SAGO FOOD PRODUCT DEVELOPMENTFOR FOOD SECURITY IN SMALL ISLANDS, MALUKU, INDONESIA

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Abstract: Abandoned local food consumption and dependency on imported rice will endanger local food security in small islands. Government policy is to reduce rice consumption and promote local food, however, while many factors influencinglocal food preferencehave been identified, very little is known about local food product development, particularly traditional sagoproduct which is called *yellow fish-soup papeda*. In fact, this *papeda* product is rather difficult to access and to prepare, and it is without nutrition contents information of papeda products. The objectives of this paper is to describe the potential of local sago food, to identify the consumer's preference and to improve traditional *papeda* product. Research showed that traditional yellow soup fish papeda has improved to the new improved *originalinstant yellow soup fish papeda* through collaborative work with food technology scientist.

Keywords: *food security, small islands,sago, traditional papeda, yellow fish soup,instant-papeda, Maluku*

Introduction

Currently, the main challenge of food securityin Indonesia and other developing countries is hunger in line with scarcity of food in the country. International Food Policy Research Institute [1] reported that there was 9.1% of the proportion of undernourished in population in Indonesia with the Global Hungry Index (GHI) of 10.3. This GHI indicatesacrucial problem of food security in Indonesia as well as India, Philippines and Cambodia and several other countries in African regions. In Asia and the Pacific, as home for 60% of global population, 733 million people still live in absolute poverty, and was estimated around 550 million people are still living in hunger and undernutrition [2], [3].Further, the future challenge of food security is howto increase food production around 70% to feed 5.2 billion people in Asia and the Pacific in 2050 and at the same time climate change impacts will reduce food production due to the temperature change, agriculture land scarcity, water shortage, raising production input price and post harvest losses.

Indonesia population was around 255 million in 2015 but population growth of 1.49% per year was higher than that of rice production [4]. National Food Security Board [5]also estimated that 70% of rural households were categorised as net rice consumers. This means that rice demand will still be higher thanrice supplyincluding consumption of imported non-rice foodsuch as flour, corn and soybean that have also increased significantly. USDA dan FAO[6]estimated that Indonesia imported rice around 1.24 million tonnes in 2014 and then will import around 1.1 million tons in 2015 to address rice consumption demand and to fulfill rice procurement target around 39.2 million tons in 2015.

In order to achieve national food self-sufficiency in Indonesia, central government has planned to reduce the consumption of imported rice and wheat flour, and to increase local food consumption. In addition, the government of Indonesia hadspentaround $US2.38 billion to boost rice production target up to 75.7 million tons paddy plus10 million tons of rice surplus in 2014 [5]. The main goal is to promote zero imported rice policyand to achieve food self-sufficiency, food security and dignity through water irrigation improvement,intensificationofchemical fertilization,expansion of rice land and reduce rice consumptionto1.5% per year, and decreaseimported flour gradually. The next goal is to accelerate production and consumption of local food commodities found in several and different regions in Indonesia[7]. However,the governmentpriority isbased on rice only. Thus, food self-sufficiency may be ratherdifficult to achieve.

Ascomplement to rice base food self-sufficiency, the potential of local food resourcesshould be reconsidered, particularly the 63,960 hectare under-utilized sago palm in Maluku islands able to produce up to 498,888 tons of starch or 308 kg/capita per year. Sago forest is also known as environmental friendly plant, and the base of foraging-sago economies and food security for the origin of Nuaulu peoplewho cultivated sago palm as staple food in Seram islands [8].As a foraging sago economy, one sago tree may produce around 180-200 kg of dry sago starch, which

isequal to total annual energy-carbohydrate intake for an adult [9].

