production cost is at US $ 108.73 of which US $ 31.20 was spent for materials needed such as bamboo and straw. Total labor, harvesting and production costs were summed at $ 126.00. With the recent prevailing market price of sago thatch, sago farmers can earn a gross income of US $ 1,023.74. Less harvesting, production and labor cost, sago farmers can gain a net income of US $ 897.93 in one harvest season.

In Mindanao, the common thing with farm-based income or even in employment-based income is that the cultivation of different vegetables, and root crops (e.g. taro, sweet potato, cassava), planting of fruit trees or fruit bearing plants (e.g. bananas) and raising of farm animals (e.g. chicken, goat, pigs or cattle) are recently being practiced. In layman's term, we call it "a little of everything." Nevertheless, 60–70% of the farmers in Mindanao derive their income mainly from rice, corn or sugarcane. These crops are classified as annual crops, which require high cost of inputs (fertilizers, insecticides and fungicides) and high labor cost. They suffer from high disease incidence and soil acidity problems due to monocropping without soil fallowing. At harvesting, rice, corn or sugarcane farmers usually experience a low net income or sometimes a negative net income. It could be due to high disease incidence within the period of cultivation or post-harvest diseases or probably due to low market price. Market prices of these farm commodities, especially corn, are cheaper due to excess in supply and very low demand. High disease incidence especially in rice (Rice Tungro Virus) can reduce yields up to 80% and this problem is not yet fully recovered. With this problem at hand, farmers are left with no choice but to rely on financiers and lending investors in exchange of their goods or farmland.

While the advantage of the sago palm farmer is that he does not practice the application of fertilizers, insecticides or fungicides and labor is only required during leaf harvesting. Disease incidence is very low, in fact the common diseases found in the sago palm area in Alubijid are only leaf spots or leaf rusts, which are not classified as systemic diseases. However, the effect of these common diseases on the roofing material quality is not yet known. The occurrence of stunted growth in young suckers were also observed, the incidence in a population per plot ranges from 1–3 suckers which is very low and does not affect the number of harvestable leaves for thatch production. The stunted growth observed in young sago palms probably caused by a virus or it could be due to an unknown nutrient deficiency symptom. As for the supply and demand, recently people rely on low cost housing and most of the roofing materials used in most houses in Alubijid are made of sago palm. Although the commodity is not a demand, the supply of the sago palm roofing material is also not in excess in the market.

Commonly exploited crop/plant resources aside from sago palm are nipa palm (*Nypa fruticans*), coconut (*Cocus nucifera*) corn (native and high yielding variety) and lowland rice (high yielding variety). Although the economics and cultural practices of nipa palm-based farming is not fully understood, in Alubijid, the sago palm roofing material and nipa palm roofing material have almost the same market price. However, consumers prefer the sago palm roofing material due to its durability and longevity. In areas outside Alubijid, sago palm roofing material is more expensive and highly preferred.

In Alubijid, farmers growing native varieties of corn are only for self-sustenance or household consumption as staple food source. While the commercial corn farmers usually cultivates at a rate of 3 croppings per year. Average yield per hectare per cropping season ranges from 4–5 tons. Average gross income per cropping season per hectare is usually US $ 520.01 while US $ 353.61 is the average net income per cropping season per hectare. Thus, the average annual net income of a commercial corn farmer per hectare is US $ 1,060.83.

Rice farmers cultivating lowland rice in irrigated areas can produce rice at a maximum of 2 cropping seasons in a year. Average yield per hectare per cropping season is 6 tons. Average gross income per cropping season is US $ 748.81 per hectare wile the average net income is US $ 582.41 per hectare per cropping season. Thus the average annual net income derived from rice farming is US $ 1,747.23 per hectare. As discussed in this paper, it can be deduced that the income of a sago farmer is higher compared to the net income of a commercial corn or rice farmer.

Moreover, conducting feasibility studies on sago palm roofing material production is of a considerable help to understand completely the economics and importance of sago palm. Finally, sago palm cultivation and sago thatch production in Mindanao focuses mainly on producing roofing materials, thus biomass measurements only resulted to leaf measurement parameter. Further research and documentation studies in sago palm communities is needed to explore more products derived from sago palm aside from starch and roofing materials production.

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