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学位論文全文に代わる要約
Extended Summary in Lieu of Dissertation

氏名：　Andi Patiware Metaragakusuma
Name

学位論文題目：
Title of Dissertation

An Analysis on the Development of Sago Production and Its Determinants in South Sulawesi, Indonesia
(インドネシア、南スラウェシにおけるサゴ生産の発展およびその影響要因に関する研究)

学位論文要約：
Dissertation Summary

More than 95% of Indonesians consume rice as their staple food. According to the publication of Central Statistics Agency of Indonesia together with Food Security Agency of Indonesia in *Kajian Konsumsi dan Cadangan Beras Nasional* 2011/ Studies of National Rice Consumption and Reserves 2011, Indonesia had a high consumption of rice, 113.7 kilograms per year per capita on average, compared with the average of world rice consumption which is only at 65 kilograms per year per capita. The high consumption of rice has been heavily influenced by politics, particularly by the rice policy in Indonesia (Afiff and Timmer, 1971; FAO, 2011). After WWII, agricultural policy in Indonesia strongly promotes rice as staple food. The poverty standard in Indonesia is also determined by rice consumption: people who consume less than 240 kilograms per year of rice are categorized as very poor (Sajogyo, 1996).

The high dependency on rice as a staple in Indonesia has resulted in large quantities of rice imports; the National Research Council of Indonesia noted that in the 1990s rice imports averaged two million tons per year. This situation posed a threat to national food security. Considering the potential of sago palm in Indonesia and the nutrient content of sago, particularly its carbohydrate content, sago is one alternative local food available for food diversification (Suswono, 2010). Flach (1997) recognized in the late 90s that dealing with food security in the long term in Indonesia could be achieved by increasing the utilization of the ample supplies of sago as an environmental-friendly high carbohydrate potential food stock. The possibilities for sago are numerous due to the large areas of sago palm in Indonesia: about 1.28 million hectares or more than 50% of the area of sago palm in the world (Pietries, 1996). Sago palm can produce up to 25 tons of starch per hectare per year; it is higher than other source of carbohydrate crops namely rice (6 tons), wheat (5 tons) (Ishizaki, 2009).

Sago is a starch obtained from the sago palm (*Metroxylon spp*) (FAO, 2013). Preparing sago for various products is not something new for rural Indonesian people, who have the basic capability to acquire adequate sago as a staple food (Metaragakusuma *et al*., 2017a). Since the beginning of the 1970s, sago has been identified as a valuable local resource in Indonesia (Regional Research and Development, 2008). There are many documents that describe sago as a staple food for local people in Indonesia going back centuries. For instance, sago was discovered as a source of food in the 13th century in Sumatra, then later it was noted that a sago factory was described in the 15th century in Malaka (Polo, 1930). In the 16th century, sago was the common food consumed by local people in Sumatra together with millet and rice (Ruddle *et al*., 1978). In the 18th century, sago was one of the tributes people had to pay every year to the Sultan of Tidore (Wallace, 1869), which demonstrates the historical significance of sago.

In recent years, the status of sago has fallen as a staple food in Indonesia because it has been replaced by rice. As mentioned previously the change in staple food has been heavily influenced by domestic politics, particularly by rice policy. In addition, the image of sago as being mostly for the poor came about when people

who joined the national transmigration program; about 25% of those people were moved to northern part of South Sulawesi including in sago producing area, chose to consume sago when their economic life conditions were not yet settled (Metaragakusuma, 2015). Inevitably, as the consumption of rice gradually increased, national production became insufficient to feed the Indonesian people, and the government needed to import rice to fulfil the need for staple food.

Sago became popular as an alternative food for food diversification after the government issued two policies, Presidential Decree No. 22/2009 and Regulation of the Minister of Agriculture No. 43/ 2009 which emphasized reviving local resources. This was followed by the statement from the Ministry of Agriculture that sago has a great potential to be developed because it has a high carbohydrate content (Metaragakusuma, 2015).

Even though some researchers have worked on increasing the utilization of sago and its development in some sago producing areas in Indonesia, such as Sumatra where the sago industry is growing rapidly, and Papua where sago palm is growing wild, very few researchers have investigated it in South Sulawesi. There exists a small area of sago palm (that may disappear) which still plays an important role as the main food source for some members of the local population and has potential for development. Although the sago plant is a part of the history and culture of South Sulawesi, until now sago is still not treated as a priority crop. Thus, this study mainly focuses on the development of sago production and its determinants, include the market size and availability, the factors hindering sago production and formulates a strategy for greater adoption of sago farming and production in South Sulawesi.