Previous research showedthat a number of sago sellers in Ambon city decreased from 20 people to 6 traders from 1961 to 1992 and sago starch consumption also decreased considerably from 12 tons to 750 kgduring the same time period[10].In 2006, market demand of *sago lempeng* (baked sago loaves) in Ambon city was estimated around 2 million pieces per annum or equivalentto 133 tons sago starch with value around IDR800 millions [11]. The declining of sago consumption in urban area (Ambon city) was influenced byhousehold income and sago price [12],the family size, life style and health concern [13]. In rural areas, the declining sago consumption was negatively correlated with household expenditure,rice consumption, tuber consumption, food diversificationand education level,but it was positively correlated with sago production [14].Maluku imports around 86,000 tons of rice with economic value US$ 75.7 millions. This is almost the same as total annual budget of provincial government.The declining of local food and dependency on imported food also occurs in the Pacific islands [15]. As a consequence in the long term, there is health and disease implications from high dependent on imported food [16], [17] such as nutrient deficiency and reduction in fibre intake that leads to deterioration in nutrition standard and increase of non communicable disease like diabetes and hypertension.

Due to limited production, the price of local food is more expensive than imported food products, particularly subsidised imported rice. In fact, sago was substituted by rice, and sago was perceived by people as staple food for the poorliving in rural areas.This situation will change staple food from local resource based into imported rice and then possibly will endanger the sustainability of local food security and dignity due to inability of local food to compete with imported rice price. Therefore, to reduce rice consumption and to accelerate affirmative action for local food preference and consumption it is necessary but not sufficient to develop local food products to solve the problem of 100 millions of hidden hunger in Indonesia [18].

Research Objectives

The main research question is how to develop technology and design to improve traditional sago product according consumer's preference in order to increase the competitiveness of local food product. Albeit the abundance potential and declining in consumption of local sago products in Maluku islands, little is known about the basic technology and design to develop new sago productsbased on to the existing consumer's preference.Therefore,the objective of this research isto develop new modified sago products based on consumer's preference and local market demand.

Research Methods

In order to achieve research objectives, action research methods that consisting of two main steps, that is research to find out understanding and then action to promote change[19], [20] was undertaken. The first step was done in the previous research that is to gather information about sago potential, values and determinecustomer preferences towards traditional *papeda ikan kuah kuning* (yellow fish soup papeda). This research is to upgrade the technology prototype for the existing traditional sago product technology. The expectation is to improve the shape and design of traditional papeda product. Research sites to to developtraditional sago products were done in laboratory of agricultural extension, Faculty of Agriculture University of Pattimura.

The next step was to produce and promote new-sago product developmentbased on the previous consumer's preference. At this stage, collaboration work was developed with relevant stakeholders, institutions, groups and key informants. In order to develop and modify traditional sago products into new-product process, a collaborative work was developed with Postharvest Research and Development Agency Laboratory in Bogor. As a result, new sago product wasproduced and then promotedby developing collaborative work with farmer group in rural, universityand high school student, financial institutions,local government agencies and food product exhibition at local and national level.

To understand the sago product development process, researchers workedand discussed with Food scientist at the Postharvest Laboratory Agency in Bogor-West Java. Then, sago product was extended, producedand promoted by researchers and trained university students. Women Group Sago Flour Producer was also formed in Waisamu village to support sago flour availability to sustain product development. The other ways to enrich analysis in this paper were obtained from discussions during sago presentation at local, national and international seminars. Thus, method of data collection and analysis was based on triangulation principle using various data, oberserver, theory and methods [21].

Results and Discussions

The potential sago palm area

Flach [22] estimated that the area of sago palm in the world is around 2,474,000 ha and the biggest area (56%) is found in Indonesia and Papua New Guinea (41%). Based on sago area, there is no agreement about sago palm area in Indonesia. Haryanto and Pangloli [23] estimated that sago palm area in Indonesia was around 851,260 ha with production of 4.9 million tons

per year. The other data shows that sago forest area is around 1.25 million hectares and around 154,000 hectares semi-cultivation sago area [24]. Based on these various data, the average sago palm area in Indonesia is around 1,127,630 hectares and 90% of its area is found in Papua[25].Based on the previous data, the land area of sago forest spreading in seven districts/ city in Maluku was estimated to be around 63,960 hectres.Table 1 showed that the potential of wet sago starch production in Maluku was estimated between 624,000 tons and 767,520 tons per year with economic value between IDR1.4 trillion and IDR1.7 trillion. If 100 kg of wet sago starch equals to 65 kg (65%) of dry sago starch, therefore the total value dry sago starch is estimated between 405,000 tons and 498,888 tons/year and potential economic value is estimated between IDR3.2 trillion and IDR3.9 trillion per year.

