The sago industry in Malaysia: present status and future prospects

Tek-Ann Chew, Abu Hassan bin Md. Isa and Mohd Ghazali bin Mohayidin[1]

Abstract

The sago palm is indigenous to Malaysia, being an important source of carbohydrate to the native population since ancient times. In this paper, the current status of the sago palm industry in Malaysia is reviewed There is now an increasing awareness of superior environmental-friendly properties of the sago palm as compared to other crops. We try to quantify these environmental benefits. Sago palm may well emerge as Malaysia's next premier crop, replicating the success of oil palm, if appropriate government policies are followed. These policy measures are discussed in this paper.

Introduction

Palms constitute one of the oldest families of plants on earth Several cultural groups have developed self-sufficient economy based on various palms Examples of such groups are the Amerindians based on the moriche palm (*Mauritia flexuosa*), the Arabs of the sub-Sahara based on the date palm (*Phoenix dactylifers*), the South Indians based on the palmyra palm (*Borassus flabellifer*), the Roto Islanders of Indonesia based on the lontar palm (*Borassus sundaicus*), the Indo-Pacific islanders based on the coconut (*Cocos nucifera*), the West Africans based on the oil palm (*Elaeis quineensis*) and the Moluccans based on the sago palm (*Metroxylon sagu Rottboll*) (Tan, 1983, p.3).

Before the emergence of rice, sago (*Metroxylon sagu Rottboll*) was the main source of sustenance for the inhabitants of the Malay archipelago region. Desiccated products made from sago starch can be stored for an exceptionally long period. This dried provision enabled the early inhabitants of the Malay archipelago to travel far and wide over long distances, making the colonization of many other islands possible. Unfortunately, sago is now only a minor crop in Peninsular Malaysia, with its acreage less than 1 % of the total land used for agriculture. The biggest sago areas in Malaysia are to be found outside the Peninsular, in the state of Sarawak Sarawak is now the world's biggest exporter of sago, exporting annually about 25,000 to 40,000 ton of sago products to Peninsular Malaysia, Japan, Taiwan, Singapore and other countries

In this paper, we first review the current status of sago in Section 2. In this age of concern about environmental degradation and pollution, the special environmental benefits of sago cultivation need to be valued and quantified This is treated in Section 3. The special qualities of sago are enumerated in Section 4. The paper ends with Conclusions and Policy Implications in Section 5.

[1]Faculty of Economics and Management, Putra University Malaysia, 43400 Serdang, Selangor, Malaysia email: tachew@econ upm edu my

Present Status

It is estimated that the present area under sago in Sarawak is 19,720 hectares, located mainly in the Division of Sibu (Tie and Lim, 1991). The five major areas are Oya-Dalat, Mukah, Pusa-Saratok, Igan and Balingan. There are about 1.69 million hectares of peat soil in Sarawak that are considered suitable for sago cultivation. Hence, the scope for the expansion of sago cultivation appears to be bright.

Currently, sago export ranks as the fourth biggest agricultural revenue earner for Sarawak, after oil palm, pepper, and cocoa. Sago brings in RM23.15 million in export earnings in 1993, overtaking the export of rubber in value terms in that particular year. The export of sago from Sarawak over the years are as shown in Table 1.

Sago production at farm level

Presently, sago is grown in Sarawak as a smallholder's crop. We did a random sample survey of 119 sago smallholders in Mukah District (Chew, Abu Hasan Isa and Mohd. Ghazali Mohayidin, 1997) in December 1996, using a prepared questionnaire. The aims of this survey were to gather information on the economics of sago production at the farm level and to determine the status of sago vis-a-vis other agricultural enterprises. The sago farmers in our sample are all Melanaus, a category of indigenous people in Sarawak who have been growing and harvesting this palm since time immemorial

Some of the results of our survey are as follows. The average size of the sago farms in our survey was found to be 5.03 ha. The average yield of palms per ha per year in our survey is 14 palms, ranging from 1 palm/ha to 41 palms/ha The average yield of 14 palms/ha is rather low compared to figures cited in literature For example, Kueh, et al. (1991) used a yield of 102 palms per ha per year in his estimation of the profitability of growing 2278 ha of sago on peat soil. Tie and Lim (1991) used a yield of 42 palms per ha per year in their paper on the prospects of sago in Sarawak. Other authors have used figures of 90 (Harun, 1995) and 70 (Department of Agriculture, Sarawak, 1996) The low yield in our survey could be because of the drop in the price of sago logs in that year as compared to the years before. The sago farmers were probably holding out, waiting for better prices.

Table 1. Export value of sago from sarawak (RM'000).