Before investigating sago development in South Sulawesi, our research first examined what are the traditional uses of sago for the sago-based food industry in Indonesia (Metaragakusuma *et al*., 2016). In this study, the benefit of sago compared to other non-rice staple foods, mainly its utilization in the food industry and a number of sago-based food products that have potential to be developed for supporting food diversification are described.

The benefits of sago are not only limited to its high carbohydrate content, but also, sago has many more advantages compared to other commodities (Leong *et al*., 2007), particularly compared to rice and wheat flour, because the consumption pattern of staple food in Indonesia is dominated by rice (78.4%) and followed by wheat flour (14.73%), while sago ranked at sixth place (1.07%) after cassava (2.88%), sweet potato (1.48%) and corn (1.38%) (Food Security Agency, 2012). Sago also has a low calorie and fat content, which are good for diet. Its protein content is very low and free from casein and gluten, so it is good to be consumed as a non-allergic food (Elder *et al*., 2006). In addition, sago is safe to be consumed by diabetic people because it does not raise blood glucose levels immediately (low glycemic index). As a resistant starch, sago can prevent the risk of constipation and colon cancer (Karim *et al*., 2008). Sago is getting popular as a healthy food in developing countries include in Indonesia.

The traditional use of sago for sago-based food industry is categorized in 6 ways: (1) sticky dough where it is considered as *nasi* (cooked rice) such as *papeda/ kapurung/ sinonggi*, (2) roasted sago such as *sagu lempeng/ dange/ sagu rangi*, (3) sago noodle, (4) various of snacks, (5) sago pearls, (6) and dried refining sago starch (Haryanto and Pangloli, 1992)

The experiences of local people in consuming sago have shown that sago has wider uses. It was found that sago is an important ingredient in a variety of products that have a high potential to be developed further for wider acceptance by consumers, especially in processing efforts in the food industry sector (Metaragakusuma *et al*., 2016). Table 1 summarizes sago-based products that have potency to be developed in supporting food diversification; total 63 products that are spread in 21 of 33 provinces Indonesia. The existence of sago-based products indicated that sago culture exist and have become an important part of human life. Nowadays, sago becomes an important raw material for food Industry and it is predicted that demand of sago in the future will

increase. This wider utilization of sago can give opportunity to home industry to grow which is indirectly can give economic impact to the farmers, and surely has a high potency to be developed further for wider acceptance purpose, especially in processing efforts in food industry sector (Metaragakusuma *et al*., 2016).

Table 1. Indonesian Sago-based Food Products

No	Province	Name of food	Raw material(s)
Sumatra Island			
1	Aceh	Lempeng ubi kayu Timpan sagu	Sago Sago & banana
2	West Sumatra	Pinere Lompong Sagu	Sago Sago & banana
3	Riau Islands	Laksa Sagu Mie Laksa Kirai Sagu MieGoreng Sagu Gobal Sagu Mie Tarempa Lendod Krenas	Sago Sago & t*amban* fish Sago Sago noodles & eggs Sago Sago noodles & eggs Sago Pearl sago
4	Jambi	Kue Satu	Sago & eggs
5	South Sumatra	Pempek Tekwan Kipo	Sago & mackerel Sago & mackerel Sago
6	Riau	Sagu Rendang Sagu Lemak Sagu Stick	Sago Sago Sago
7	Bangka Belitung	Kericu	Sago, squid eggs & eggs
Kalimantan Island			
8	West Kalimantan	Mie Sagu	Sago & shrimp
9	Central Kalimantan	Papeda Sagu Goreng Talam Jagung	Sago Sago Sago & corn Starch
10	East Kalimantan	Bubur Gunting	Sago
Java Island			
11	West Jawa	Sagu rangi Ongol-ongol Cendol Mie gleser Mie leor	Sago Sago, brown sugar, coconut crumb Sago, food dye Sago Sago
Sulawesi Island			
12	South Sulawesi	Kapurung Dange Bagea Sinole Lange Ongol-ongol Jalaure Cakko-cakko Cendol	Sago, fish, chicken & peanuts Sago Sago &palm Sugar
13	Southeast Sulawesi	Sinonggi	Sago

No	Province	Name of food	Raw material(s)
14	Central Sulawesi	Papeda Kapurung Jepa	Sago Sago Sago
15	North Sulawesi	Bagea Kenari	Sago & walnuts
16	Gorontalo	Ilabulo Kue Kokole Duwo Delepao Ilepao Bagea	Sago & chicken liver Sago Sago & fish Sago & fish Sago
NTT, Maluku and Papua Island			
17	East Nusa Tenggara	Akar Bilang	Sago
18	Maluku	Papeda Sagu Lempeng Bagea Sinoli Buburnee	Sago Sago Sago Sago Sago
19	North Maluku	Sagu lempeng Papeda Bagea kenari	Sago Sago Sago & walnuts
20	Papua	Papeda Puding Sagu Buah Merah Bubur Kacang Sagu Buburnee	Sago Sago, redfruit &jackfruit Sago & reen beans Sago
21	West Papua	Papeda	Sago

Karim *et al* (2008) reported that current world sago palm production is not only of the wild or semi wild plant and is not only used as a staple food for local people. Sago palm has become a commercial crop and an important source of starch for food and non-food industries. Because of its importance as a raw material for the production of some processed food items (eg *kapurung*), if demand for sago does, as predicted, will increase in the future, the availability of raw sago starch in the future may become a challenge to expanding production (Metaragakusuma *et al*., 2016).