Tabel 1. Sago areal and value estimation in Maluku Islands

Sago Forest Locations	Areal (ha)[1]	References	Wet sago starch potential/year (tons)	Value (IDR Million)	Dry sago starch potential/year (tons)[2]	Value (IDR Million)
Central Maluku	6,425	Alfons and Bustaman, 2005	77,100	173,475	50,115	400,920
Western Seram	10,286	BPPS Maluku, 2009a	123,432	277,722	80,231	641,846
Eastern Seram	30,645	BPPS Maluku, 2009b	367,740	827,415	239,031	1,912,248
Aru islands	9,762	Louhenapessy, 1992	117,144	263,574	76,144	609,149
West Southeast Maluku	1,130	BPPS Maluku, 2009a	13,560	30,510	8,814	70,512
Buru	5,457	Alfons and Bustaman, 2005	65,484	147,339	42,565	340,517
Ambon	255	Alfons and Bustaman, 2005	3,060	6,885	1,989	15,912
Total 1	63,960		767,520	1,726,920	498,888	3,991,104
Total 2	60000	Bintoro, 2012	720,000	1,620,000	468,000	3,744,000
Total 3	52000	BPS, 2012	624,000	1,404,000	405,600	3,244,800

Sources: Adopted from Alfons and Bustaman, Louhenapessy, BPPS, Bintoro and BPS (several years)

Notes:

[1]The total number of mature sago trees per ha was vary according to sago palm environment, that was 24 trees (Flach, 1980), 20 trees (Louhenapessy, 1994; Haryanto and Pangloli, 1992) and 40 trees per ha (BPPS, 2009). In the Table, it was assumed that there was of 40 trees of mature sago trees/ hectare.

[2]The best soil to sago palm productivity is not too wet or too dryland (Louhenapessy, 1999). Dry sago starch/ tree was estimated around 170 kg (Flach, 1980) but the other source stated that productivity in average was of 213 kg and it depends on the types of sago tree (Rumalatu, 1981), such as Tuni (265 kg), Molat (231 kg) and Makanaru (144 kg). Sago farmer in Saparua (Central Maluku) found that sago palm is able to produce up to 250 kg dry sago starch. In the Table, sago productivity in Maluku was estimated around 195 kg/tree.

This potential value of sago starch is around three folds of annual Maluku province government budget. In fact, the total sago starch production at current situation by existing sago processing industries was estimated to be around 4,560 ton per year with economic value of IDR 36.5 billions. This was 2% of its total value of sago forest potential whereas the rest of 98% of sago potential was stillk under utilized.

The preference of sago products

Apart from sago values, sago palm is still perceived as under utilised crop or green pearl food crops in Indonesia [26], [24]. Thus, the direction of sago development in Maluku was at the cross road [27]. On one hand, local government has made regulation, promoted sago as the staple food but there was no credit incentive to sago developmentwhilst on the other hand central governmentfocused on rice, soybean and corn. Preferably, the direction of sago development should be market demand oriented which is based on the preference of the consumers. Market demand and the preference of consumers are necessary but not sufficient condition to sago product development,dry sago flour base

processing industries, wet sago starch industries and sago forest area systems management.

To produce sago product based onconsumer preference and market, sago starch processing should be changed from conventional to modern technology[28], [[29]. In 2014, there were only two advanced-modern sago starch processing in Maluku to produce around 100 ton wet sago starch per month with eonomic value was around IDR2.25 billion (US$225,000) per annum.Previous research found that there were 10 kinds of traditional sago food products, 19 types of sago productswhich is made from wet sago starch, and the other 21 types of sago products that is made from dry sago starch in Maluku [30]. These sago products were produced by home industries with uncertain market target. Therefore, manysago industries in Maluku were stagnant and then failed to sustain in line withdifficulties to market access, inefficiency, limited raw materials, high operational costs and low price of wet sago starch [27], [31].

