



IPB University
— Bogor Indonesia —

Uplifting Underutilized Crops for Economic and Industrial Importance: Sago (*Metroxylon sagu* Rottb.)

Ervizal A.M. Zuhud and Primadhika Al Manar
(Professor, IPB University - Indonesia)

**Presented at the 2nd Regional Conference on
Agrobiodiversity Conservation and Sustainable Utilisation
(RAC2) 2024**

Kuching (Malaysia), 12 June 2024





CONTENT

01 Introduction

02 History of Sago

03 Characteristics of Sago

04 Sago Production Potential

05 Utilization & Bioprospecting of Sago

06 Sago for Global Food Security



- **Global climate change** has threatened food security, particularly the production of seasonal food crops
- **The hope for food** in the future will rely on annual plants in the form of **trees**
- **Sago** is one of the tree stands that is **adaptive to climate change**





- Sago covers **6.5 million hectares** worldwide, with the majority in **Indonesia (5.5 million hectares)**
- **Sago starch** primarily comprises **carbohydrates** like wheat flour, tapioca, and rice flour
- **Sago starch can be a staple food**, resulting in biscuits, noodles, and other widely accepted and known food products

HISTORY OF SAGO



IPB University
— Bogor Indonesia —

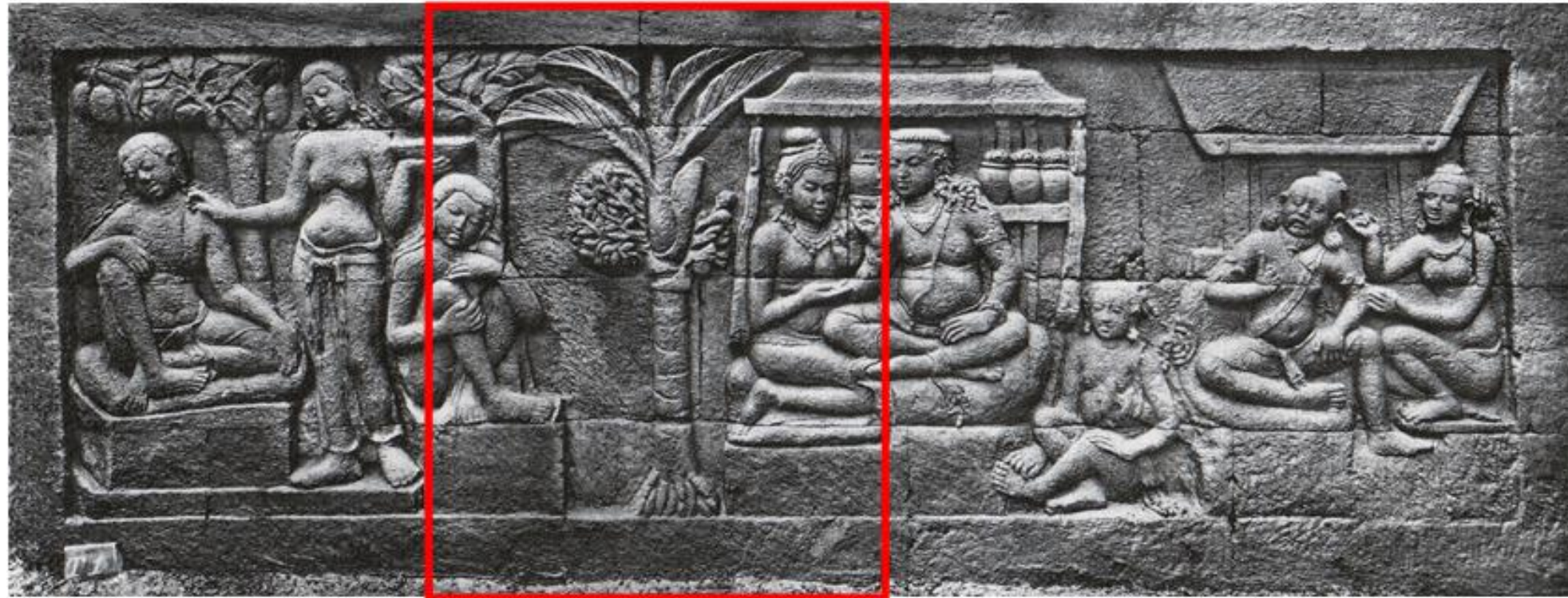
Relief of life palms (sago, sugar palm, coconut, siwalan, areca nut) on the karmawibhanga relief at Borobudur Temple, built in the 8th century.