Furthermore, our study investigated the current status of sago production in South Sulawesi including its market status and challenges as a new food-industry source. It shows that sago production is considered low and in this 8 year period (2006 – 2013) was decreased by 86% (*see* Figure 1) (Metaragakusuma *et al*., 2017a).

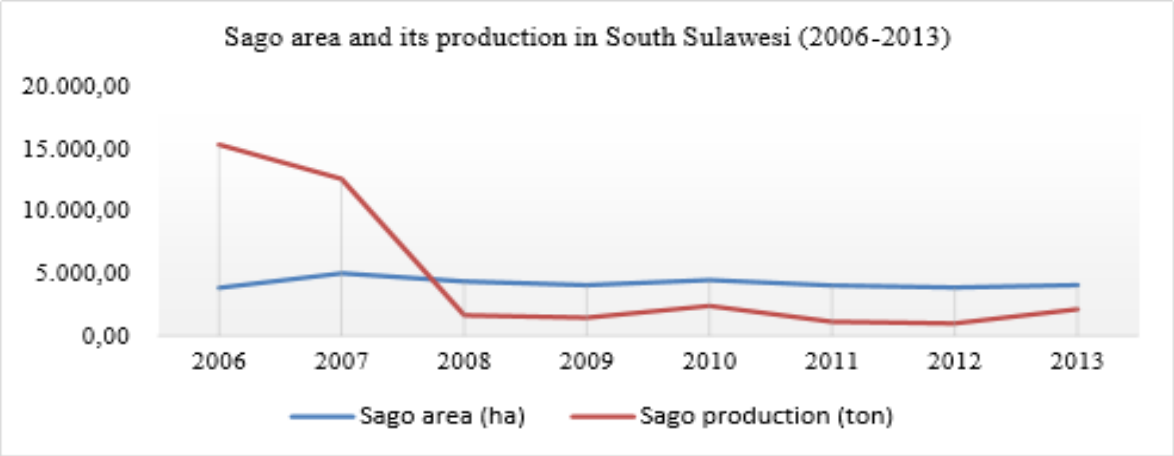


Figure 1. Sago area and its production in South Sulawesi (2006-2013)

Sago area and its land productivity can be seen also in Figure 2. The low production of sago is considered a challenge for the future market, and sago production needs to be sustained and increased if it is to meet projected market needs (Metaragakusuma *et al*., 2017a).