To explore the preference of consumers, research found out that amongst many types of local sago products, there were two priority products that were favored by consumers, namely *papedaikankuahkuning* (yellow soup fish *papeda*) and *sagulempeng* (sago loaves baked). The first product was known as the main staple food of local people for long time whilst the second product was known as snack during tea time.In several remote and isolate villages in Seram islands, people still consumed sago starch as 70% of energy supply [32] but this situation has changed totally into rice in urban areas.Based on consumer's preference, around 95.7% of respondentsat all age groupa arereally liked*papeda*whilst the rest of 4.3% did not like papeda. Besides, almost all respondentslike rice and consume more frequently even though the price of rice was perceived higher than *papeda*and the other local food. In this case, Drewnowski and Hann [33] found out that preference and frequency of consumption have significant relationship. Eventhough the percentage of sago preference and frequency of consumption was lower than that of rice however high percentage of preference for papeda indicated that people still have high expectation to consume*papeda*(Table 2).

Table 2. Consumer's perception for preference, frequency and price of rice and papeda

Consumer's Perception		Papeda by age group (n=93)			Rice by age group (n=93)			Total (%)	
		≤30	31-59	≥60	≤30	31-59	≥60	Papeda	Rice
Preference	Really like	40	36	13	30	26	7	95.7	67.7
	Like	0	0	0	14	11	5	0.0	32.3
	Fair	0	0	0	0	0	0	0.0	0.0
	Don't like	2	0	2	0	0	0	4.3	0.0
Frequency to eat per week	1-2	23	12	2	0	0	0	39.8	0.0
	3-4	16	16	7	10	5	4	41.9	20.4
	≥5	5	9	3	34	32	8	18.3	79.6
Price/ unit	Very expensive	2	2	1	16	21	7	5.4	47.3
	Expensive	15	10	8	12	8	5	35.5	26.9
	Fair	26	21	3	16	7	0	53.8	24.7
	Cheap	1	4	0	0	1	0	5.4	1.1

Papeda= sago flour + fresh fish + spices and vegetables; Rice = Rice + Fish/Egg + Vegetables
Source: Field work, Girsanget et al, 2012

The high preference of consumers on papeda indicated that papeda can be promoted as the primary local staple food based on market demand, natural and cultural resources in Maluku. According to the purchasing power of the household and the price of papeda, in general there were 5 types of existing papeda products in rural Maluku: (1) sago starch in boiled water; (2) sago starch in boiled water, chili and lemon; (3) sago starch in boiled water, chili and lemon, fish and yellow spices; (4) sago starch in boiled water, lemon and chili, fish, yellow spices, and tubers; and (5) sago starch in boiled water, lemon and chili, fish, yellow spices, tuber-banana and vegetables. Eventhough the content of each type of papeda product is differentbetween each other but each type needs

boiled water because without boiled water sago starch will not be ready to eat, therefore papeda is a hot food. The price of papeda number 5 was higher than the previous type of papeda because it consists of complete ingredients and spices. Papeda product number onewithout spices and fish is a very simple and cheap whereas papeda number 4 and5 aremore expensive than the previous product. Most respondents would like to consume papeda number 4 or 5 but income, time and taste were indicated as the restricted factor to the consumption level.

The main reason for people to choose papeda as the staple food was based on perception that papeda was original and cultural food of Maluku people, which was practiced from generation to generation. Papeda wasalso the icon of original food from Maluku, organic food that consists of higher nutrition, fibre and was perceived more delicious than that of the other local food. However, based on field observation, people prefer to eat rice than papeda due to several reasons. The first reason was satisfaction, time, accessibility and availability. Different from rice, to make papeda it needs at least four components such as sago starch, fresh fish and spices and traditional vegetables that is not easy to find at the same time in any places in traditional or super market. The number of papeda restaurant was also very limited in urban and rural Maluku islands. The second reason was that existing traditional papeda preparation is more complex and difficult to prepare than rice. The other reason was lack of promotion and unattractive design of packaging and labeling. Local food industries have not yet produced and promoted papeda with attractive packaging and labeling in Maluku islands. Therefore it can be understood that even though almost 98% people really like papeda but around 80% of total respondents said that they consumed papeda between 1 and 4 times a week. Conversely, almost 80% respondents consumed rice more than 5 times a week even though 47% of respondents perceived that the price of rice was very expensive.