Year	Sago Export	Total Agricultural Export	Sago Export as %
1970	3836	106550	3.60
1971	3352	89796	3.73
1972	2310	83070	2.78
1973	3620	159232	2.27
1974	7102	176777	4.02
1975	5305	157354	3.37
1976	6702	226160	2.96
1977	8312	266519	3.12
1978	6824	276488	2.47
1979	6940	313694	2.21
1980	8816	300455	2.93
1981	9637	218268	4.42
1982	8355	202713	4.12
1983	9677	235893	4.10
1984	10022	264403	3.79
1985	7056	313630	2.25
1986	12002	364873	3.29
1987	8724	421012	2.07
1988	13816	477059	2.90
1989	13784	445199	3.10
1990	22541	389436	5.79
1991	22852	376302	6.07
1992	31146	377737	8.25
1993	23151	383476	6.04
1994	24445	544420	4.49

Soyrce: Agricultural Atatistics of Sarawak, Jabatan Pertanian Negeri Sarawak, Kuching Figures for 1994 are provisional figures

Out of the 119 sago farmers interviewed, 89 or 73 % reported having income from nonsago agricultural activities or from off-farm employment. Other agricultural activities include growing tropical fruits and vegetables such as durian, rambutan, pineapples, bananas, chempedak, chillies, beans and so on. Livestock such as chickens and ducks are also reared. Duck rearing is especially common because of the proximity of sago holding of canals and rivers.

Only 47 or 39 % of our sample of farmers spend money on sago palm maintenance, which in this case involves the simple clearing of unwanted bushes and undergrowth around the sago palms. The mean cost of maintenance is only RM 254.64 (US$ 1.00 = RM 2.50, at the time of our survey) per ha per year. None of the sago farmers apply fertilisers on their palms. In fact, some writers have written of sago palm as being grown naturally in a semi-wild condition The sago palm is therefore not considered as a completely cultivated palm (Tie and Lim, 1991).

The sago palms are felled in about 10 to 15 years after planting, depending on the fertility of the terrain. The sago trunks are then cut into sections, each 75 cm to 90 cm long. Each sago trunk yields from 10 to 12 sections. These sago sections are tied together in the form of rafts and tugged by boats to sago factories for processing. The sago factories are invariably situated along river banks, for easy transportation Independent agents collect the sago sections and arrange for the transportation of the sections to the factories, for a fee. Floating of sago sections along the canals and rivers is the most common form of transportation to the factories. Lorries are also used in cases where the canals are too dry for movement.

At the time of our survey, the price for one sago section received by the farmers in Mukah District is about RM 5.00. Transportation cost from farm to factory is about RM 0.20 to RM 0.30 per section. For a farmer having about 5 ha, the income received from sago is therefore about RM 3,500 ($5 \times 14 \times 50 = 3500$) per year, assuming 10 sections per palm. This is considered insufficient for a family of 7 household members. We were told that a farmer's family needs about 10 ha of sago to live comfortably from this palm alone Otherwise, supplementary sources of income from other agricultural activities and off-farm sources are required. Employment as part-time fisherman is also quite common among sago farmers in Mukah because of the proximity of sago-growing areas near the sea and rivers.

The Land Custody and Development Authority of Sarawak (or termed PELITA, a government statutory body), has started the development of two sago plantations -one located at the boundary between Oya and Igan known as the Dalat Sago Plantation and the other located in the Mukah District known as the Mukah Sago Plantation. The Dalat Plantation is estimated to cost RM13.7 million covering an area of

1,600 ha while the Mukah Plantation is estimated to cost RM35.6 million covering an area of 20,000 ha. The underlying aim in these plantations is the application of modern, scientific agricultural technology and a large-scale institutional organisation, to exploit the cultivation of sago, that has thus long been cultivated in a very primitive and semi-wild fashion. Whether the Sarawak government's effort in this venture is going to be successful or not remains to be seen, as this is the first attempt at growing sago on a plantation scale anywhere in the world. The first harvest is only due in year 2000.

Sago processing (Extraction) factories

In contrast to the cultivation of sago which is based on primitive, smallholding agriculture, the processing of sago sections to derive the sago starch is done by using the latest extraction technology, which is adapted from technologies used in the extraction of starch from cassava or possibly the extraction of oil from oil palm and kernel palm. In the sago extraction process, the sago logs are first debarked, followed by maceration using a rasper. Newer types of raspers have eliminated the need for debarking The sago chips resulting from the maceration process are then further disintegrated using a hammer mill. The starch slurry is then passed through a series of centrifugal sieves to remove the coarse fibres. Cyclone separators are then used to extract the starch which is then dried by using a rotary vacuum drum drier, followed by hot air drying.