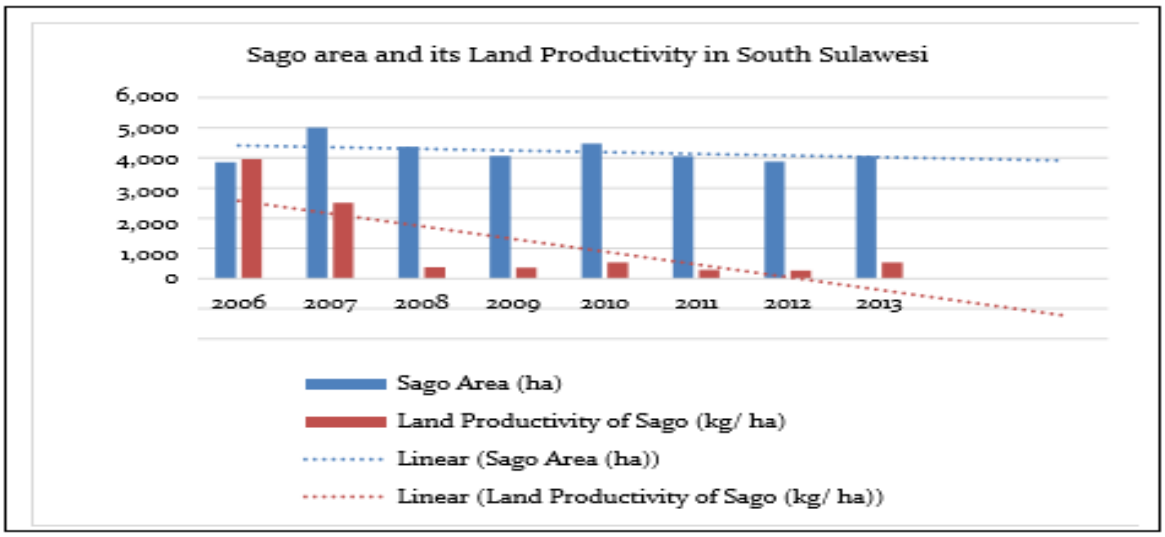


Figure 2. Sago area and its Land Productivity in South Sulawesi

To find out more about the sago market in South Sulawesi, two case studies are elaborated; 1) Al-Furqan Tribinatama, a producer of dried sago starch marketed as TSP (*Tepung Sago Palopo*/ refining dried sago starch), 2) Aroma Luwu Kapurung Restaurant, a food restaurant which sells *kapurung*, a traditional food from Tana Luwu which uses sago as a raw material). Results shows that market for sago exists and the sales trend showed an increase (*see* Figure 3) as well as the number of sales spots has increased. Sago has market potential not only inside but also outside of the sago production areas and there is a possibility to further expand the area of sago market. Furthermore, the number of our case study`s restaurant outlet (*see* Figure 4) has also increased from 1 outlet in 1999 to 4 outlets in 2011, yet, all of these outlets are located in Makassar City (Metaragakusuma *et al*., 2017a)..

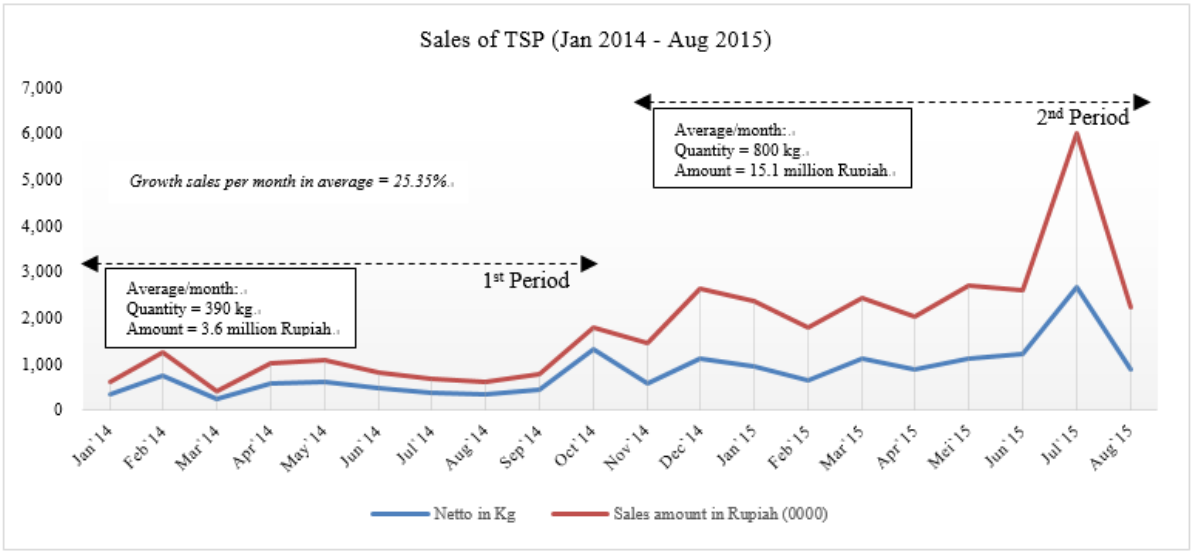
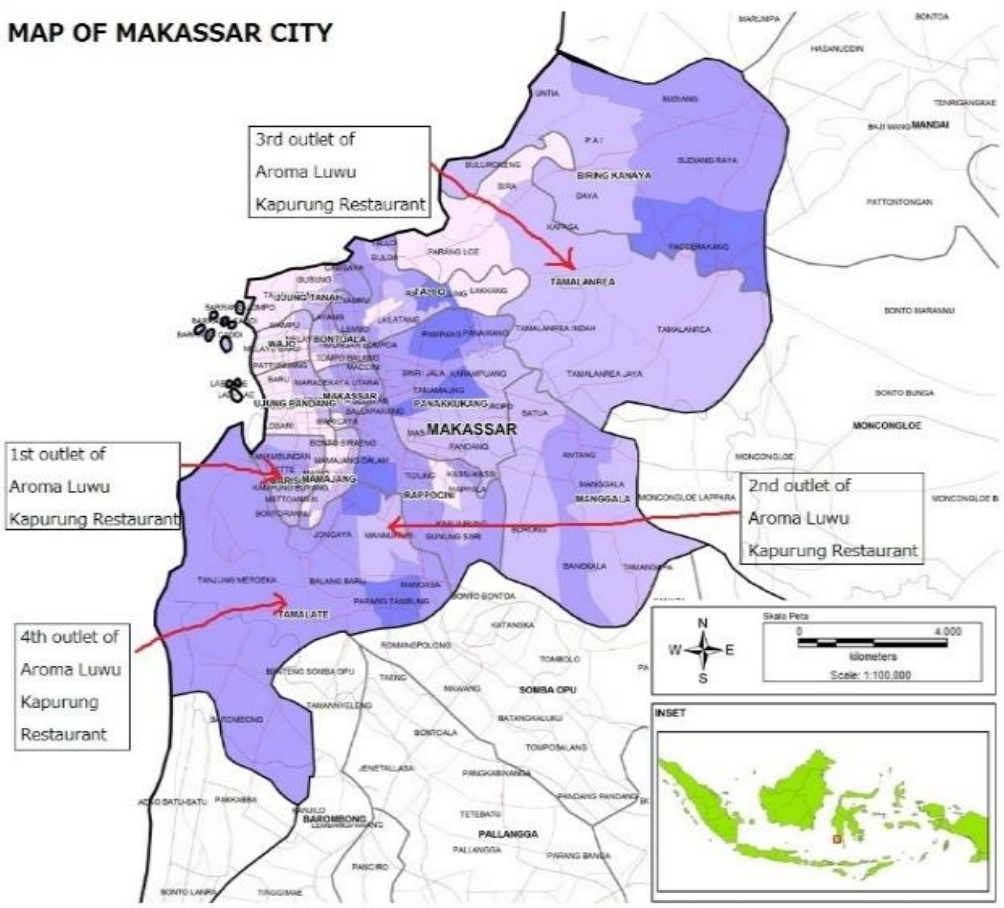