The second popular sago productin Maluku was sago *lempeng* (loaved bake sago).*Sago lempeng* was produced by home industries with conventional technology in rural Maluku. Production process started by drying wet sago starch under the sun. Then the dry stach was sieved with fine filter about 3-4 times or used sago refining machineto make smooth sago starch. Next, the fine and delicate dry sago starch was put in the six printed holesform sago lempeng, which is called 'Forna'. Forna is made from iron, and has 6 holes as the place to cook for delicate dry sago stach on hot charcoal fire. Home industries usually use several pairs of *Forna* to cook sago lempeng. This product was ready to eat after being cooked in the 'Forna' plate for about 5 minutes.

Because *sago lempeng* can be kept for longer time, this product was known as 'food during the war' because soldier in the forest kept the food in bamboo and then stored in the river as the source of food in the forest. Unlike papeda which is used as staple food, *sago lempeng*was consumed by people as a snack during the tea time, and some times people consumed with grilled or fried fish. Based on field work, 96% of respondent liked *sago lempeng* whilst the rest of 4% disliked sago lempeng. Some reasons to consume *sago lempeng* were based on several considerations as follows: (1) it is practical to eat after dipped inhot water and easy to handle and carry; (2) it can be kept for months and even years if it is kept in dry place; (3) it contains high carbohydrate; (4) it is simple and cheaper. Around 2 million pieces of sago lempeng aresold in Ambon per year [27] while the rest issold to Papua and the province of Nusa Tenggara Timur.

Sago Product development processes

Based on the previous survey, the main problems of conventional papeda product were that *papeda*is uneasy to access, time consuming to prepare in any places andwithout attractive labelling and packaging design. Thus, an action research methodology was conductedto solve the problem 20] and to modify the conventional papeda to new-product of*papeda siap saji ikan kuah kuningoriginal*(instant original yellow soup fish papeda).In this case, an intensive collaborative work was undertaken and collaborated with food scientist to design and produce new-papeda product based on consumer's preference. The basic raw materials were fine dry sago starch, fresh marine fish, spices and vegetables. These product components were processed and then put into one package and labelledso that consumers will find iteasier to access and hopefullyfind it easier to prepare papeda with boiled water.The purpose of making new-papeda product was to change consumer's perception about *papeda*and then to encourage people to consume *papeda* as staple food. This product was more delicious, easy to access and simple to prepare and to serve by only addingboiled water. Price of *papeda* was also affordable to people,and the new produt is much more attractive because it waswrapped-up with new packaging and labelling design. Each package has nutritionalinformation and consumption instruction on how to prepare*papeda*. One pack of *papeda*consisted of three components: one sachet sago starch (42 gr), one sachet spices (25 gr) and one sachet freshly cooked fish (100 gr) with total energy around 550 Kcal.

To fulfill the consumer's expectation, the new-papeda product has been certified by Food and Drugs Certification Agency, Ambon City Health of Agency including certification from Moslem Halal Certification. The first step to produce papeda was to change wet sago starch, which is heavy with unpleasant smell into lighter and odorless dry sago starch. The way to produce dry sago starch was to wash wet sago starch several times in clean water and continue to dry it under the sun. At the same time fresh marine fish wasalso cooked, let it cool and prepared into a sachet as well as spices. These components of papeda such as sago flour sachet, marine fish and spices plus local-organic vegetables are put together into one package and label which is called new-original yellow soup fish papeda (Figure 1).