There are currently 11 modern sago processing plants in Sarawak. Each plant has fixed assets and equipment costing from 2 to 5 million Ringgits. The throughput of each of these plants ranges from 200 to 600 metric tons of dry sago flour per month. It has been claimed, justly perhaps, that the world's most efficient sago extraction industry is in Sarawak. Cost of processing is estimated to be RM9.00 per sago section, with the conversion rate of about 65 sections to produce 1 tonne sago flour (Chew, Abu Hassan Isa and Mohd. Ghazali Mohayidin, 1997) The main cost item in sago extraction is the cost of the sago logs which accounts for 60% to 70% of the total processing cost. Fuel, utility costs, depreciation and administration take up another 20% while labour cost accounts for about 10%. With each sago section priced at RM 5.00, for example, it would cost about RM 585 (65 × 9) to produce 1 tonne of sago flour. The modern sago processing plants in Sarawak are so efficient and consume sago logs in such large quantities that the problem now is the insufficiency of logs to satisfy the demands of all the sago factories. Hence, many of the sago factories in Sarawak are now operating at undercapacity. All the sago factories, except one, are owned by private sector.

The one plant owned by the Sarawak State Development Corporation (SEDC, a government statutory body), Sarasago Industries Sdn. Bhd., is now temporarily closed because of difficulty in getting enough sago logs. Similarly, the traditional, small-scale cottage mills, which produce a type of inferior, wet sago called 'lementak', for the local markets, are slowly being wiped out because of the competition from the high-quality, dry sago flour produced by the modern factories.

Potential for the Development of Sago in Sarawak

Theoretically, the potential for the further expansion of sago in Sarawak appears tremendous, given the fact that there are about 1.69 million hectares of peat soil that can be cultivated with this palm. Furthermore, it has been claimed that sago can yield up to 37 tonnes of starch/ha/year, one of the highest among starch-producing crops in the world (Jong, 1995). However, these exciting prospects must be tempered with some sobering economic facts with regard to the profitability of sago cultivation vis-a-vis oil palm cultivation.

Financial IRR of sago cultivation

To compute the financial IRR of sago cultivation, we made use of 3 sets of data available in the literature. One set of costs and returns of sago cultivation is taken from the article by Kueh, Elone, Tie, Ung and Jaman Hj. Osman (1991).

This set of estimation is for a sago plantation of 2278 hectares grown on deep peat. The second set of figures is from Harun Ramain (1995), who estimated the profitability of growing sago on a 10 – hectare smallholding The third set of figures is from in-house Seminar as given in the Mini-Seminar Report, compiled by the Department of Agriculture, Sarawak (1996), for a 1-hectare farm. The 3 sets of figures for sago cultivation were first standardised by using a common price of RM 40 for one sago trunk. The different authors used different prices in their original reports (RM 40 for Mini-Seminar Report, RM 26 used by Harun and RM22 used by Kueh et al). We then added in a conservative land cost of RM 5,000 per ha. In the original calculations, land cost was assumed as zero, which we consider unrealistic for a financial analysis. The financial IRRs recomputed are 6.18% (Mini-Seminar), 0.9% (Harun) and 8.06% (Kueh et at.) (Chew et al.). With such low rates of financial return compared to financial IRRs of over 20% for oil palm (Khera, 1976), it is not surprising therefore that much of the sago land is drained and converted to oil palm cultivation, leading to a near-total demise of the sago industry in Peninsular Malaysia

Economic IRR of sago cultivation

To compute the economic IRR of sago cultivation, we must first estimate the much-touted environmental benefits derived from growing sago in a peat forest environment. To do this we must estimate the Total Economic Value (TEV) of a peat swamp forest, where TEV is defined as follows (Pearce, 1990):

$$TEV = UV + NUV$$
$$= DUV + IUV + OV + EV + QOV$$

where,

TEV = total economic value;
UV = use value;
NUV = nonuse value;
DUV = direct use value;
IUV = indirect use value;
OV = option value;
EV = existence value;
QOV = quasi-option value.

Direct use value for a peat swamp forest, where sago flourishes, includes timber and nontimber products and tourism (recreation). The output of subsidiary products such as rattan, latex, fruits and so on are measurable according to market prices. Other products such as medicinal plants and yet-to-be-identified flora and fauna are impossible to quantify. Indirect values include ecological functions of the forest, such as their watershed and mineral cycling functions. Tropical forests also store carbon dioxide, which mitigates global warming. Another indirect benefit is the efficient nutrient cycling that occurs in a forest, contributing to environmental stability and resilience.

There are not many studies where TEV is quantified for a tropical forest resource. One such rare study is the work by Kanta Kumari (1995), who quantified the TEV of a peat swamp forest in Selangor. Since sago flourishes naturally in peat forests, the values obtained by Kumari can easily be modified to derive the nontangible environmental benefits obtained from growing sago.

Table 2 shows the TEV of a peat swamp forest under different management (timber exploitation) systems. TEV on a per hectare basis varies from a low of RM 10,231 to a high of RM 12,464 These figures are net present values (NPV), using a social interest rate of 8% (Kumari, 1995).