Figure 3. Sales of TSP for 20 months from Jan 2014 to Aug 2015



Map Source: (Ministry of Public Works, 2012)

Figure 4. Location of ALKR Outlets (dispersed throughout the city) in Makassar City

The sustainability of sago will determine the existence of sago-based food industries in the future. What needs to be done is the optimization of sago potential, so sago production can be increased. Besides that, in order to anticipate the future needs of sago, sustainable processes should be implemented, first by planting more sago seedlings (Metaragakusuma *et al*., 2017a).

For further investigation, the different factors affecting sago producing farm households (SFHs) using production in the biggest sago producing area in South Sulawesi, Luwu Utara Regency, were examined. A total of 54 valid questionnaires were collected from 19 sago processors during July and August 2015. Respondents were divided into two groups: (a) those with high sago production—more than 2.0 ton/month on average in the SFH1 group, 18 respondents (33.3%); and (b) those with low sago production—less than 2.0 ton/month on average in the SFH2 group, 36 respondents (66.7%).

Statistical independent *t*-test analysis was used to investigate factors contributing to differences among SFHs' production of sago. The three most important factors in sago production were identified: working hours, income, and motivation (*see* Table 2). It makes sense that working hours can impact income; it has been proven by many researchers that working hours and income are directly proportional. However, there is an interesting finding in this study, which is that a farmer's motivation is one of the most important factors. It can be concluded that motivation can influence the number of hours of a SFH works. Undeniably, motivational training and support from related stakeholders can encourage a sago farm household (SFH) to achieve a better livelihood (Metaragakusuma *et al*., 2017b).

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Table 2. Farmers` characteristics in 3 categories (socio-demographic, sago consumption, and sago processing), variable definition and comparable variables of sago production (SFH1 and SFH2)