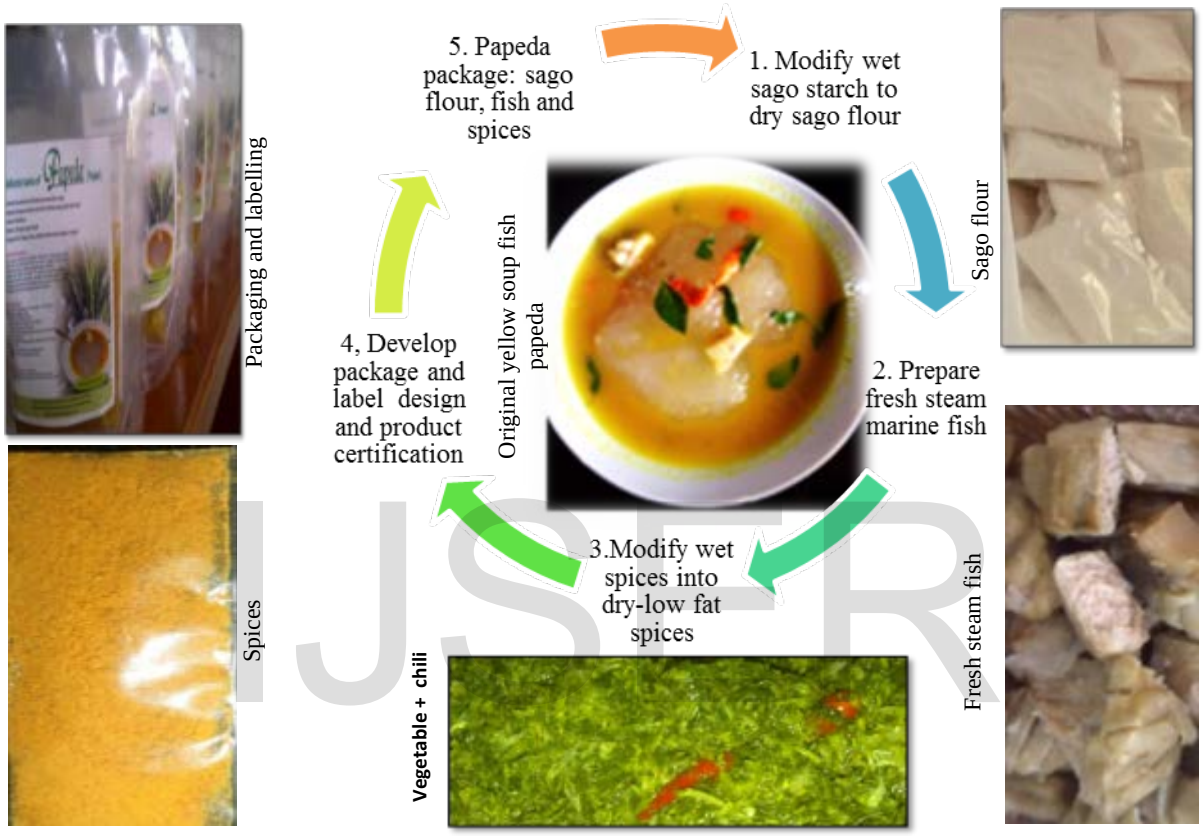

Figure 2 Papeda product development: Sago flour (42 gr), fresh marine fish (100 gr), organic vegetable, spices (25 gr) and wrap-up in one packaging and labeling

The main content of one package instant yellow soup fish papeda is as follows: 40 g sago flour, 100 g tuna fish, 30 g spices and vegetables. The nutrition content is around 19 g protein (34% of Nutition Sufficient Account), 223 kilo calorie of total energy or 11% of total energy sufficiency account. The steps to make instant yellow fish soup papeda is as follows: (1) mix sago flour with three spoon of water; (2) add boiled water (100oC) around 400 ml (2 glasses) and then mixing until form 'papeda porridge'; (3) boiled water around 300 ml or 1.5 glasses and then put fish and spices into the boiled water and let until 3 minutes; (4) instant yellow soup fish papeda is ready to consume. People do not eat papeda with spoon but directly using lips and mouth. This is the sign how local people give respect to local food as an inheritage from generation to generation.