Table 2. Total economic valuation of peat forest conservation benefits(RM/ha).

Good/Service	Unstainable A		Substainable B_1		Substainable B_2		Substainable B_3	
	20% Damage	50% Damage	20% Damage	50% Damage	20% Samage	50% Damage	20% Damage	50% Damage
1 Timber	3448	2149	2360	1453	1750	1085	1276	804
2 Hydrological	319	319	319	319	730	730	999	999
3. Endangered spp	378	447	436	484	469	504	494	519
4. Carbon stock	8011	7080	8677	8049	8677	8049	8677	8049
5. Rattan	35	22	177	110	194	121	214	134
6. Bamboo	157	98	157	98	76	49	78	49
7. Recreation	57	57	57	57	57	57	57	57
8. Domestic water	30	30	30	30	30	30	30	30
9. Fish	29	29	29	29	29	29	29	29
TEV (RM/ha)	12464	10231	12242	10629	12014	10654	11854	10670

Note: Adapted from Kanta Kumari(1995)
A, B_1, B_2 and B_3 refer to different timber extraction methods(see Kumari, 1995)

For our purpose, in evaluating the economic viability of sago as an economic resource, we need to alter some of the figures in Table 2. These reasons for these modifications are:

(a) Unlike the case for Kumari, where he evaluated the benefits derivable from different types of timber exploitation from a peat forest, we are interested in evaluating the benefits of growing sago in peat conditions, as against growing its main rival, the oil palm However, to grow the latter, the peat forest must be drained, resulting in a drastic alteration in the natural environment of the forest.

(b) No one has compared the carbon sequestration ability of sago palm against that for oil palm Given that the sago palm has many more fronds compared to sago palm and the fact that sago continuously produce suckers, the carbon fixation properties of sago should be superior to that of oil palm. Kumari (1995) had estimated that the difference in carbon sequestration between the worst peat forest exploitation method and the best exploitation method is (RM 8,677 − RM 7,080 = RM 1,597) per hectare The worst exploitation technique involves large-scale destruction of the trees and ground, requiring a considerable time for the forest to rebuild up its carbon sequestration property to its equilibrium level. The most benign forest exploitation method, on the other hand, involves comparatively less severe damage to forest trees and the forest floor. This difference of RM 1,597 per hectare can therefore be used as the proxy measure of the difference in carbon sequestration ability between a sago plantation and an oil palm plantation. The logic is fairly simple. Oil palm cultivation involves the periodic clearing, during the planting stage, of an existing forest whereas sago cultivation involves leaving large tracts of the peat forest virtually intact in its original state. In the absence of a better estimate of the differential carbon sequestration rate between the two palms, this figure of RM 1,597 would suffice.

(c) Oil palm cultivation involves the drainage of the peat forest. Decomposition of the humus matter occurs as a matter of course, leading to a release of carbon dioxide to the atmosphere Sago cultivation, on the other hand, involves minimal disturbance to the original forest floor. Kumari (1995) assumes that one hectare of peat forest has 150 Ct (carbon tonne). Each tonne of carbon is assumed to have a social value of RM 14. Assuming that oil palm cultivation involves a near destruction of a peat forest, though not all the humus will completely decompose and escape into the atmosphere, a reasonable assumption would be to assume that the cultivation of oil palm in a peat forest will release 100 Ct, giving a value of $(100 \times 14) =$ RM 1,400 of carbon damage.

(d) The environmental-friendly benefits of sago on a per hectare basis, compared to that of oil palm, can therefore be summed up as follows. The difference between the carbon fixation abilities of the two palms is RM 1,597, as argued above. The loss of humus, at RM 1,400 for the lst, the 25th., the 75th., and the 100th. year, assuming a life cycle of 25 years before replanting, discounted at 8% social interest rate gives a net present value (NPV) of RM 1,525.57. The other benefits derivable from sago cultivation, because of its minimal disturbance to the original ecological habitat of a peat forest, are: hydrological benefit estimated at RM 999; endangered species estimated at RM 519; recreational benefit estimated at RM 57; domestic water benefit estimated at RM 30; and fish benefit estimated at RM29 (all figures taken from Table 2 by Kumari, 1995[1]). The sum of all the benefits give a net present value of RM 4,756.57 per hectare or about RM 5,000 per hectare. This figure can then be assumed to be the environmental-friendly benefits of sago cultivation as compared to oil palm cultivation. However arbitrary these figures may appear, they represent a first stab at quantifying the much-talked about, but never-quantified benefits of sago cultivation.

To compute the economic IRRs, we made the following adjustments:

(a) The agricultural figures of costs (materials and labour) were adjusted by multiplying by a factor of 0.9, following the standard conversion factor (Veitch, 1986).