Characteristics (Variable name in the model)	Value Assignment	Number of respondents	Respondent Group		Mean (SD)		Sig[1]
			SFH1	SFH2	SFH1	SFH2	
Number of respondents		**54**	**18 (33.3%)**	**36 (66.7%)**			
Category 1: Socio-demographic profile of farmers							
Gender					1.00	1.00	.000a
Female	=0	54 (100%)			(.000)	(.000)	
Male	=1						
Age (years)	Actual age				40.94	41.28	0.107
21 – 30		7 (13%)	3 (16.7%)	4 (11.1%)	(11.40)	(10.42)	
31 – 40		22 (40.7%)	7 (38.9%)	15 (41.7%)			
41 – 50		14 (26%)	3 (16.7%)	11 (30.6%)			
51 – 60		8 (14.8%)	4 (22.2%)	4 (11.1%)			
More than 60 years old		3 (5.5%)	1 (5.5%)	2 (5.5%)			
Marital status					1.00	0.89	-2.092
Unmarried	=0	4 (7.4%)	0 (0%)	4 (11.1%)	(0.00)	(0.32)	
Married	=1	50 (92.6%)	18 (100%)	32 (88.9%)			
Education (level)	Actual years				7.50	7.42	-132.000
Did not finish PS		1 (1.9%)	0 (0%)	1 (2.8%)	(2.12)	(2.21)	
Primary School		32 (59.3%)	11 (61.1%)	21 (58.3%)			
Junior High Sch./ equivalent		15 (27.7%)	5 (27.8%)	10 (27.8%)			
Senior High Sch./ equivalent		6 (11.1%)	2 (11.1%)	4 (11.1%)			
Household members	Actual numbers				4.00	4.31	0.954**
1 – 2		2 (3.7%)	0 (0%)	2 (5.6%)	(0.91)	(1.43)	
3 – 4		32 (59.3%)	13 (72.2%)	19 (52.8%)			
5 – 6		18 (33.3%)	5 (27.8%)	13 (36.1%)			
7 – 8		2 (3.7%)	0 (0%)	2 (5.6%)			
Besides sago, do you have other agricultural activities?					0.94	0.92	-0.223
					(0.54)	(0.37)	
No	=0	10 (18.5%)	5 (27.8%)	5 (13.9%)			
Yes	=1	44 (81.5%)	13 (72.2%)	31 (86.1%)			
Income from sago/month on average	Actual amount in IDR million	8 (14.8%)			8.69 (7.05)	2.19 (1.34)	-3.878***
Up to 1 million		9 (16.7%)	0 (0%)	8 (22.2%)			
1.1 – 2 million		16 (29.6%)	7 (38.9%)	9 (25.0%)			
2.1 – 4 million		10 (18.5%)	4 (22.2%)	16 (44.4%)			
4.1 – 6 million		11 (20.4%)	5 (27.8%)	3 (8.3%)			
More than 10 million			2 (11.1%)	0 (0%)			
Household expenditure	Act.number IDR				3.90	1.97	-2.558**
< 1 million		3 (5.6%)	0 (0%)	3 (8.3%)	(3.14)	(0.88)	
1.1 – 2 million		18 (33.3%)	0 (0%)	18 (50%)			
2.1 – 4 million		30 (55.6%)	16 (88.9%)	14 (38.9%)			
4.1 – 6 million		2 (3.7%)	1 (5.6%)	1 (2.8%)			
> 10 million		1 (1.9%)	1 (5.6%)	0 (0%)			
Category 2: Sago Consumption							
Do you/your family members consume sago?					1 (0)	0.97 (0.17)	-704
No	=0	1 (1.9%)	0	1 (2.8%)			
Yes	=1	53 (98.1%)	18 (100%)	35 (97.2%)			