Based on laboratory analysis, instant yellow soup fish papeda has branded according to government standard and legality, as a small scale home industry product development from the government of Ambon city. First, legality from local Ambon city government that is PIRT No: 206817 10 100 16-19. Second, permission and supported from Food and Drugs Control Agency No PM 02.04.1093.06.14.006 as well as Halal legality Number 20100000671014. Based on laboratory analysis, original instant yellow soup fish papeda is free from bacteria, *E.coli, S.aureus and Salmonella*, thus it is save to consume.

(a) a package of papeda; (b) consume papeda without spoon

Figure 2. Original instant yellow soup fish papeda in package and the way how consumer to eat papeda in small islands Maluku, Indonesia

Table 3. Laboratory test results of instant original yellow soup fish papeda

Test Parameter	Test Results	Requirements	Methods
MPN E. coli	< 3 APM/ g	< 3 APM/ g	MA PPOMN/72/MIK/06
Number of S. Aureus	< 1,0 x 10^1Kol/g	≤ 1,0 x 10^3 Kol/g	MA PPOMN/66/MIK/06
Salmonella Identification	Negative	Negative/ 25 g	MA PPOMN/74/MIK/06

Source: Food and Drugs Control Agenvy, Ambon, 2015

Conclusion and Recommendations

The potential of sago forest is estimated around 63,960 ha to produce around 498,888 tons dry sago starch per annum with economic value is IDR 3,991 billion or $US307 million. This value is four times of annual provincial government budget in Maluku islands. In fact, the potential of sago forest is unexploited because of low market demand, unattractive job particularly to the young people, time consuming and need hard work with limited financial benefit to extract sago starch. Beside, food security policy is still based on rice self-sufficiency and sago palm is only the secondary priority to central and local government policy. As a consequence, sago consumption declined considerably and it is estimated that more than 90% of total sago potential is unexploited whislt at the same time sago land conversion rate was estimated up to 15% per annum in Maluku islands. Moreover, sago land conversion into resettlement, movement to other crops and introduction to oil palm plantation are the main threat to the existing sago forestarea [34]. This problem needs government intervention to save sago forest, otherwise, Maluku islands will lose the origin ofsago palm genetic or the green pearl of sago palm in the next generation.

Based on consumer's preference analysis, research find out that 100% consumers like and consume rice but local food traditional*papeda ikan kuah kuning* (yellow soup fish *papeda*) is also the most preferred amongst sago products by 97.5% of total consumers. More than half of respondents perceive that the price of rice is more expensive than that of papeda or sago products. In fact, even though 74.2% of total respondents perceive that the price of rice is expensive but 79.6% of them consume rice more than 5 times per week (almost every day). This means that people will always eat rice even though the price increases continuously. On the contrary, even though about 40.9% of people perceived that the price of *papeda* is expensive but only of 18.3% of them consume *papeda* more than 5 times per week. It means that even though the price of *papeda* is perceived cheaper or the price of rice is perceived more expensive than *papeda*, frequency to eat *papeda*is three folds less than rice. Reasons why people do not eat *papeda*is associated withthe social mind set and perception that rice has higher social prestigious food than that of traditional papeda. Besides, traditional *papeda* is alsoperceived not easy to prepare, difficult to access, expensive, unpleasantaroma, unattractive due to the poor product packaging and labelling design.

Based on the previous finding, therefore,action research has been done to develop a new-modified *instant original yellow soup fishpapeda*

that is more practical than traditional product, more healty and nutritious, and easy to access and more prestigious withattractive labelling and packaging design. The new-*papeda* product is called *papeda siap saji original ikan kuah kuning* or original instant yellow soup fish *papeda*. This product will support Government legalities to develop local food according to the Decision of President of Republic Indonesia No 22/2009 (Kepres No 22/2009) to reduce1.5% per annum of rice consumption and the Regulation of Provincial Government of Governor of Maluku No 110/2011 about Regulation on Sago Forest Developmentto accelerate *papeda* and the other local food development in Maluku islands.Next research is needed for the preference and marketing of the new-*instant orogonal yellow soup fish papeda*that consists of sago flour, marine tuna fish, spices and vegetables.

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