(b) The environmental - enhancing benefit of sago cultivation, as discussed above, was added to the income stream. The inclusion of this environmental benefit was added in at the point where the income stream first turn positive from the initial, negative values, with the appropriate compounding so that the NPV is equivalent to RM 5, 000 as estimated. If the environmental benefit is simply added in to the initial years, resulting in a positive-negative-positive income stream, the computation of the standard IRR using the Excel or Lotus software becomes impossible.

The economic IRRs obtained are 19.18% (Mini-Seminar), 18.42% (Harun) and 17.35% (Kueh et al.)[2]. If the environmental benefits were not included, the economic IRRs are respectively 13.77%, 13.24% and 12.93%, assuming a sago log price of RM 40.00 per trunk. If we were to arbitrarily increase the environmental benefits from RM 5,000 to RM 10,000 per hectare, the economic IRRs increases to 24.15%, 22.77% and 21.15% respectively for the 3 cases. Increasing the environmental benefits from RM 5,000 per hectare to RM 10,000 per hectare may not be unrealistic as it may appear, because the value of one tonne of carbon reduction from the atmosphere has been estimated to range from Nordhaus's (1991) low estimate of global warming cost of US $ 1.89 per tonne of carbon to alternative estimate of US $ 100 per tonne of carbon (Schneider, 1992). We were using a figure of RM 14.00 per carbon tonne (equivalent to about US $ 5.60) in our calculations.

Special Qualities of Sago Palm Reiterated

There are a number of characteristics of sago palm, that makes it quite a remarkable plant. First, sago is an extremely hardy plant, thriving in swampy, acidic peat soils, where few other crops survive. The palm is immune to floods, drought, fire and strong winds. Its large fibrous root system traps silt loads and removes pollutants, faecal contaminants and heavy metals. Sago forest also acts as an excellent carbon sink for carbon sequestration, thereby mitigating the greenhouse effect and global warming arising from the release of carbon dioxide into the atmosphere due to industrialization and increases in motorised vehicles (Stanton, 1991). In short, in this age of concern for the environment, sago is the crop par excellence for sustainable agriculture.

Second, sago palms continually produce suckers which in turn grow into adult palms. This implies that a sago holding can virtually produce palms in perpetuity. There is then no necessity for replanting. This eliminates the need for recurring expensive establishment costs, after every harvest of the adult palms.

Third, starch accumulates in the trunk of the sago palm.

This starch accumulation continues until the flowering stage Maximum starch content occurs just before the palm flowers. Sago is special among agricultural commodities in that a farmer is not forced to harvest his palms if the sago price is low. He can postpone his felling of the palms for a period of up to 3 years, until the onset of flowering, without any significant loss in starch content or quality. Thus, the sago palm acts as a form of 'savings' for the farmers. The trees need only be felled when there is a sudden need for cash. Such an occasion may arise because of an impending marriage of one of the members of the family, for example. In other words, the price elasticity of supply of sago can be quite elastic, unlike the case for most agricultural products. The inelastic-supply characteristic of agricultural commodities has always been the bane of agricultural producers, resulting in poor returns during good harvests. This problem is especially acute for farmers in developing countries.

Fourth, sago starch has a multitude of uses. In Sarawak, sago is widely used to produce sago pearls and 'tabaloi', a local biscuit delicacy. Sago pearls can be boiled, either alone or mixed with other food, and consumed directly as a carbohydrate source. Sago is also widely used, together with rice, corn and potatoes, in the manufacture of noodles in Malaysia. The other industries that make extensive use of sago are the monosodium glutamate industry, the soft drink industry in the making of various syrups and the glue industry involved in plywood manufacture. New uses for sago include its use in the manufacture of biode-gradable plastics, alcohol, ethanol and citric acid. In other words, sago starch is a very versatile multiple-use product. The nearest substitute product for sago starch is cassava (tapioca) starch. This can be seen in Table 3, which shows the correlation matrix for the prices of various carbohydrate sources. The price of sago has the highest correlation (r = 0.5448) with the price of tapioca, among all the starch sources. This shows, in a simplistic way, that among the different starch sources, cassava and sago are the closest substitutes to each other.

Table 3. Correlation matrix for prices of various carbohydrate sources.

	Barley	Cassava	Maize	Oats	Potatoes	Sago	Rice	Sorghum	Wheat
Barley	1.0000								
Cassava	−0.4930	1.0000							
Maize	0.8876	−0.4468	1.0000						
Oats	0.7414	−0.1545	0.7238	1.0000					
Potatoes	0.4126	0.1079	0.3220	0.6380	1.0000				
Sago	−0.2437	0.5448	0.0834	0.0792	0.2275	1.0000			
Rice	0.6318	−0.1237	0.5746	0.8461	0.4501	−0.1207	1.0000		
Sorghum	0.8022	−0.2456	0.9531	0.7477	0.3857	0.3322	0.5349	1.0000	
Wheat	0.7403	−0.1853	0.6993	0.9503	0.6739	0.1723	0.7486	0.7622	1.0000

Note: Computed from prices taken from FAO Yearbook, for the period 1984 – 1993, except for sago price

The prices for sago were taken from Agricultural Statidtics of Sarawak, published by the Department of Agriculture, Sarawak.