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Characteristics (Variable name in the model)	Value Assignment	Number of respondents	Respondent Group		Mean (SD)		Sig[1]
			SFH1	SFH2	SFH1	SFH2	
Total family sago consumption/ month (kg)	Actual weight				16.42 (16.23)	7.86 (11.32)	-2.006*
None		1 (1.9%)	0 (0%)	1 (2.8%)			
Up to 10 kg		43 (79.6%)	11 (61.1%)	32 (88.9%)			
11 – 25 kg		5 (9.3%)	3 (16.7%)	2 (5.6%)			
26 – 35 kg		1 (1.9%)	1 (5.6%)	0 (0 %)			
More than 35 kg		4 (7.4%)	3 (16.7%)	1 (2.8%)			
Mainly, sago is consumed as:					1.17 (0.38)	1.44 (0.91)	1.575
Main staple food/ *dange*	=1	39 (72.2%)	15 (83.3%)	24 (66.7%)			
Raw material for traditional food/ *kapurung*	=2	14 (25.9%)	3 (16.7%)	11 (30.6%)			
Raw material for making cakes	=3	0 (0%)	0 (0%)	0 (0%)			
Raw material for making beverages	=4	0 (0%)	0 (0%)	0 (0%)			
Other	=5	0 (0%)	0 (0%)	0 (0%)			
N/A	=6	1 (16.7%)	0 (0%)	1 (2.8%)			
Frequency of sago consumption					1.39 (0.98)	1.81 (1.28)	1.211
Every day	=1	35 (64.8%)	14 (77.8%)	21 (58.3%)			
Three times a week	=2	11 (20.4%)	3 (16.7%)	8 (22.2%)			
Once a week	=3	4 (7.4%)	0 (0%)	4 (11.1%)			
Several times a month	=4	3 (5.6%)	1 (5.6%)	2 (5.6%)			
Once a month	=5	1 (1.9%)	0 (0%)	1 (2.8%)			
N/A	=6	0 (0%)	0 (0%)	0 (0%)			
Your opinion about sago as an alternative food/rice substitute					6.11 (1.08)	6.06 (1.26)	-160
Strongly disagree	=1	0 (0%)	0 (0%)	0 (0%)			
Disagree	=2	0 (0%)	0 (0%)	0 (0%)			
Somewhat agree	=3	0 (0%)	0 (0%)	0 (0%)			
Neutral	=4	12 (22.2%)	3 (16.7%)	9 (25%)			
Quite agree	=5	0 (0%)	0 (0%)	0 (0%)			
Agree	=6	14 (25.9%)	7 (38.9%)	7 (19.4%)			
Strongly agree	=7	28 (51.9%)	8 (44.4%)	20 (55.6%)			
Category 3: Sago Processing							
Sago land ownership					0.67 (0.49)	0.67 (0.48)	0.000
No	=0	18 (33.3%)	6 (33.3%)	12 (33.3%)			
Yes	=1	36 (66.7%)	12 (66.7%)	24 (66.7%)			
How many clusters of sago do you have?	Actual number of clusters				52.94 (74.83)	28.78 (79.57)	-1.073
None		18 (33.3%)	6 (33.3%)	12 (33.3%)			
Less than 50		26 (48.1%)	6 (33.3%)	20 (55.6%)			
50 – 150		4 (7.4%)	3 (16.7%)	1 (2.8%)			
151 – 200		5 (9.3%)	3 (16.7%)	2 (5.6%)			
301 – 400		1 (1.9%)	0 (0%)	1 (2.8%)			
Working hours on sago/ day on average	Actual hours				5.34 (1.59)	2.46 (2.07)	-5.172***
Less than 3 hours		25 (46.3%)	1 (5.6%)	24 (66.7%)			
3 – 5 hours		10 (18.5%)	5 (27.8%)	5 (13.9%)			
5 – 8 hours		19 (35.2%)	12 (66.7%)	7 (19.4%)			
Spending money for sago processing/ month on average	Actual amount in thousand IDR				1,950 (3,160.88)	427 (304.11)	-204
Less than 300,000		17 (31.5%)	1 (5.6%)	16 (44.4%)			
300,000 – 800,000		18 (33.3%)	3 (16.7%)	15 (41.7%)			
800,001 - 1.300,000		12 (22.2%)	7 (38.9%)	5 (13.9%)			
1,300.001 - 1.800,000		5 (9.3%)	5 (27.8%)	0 (0%)			
1,800,001 – 2,300,000		2 (3.7%)	2 (11.1%)	0 (0%)			

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Characteristics (Variable name in the model)	Value Assignment	Number of respondents	Respondent Group		Mean (SD)		Sig[1]
			SFH1	SFH2	SFH1	SFH2	
Sago price per/kg (IDR)	Actual amount				2,300	2,146	
1,600 – 2,000		17 (31.5%)	4 (22.2%)	13 (36.1%)	(25897)	(245.46)	-2.135**
2,001 – 2,400		27 (50%)	6 (33.3%)	21 (58.3%)			
2,401 – 2,800		10 (18.5%)	8 (44.4%)	2 (5.6%)			
Type of sago processing					1.06	0.94	-1.649
Conventional (micro-scale tech)	=0	2 (3.7%)	0 (0%)	2 (5.6%)	(0.24)	(0.23)	
Small-scale technology	=1	51 (94.4%)	17 (94.4%)	34 (94.4%)			
Small-scale with technological upgrading	=2	1 (1.9%)	1 (5.6%)	0			
Sales of sago/month on average	Actual amount (t)				4.15	0.97	-3.144***
Up to 2 tons		36 (66.7%)	0 (0%)	36 (100%)	(4.27)	(0.55)	
2.1–4 tons		11 (20.4%)	11(61.1%)	0 (0%)			
More than 4 tons		7 (13%)	7 (38.9%)	0 (0%)			
The reason for involvement in sago production					2.89	1.89	-3.358***
					(0.96)	(1.06)	
To fill the empty time	=0	3 (5.6%)	0 (0 %)	3 (8.3%)			
To fulfill daily needs	=1	15 (27.8%)	3 (16.7%)	12 (33.3%)			
To support family's economic life	=2	8 (14.8%)	0 (0%)	8 (22.2%)			
The benefit is promising High demand	=3	23 (42.6%)	11 (61.1%)	12 (33.3%)			
	=4	5 (9.3%)	4 (22.2%)	1 (2.8%)			

Note: Based on *t*-test sig[1]: ***significant at the 1% level, **significant at the 5% level, *significant at the 10% level. SD: Standard Deviation

Departing from the current status of sago development in South Sulawesi, it is important to review the past condition for sago development in South Sulawesi. Obviously, that situation can be a platform for sago development in the future. Many initiatives have been conducted in the past; (1) a project for improving sago production through factory building and improved processing in 1985, (2) the planting of 100 sago seedlings followed by promotion and campaigning on the importance of sago with the slogan "Ayo Menanam Sago (let's plant sago)" in 2010, and (3) the planting of 200 sago seedlings to encourage local people to preserve sago palm in 2012 (Metaragakusuma, 2015). However, these activities are considered failures because of a lack of continuity; consequently planting sago did not take off; to local people, planting sago is still uncommon and it is better to plant other cash crops (Metaragakusuma, 2015), and also because these activities were conducted independently (Trisia *et al*., 2016); activities like planting and harvesting sago require collaboration with related stakeholders.