Finally, sago palm seems to have few pests or diseases. The sago beetle is one such pest which bores into the trunks of the sago palms, leaving its eggs inside. However, surprisingly, this pest is considered as a blessing in disguise, as the larvae of this sago beetle is consumed as a highly esteemed delicacy by the local population, eaten either raw or fried. Monkeys and wild boars are the other pestilence of sago, digging up and eating the young palms during the sucker stage.

Conclusions and Policy Implications

Even though, sago is considered by many plant scientists, especially Japanese scientists, as the 'starch crop of the 21st century' (Jong, 1995). The present method of cultivation of sago palm shows that it is currently grown using primitive agricultural technology. Sago is at present essentially a smallholder's crop, producing low yields with minimal maintenance and zero fertilisation. Current methods of cultivation in Sarawak is not that much different from what had occurred through the millennium and what is occurring even now in the virgin jungles of Papua New Guinea.

The Sarawak government is trying to pioneer the cultivation of sago on a plantation scale, trying to tap 20th century agricultural technology and large-scale organisational structure to grow this supposedly wonder crop. However, whether the Sarawak government will be successful or not is still left to be seen Using history as the guide, the successful cultivation of perennial crops like rubber, oil palm, cocoa and coconuts in Malaysia were all pioneered first by private entrepreneurs. Government statutory bodies followed when the technology for growing these crops on a large scale had been invented and demonstrated many times over, by the private sector. That the Sarawak government is pioneering the cultivation of sago on a plantation scale when the clonal material and plantation technology for this palm have not been established by private entrepreneurs, is therefore truly a unique and bold endeavour. And a rather risky one as well.

Given that the current estimate of the area under sago is only 19, 720 hectares, mainly in the Sibu Division in Sarawak, and that there are about 1.69 million hectares of peat soil in Sarawak that can be cultivated with sago, the future for sago appears therefore to be very bright. Added to this the environmental benefits of sago, with its hardy, flood-resistant properties and its superior carbon sequestration quality and its zero requirement for fertilizers, it is not surprising that sago has been predicted to be the crop of the future. A recent article in a Malaysian business magazine forecast sago as Sarawak's next golden crop (Chan, 1997).

However, realities on the ground tell a different story. The sago industry in Peninsular Malaysia was completely decimated by the competing demands for land and capital by the much more profitable oil palm The financial IRR (Internal Rate of Return) for oil palm is over 20% (Khera, 1976), while that for sago is only around 0.9% to 8.06%, as discussed above. Oil palm is now tried out in different peat localities in Sarawak, such as the FELCRA (Federal Land Consolidation and Rehabilitation Authority) oil palm scheme in Balingian District near Dalat. Given the short gestation period for oil palm of only 4 years and the current high prices for palm oil and palm kernel oil, sago is no match for oil palm in terms of financial profitability. Numerous instances have shown in Peninsular Malaysia that with adequate drainage and chemical applications, oil palm can be profitably grown on acidic peat soils. Unless steps are therefore taken to dramatically increase the profitability of sago, the sago industry in Sarawak may well follow the path to extinction, as had occurred in Peninsular Malaysia.

What can be done to increase the profitability of sago cultivation? There are 3 possibilities: (a) increase its starch yield; (b) reduce the gestation period of sago from the present 10 to 15 years to a shorter period, say 5 years; and (c) reduce the cost of production of sago. Yield increases and reduction in gestation period can only be achieved by research in plant selection and breeding work The spectacular improvements in the yield of oil palm and its maturity period in Malaysia were achieved by a similar research programme, undertaken by a wide variety of governmental and private groups, in the 1900s (Hartley, 1967). Unfortunately, there are currently no private groups carrying out research on sago in Malaysia. In fact, there are now only two government centers, the Dalat Sago Research Station and CRAUN (Crop Research and Application Unit, Lembaga Pem-bangunan dan Lindungan Tanah, Sarawak or PELITA), carrying out research on sago cultivation. The amount of research resource devoted to sago is clearly inadequate for the monumental task of converting sago from its present semi-wild status to a modern clone, with high yields, short maturity period and responsiveness to fertilizers. One must not forget that in the international market, sago starch competes directly with tapioca starch. Tapioca or cassava matures in about 12 months and is a heavily-researched crop, whose yields have been elevated from a dismal 6 tonnes/ha to 20 – 30 tonnes/ha. It has also been reported that super cassava clones with yields of 40 tonnes/ha have been developed (Taye, 1996).

To encourage the private sector to participate in sago cultivation and sago research, the Sarawak government should consciously tipped the balance in favour of sago cultivation by reducing its cost of production. One such method would be a liberal policy of cheap peat land alienation, done openly through a competitive bidding system, for sago cultivation, with the strict proviso that only sago can be grown This is to deter the alteration of peat areas through drainage and their cultivation with oil palm Cheap land alienation was the policy used previously by the Colonial Government to encourage the cultivation of rubber and oil palm (Courtenay, 1971). If the cost of land is sufficiently low, sago's profitability will increase. When a sufficient 'critical mass' of numbers of private entrepreneurs have entered into sago cultivation, the setting up of private research stations devoted to sago research will automatically by itself follow, as had occurred in the case of oil palm. Without such a massive push by private sector interests, it would be difficult, in fact well-near impossible, to replicate the success of oil palm in Malaysia, for sago palm. Given the need to reduce pollution and the concern for the environment, the widespread replacement of sago palm with oil palm would indeed be an environmental loss

By quantifying the environmental benefits of sago cultivation (assuming that the social cost of 1 carbon tonne is RM 14.00 and making use of selected figures used in deriving the 'total economic value' of peat swamps as given in Kanta Kumari (1995)), the economic IRR of sago cultivation was estimated to lie between 17% to 19%. However, because there is currently no compensatory mechanism to pay for carbon fixation and cleansing of the atmosphere from developed countries to under-developed countries with tropical forests (Stavins, 1995; Schneider, 1996), the environmental benefits derived from sago cultivation can not be monetised and therefore remains largely of theoretical interest only. Environmental groups should bring up the environmental-enhancing properties of sago cultivation in peat forest in international forums so that some form of compensatory trade-off mechanism can be established to monetise these properties. In this way, both developed and developing countries can mutually benefit

Footnotes

1. Taking arbitrarily the largest figures in Table 2, to reflect the worst-damage scenario.
2. To give an idea as to the type of figures involved, we have include the computation of the economic IRR for the set of figures taken from Kueh et al. in the Appendix of this paper.

References

Chan, S. C., 1997. Sago Sacks of Gold. Malaysian Business, February 16, issue.

Chew Tek-Ann, Abu Hassan Isa and Mohd. Ghazali Mohayidin., 1997. An Economic Study of the Sago Industry in Malaysia, IRPA Project (Project No. 51171).

Courtenay, P. P., 1971. Plantation Agriculture. London, Bell and Sons Ltd.

Department of Agriculture, Sarawak. 1996. Proceedings In-House Mini-Seminar on Sago Cultivation. Held on 29th January to 1st. February 1996 in Mukah.

Department of Agriculture, Sarawak (various issues). Agricultural Statistics of Sarawak. Kuching.

FAO Yearbook (various issues). Food and Agricultural Organisation of the United Nations, Rome.

Hartley, C. W. S. 1967. The Oil Palm. Longmans, Green and Co. Ltd.

Harun bin Ramain. 1995. A Study of Financial Evaluation of a Typical Sago Smallholding in Mukah, Sarawak. Final year project paper for Bac. Sc. (Agribusiness) Degree, Universiti Pertanian Malaysia.

Jong Foh Shoon, 1995. Interview. Published in New Straits Times, July 24.

Khera, Harcharan Singh, 1976. The Oil Palm Industry: An Economic Study. Kuala Lumpur, Penerbit Universiti Malaya.

Kueh Hong-Siong, Robert Elone, Tie Yiu-Liong, Ung Cin-Min and Jaman Hj. Osman., The Feasibility of Plantation Production of Sago (Metroxylon sagu) on an Organic Soil in Sarawak, in Ng Thai-Tsiung, Tie Yiu-Liong and Kueh Hong-Siong (Editors) 1991 Proceedings of the Fourth International Sago Symposium Held in Kuching, Sarawak on August 6 – 9, pp. 127 – 136

Kueh Hong-Siong, The Effects of Soil Applied NPK Fertilizers on the Growth of the Sago Palm (Metroxylon sagu, ROTTB.) on Undrained Deep Peat, in Suranat Subhadrabandhu and Sayan Sdoodee (Editors). 1995. Fifth International Sago Symposium. Published by ISHS, Leiden, Netherlands, June.

Kumari Kanta, 1995. An Environmental and Economic Asses-sment of Forest Management Options: A Case Study in Malaysia. Pollution and Environmental Economics Division, World Bank, Washington.

Nordhaus, W., 1991. A Sketch of the Economics of the Green-house Effect American Economic Review, Papers and Proceedings, 81, 2, 146 – 150.

Pearce, D., 1990 An Ecological Approach to Saving Tropical Forest, LEEC Paper 90 – 06, London

Schneider, Robert, 1996 The Potential for Trade with the Amazon in Greenhouse Gas Reduction. Laten Dissemination Note II, from INTERNET (http://www.worldbank.org/html/lat/english/).