Highlighting the failed initiatives for sago development in the past, plus the results of previous studies, leads to the conclusion that sago development in South Sulawesi is difficult. There is no comprehensive framework or clear strategy related to sago development in South Sulawesi. Why is it so difficult? The simple answer is because of the size of the sago plant. Osozawa (2016) noted that the sago plant is much bigger than the human body, so cultivation is impossible for one person; teamwork is a must.

The intensive process of developing a framework for sago development through teamwork has started with the sago rehabilitation project, a project funded by Japan Society for the Promotion of Science (JSPS). The aim of this project is to protect and rehabilitate sago palm forests, while at same time meeting the socio-economic development for sustainable management of the ecosystem. The prospects for this project look promising, and it could be the start of a new era for better sago development in South Sulawesi.

The triple helix model of UIG (university-industry-government) is applied as a framework to the concept Sago Techno Park (STP) in the JSPS project. The cluster development of sago in the STP concept Tana Luwu can be seen in Figure 5 below shows. UIG model is a commonly used model as a framework for regional

development, but in the context of sago development in Tana Luwu, the local community is no less important than the other participants mentioned above. As a form of adaptation strategy for better sago development, the community should be involved. In this project, social adaptions will be developed to create society forest co-existence by using sago palm in the proposed new social model.

Figure 5. Cluster development of sago in Tana Luwu

To accommodate the community as the forth helix, the framework of a quadruple helix is preferred, that is, a collaborative approach by four stakeholders: academia (A), business (B), community (C), and government (G). All helices stand equally as main actors. For instance, in technology transfer, the community not only obtains knowledge from academics, but also contributes through planting sago, research support, and information transfer related to local wisdom, culture, and the legacy of generations of sago use. The community can also be a partner in the sago business and businesspeople can have the opportunity to develop local small and medium industries and, if necessary, open collaboration systems with other countries can be established to obtain advanced skills and develop human resources. In addition, the community is important for supporting the government in implementing programs related to sago development. Government actions in determining the legal framework, by providing the necessary seedlings funding for sago production adoption and by facilitating access to suitable land, are key to front-line efforts addressing the implementation of sago development.

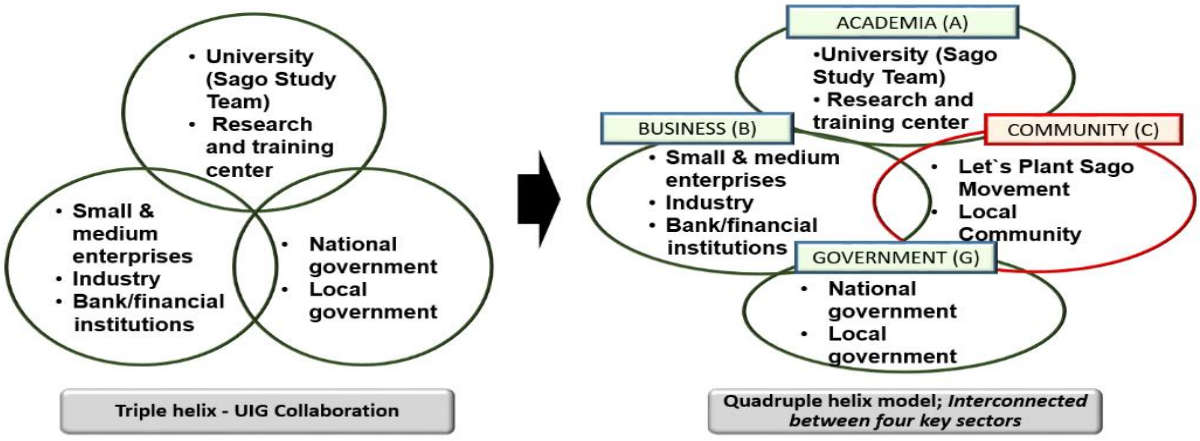

Figure 6. Triple helix to quadruple helix model in the concept of the Sago Techno Park

The ABCG collaboration framework in implementing the concept of the Sago Techno Park is strongly recommended for better sago development in South Sulawesi in the future. Obviously, this concept can be duplicated for sago development in other sago areas, particularly to develop social forest co-existence.

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