Stanton, W. R. Long-Term and Ancillary Environmental Benefits from Sago Agroforestry Systems, in Ng Thai-Tsiung, Tie Yiu-Liong and Kueh Hong-Siong (Editors). 1991. Proceedings of the Fourth International Sago Symposium. Held in Kuching, Sarawak on August 6 – 9, April, pp. 24 – 35

Stavins, Robert N., 1995 The Costs of Carbon Sequestration: A Revealed-preference Approach. Discussion paper 95 – 21, Resources for the Future, Washington, April

Tan Koonlin, 1983. The Swamp-Sago Industry in West Malaysia. Institute of Southeast Asian Studies, Singapore.

Taye Babaleye, Cassava, 1996. Africa's Food Security Crop. CGIAR (Consultative Group on International Agricultural Research) News, 3, 1.

Tie Yiu-Liong and Kelvin Lim Eng-Tian. The Current Status and Future Prospects of Harvestable Sago Palms in Sarawak, in Ng Thai-Tsiung, Tie Yiu-Liong and Kueh Hong-Siong (Editors). 1991 Proceedings of the Fourth International Sago Symposium. Held in Kuching, Sarawak on August 6 – 9, pp. 11 – 16.

Veitch, M. D., 1986 National Parameters for Project Appraisal in Malaysia, Vol. 1, Economic Planning Unit, Prime Minister's Department, Kuala Lumpur, Malaysia.

Appendix

Coses and returns for sago planatation (2278 ha deep peat) (RM'000)

Year	Capital cost	Variable cost	Total cost	Adjusted cost(0.9)	Total revenue	Total revenue adjuisted from log price of RM22 to RM40	Revenue-adjusyed cost
1987	2193.9		2193.9	1974.51	0	0	-1974.51
1988	5815.4		5815.4	5233.86	0	0	-5233.86
1989	1730.2		1730.2	1557.18	0	0	-1557.18
1990	966.2		966.2	869.58	0	0	-869.58
1991	726		726	653.4	0	0	-653.40
1992	530.8		530.8	477.72	0	0	-477.72
1993	561.9		561.9	505.71	0	0	-505.71
1994	534.6		534.6	481.14	0	0	-481.14
1995	559.3		559.3	503.37	0	0	-503.37
1996	718.9		718.9	647.01	0	0	-647.01
1997	1036.3		1036.3	932.67	0	0	-932.67
1998	1220.6		1220.6	1098.54	0	0	-1098.54
1999	1272.8		1272.8	1145.52	673.2	1224	31054.72
2000		2187	2187	1968.3	4488	8160	6191.70
2001		2030	2030	1827	4488	8160	6333.00
2002		2241.1	2241.1	2016.99	4488	8160	6143.01
2003		2107.5	2107.5	1898.75	4488	8160	6263.25
2004		2105.4	2105.4	1894.86	4488	8160	6265.14
2005		2131.5	2131.5	1918.35	4488	8160	6241.65
2006		2119	2119	1907.1	4488	8160	6252.90
2007		2059.5	2059.5	1853.55	4488	8160	8306.45
2008		2281.6	2281.6	2053.44	4488	8160	6106.56
2009		2551.5	2551.5	2296,35	488	8160	5863.65
2010		2115	2115	1903.5	4488	8160	6256.50
2011		2083.1	2083.1	1874.79	4488	8160	6285.21
2012		2118	2118	1906.2	4488	8160	6253.80
2013		2055	2055	1849.5	4488	8160	6310.50
2014		2255.1	2255.1	2029.59	4488	8160	6130.41
2015		2102.5	2102.5	1892.09	4488	8160	6267.75
2016		2061	2061	1854.9	4488	8160	6305.10
2017		2080.1	2080.1	1872.09	4488	8160	6287.91
2018		2134.5	2134.5	1921.05	4488	8160	6238.95
2019		2523.4	2523.4	2271.06	4488	8160	5888.94
2020		2405.5	2405.5	2164.95	4488	8160	5995.05
2021		2094	2094	1884.6	4488	8160	6275.40
2022		2037	2037	1833.3	4488	8160	6326.70

Economic IRR = 0.1735

NPV at 10% = 14810.72

Source: Costs and returns taken from page 136 of article by Kueh Hong-Siong, Robert Elone, Tie Yiu-Liong, Ung Chin-Min and Hj. Osman The Feasibility of Planation Production of Sago (Metrozylon sagu) on an Organic Soil in Sarawak. In Ng Thai-Tsiung, Tie Yiu-Liong, Kueh Hong - Siong(Editors) Proceedings of 4th International Sago Symposium held August 6 – 9, 1990 in Kuchingg, Sarawak(April 1991).