HISTORY OF SAGO



IPB University
— Bogor Indonesia —

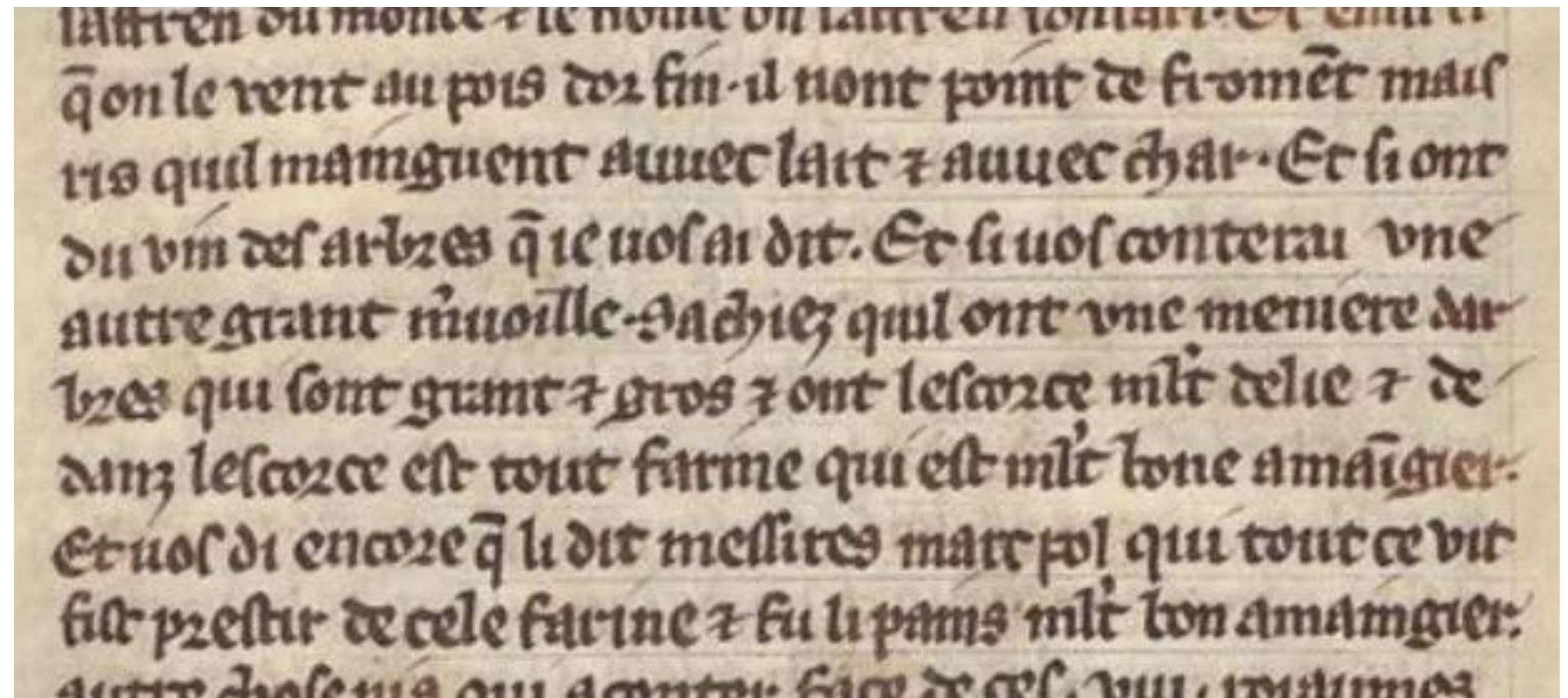


areca nut

coconut



Marco Polo and Sago in Fanrus/Faurus (Barus, Sumatra) - 1292 Masehi

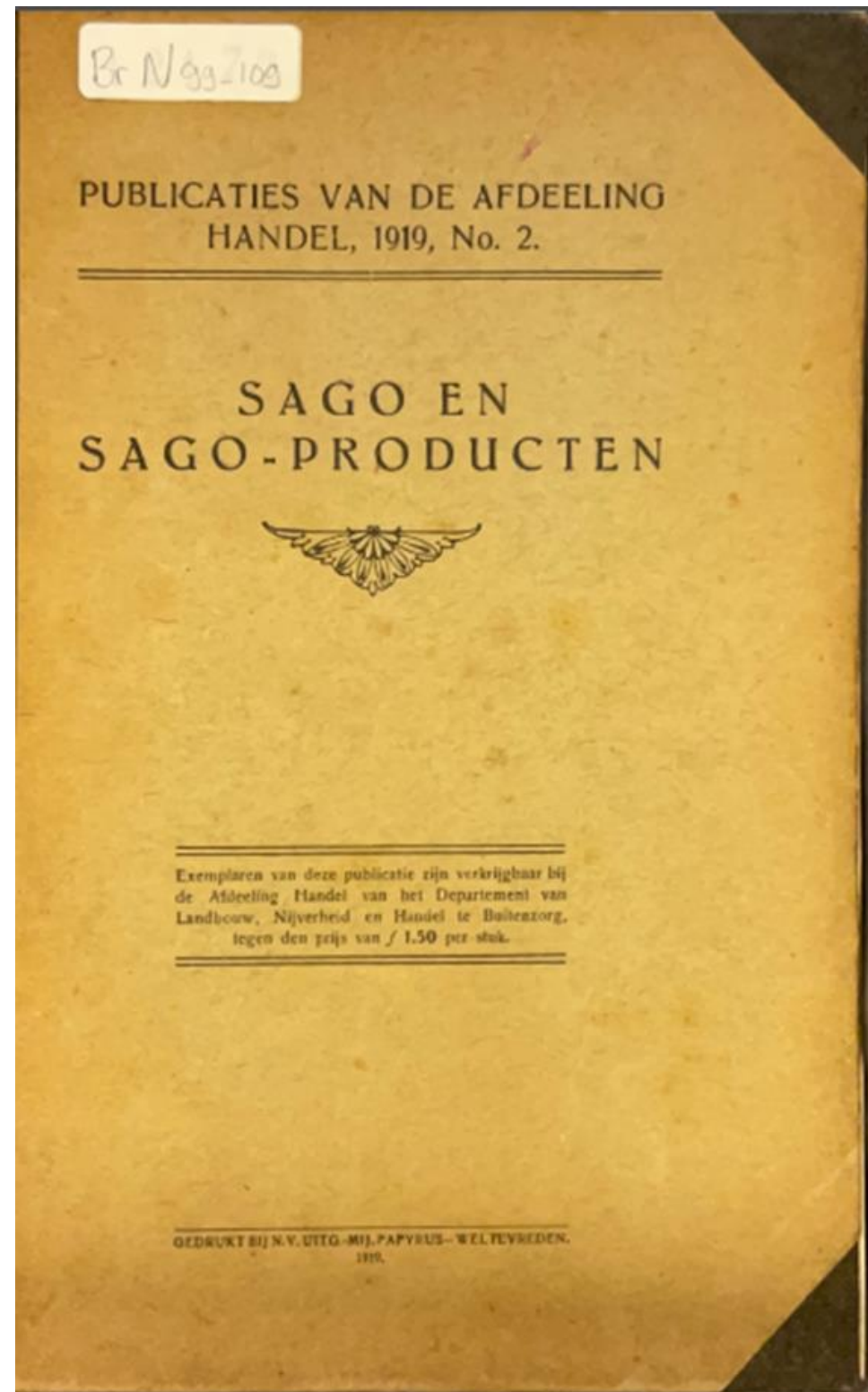


“You should know that they have a kind of **tree which is large and thick and has a loose/thin bark and inside the bark is all flour** which is very good to eat. And I tell you further that Mr. Marc Pol, who lived all this, did try this flour and made bread [that was] very good to eat.”

HISTORY OF SAGO



IPB University
— Bogor Indonesia —

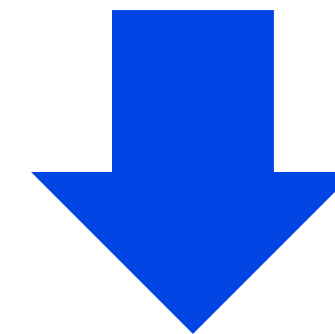


Afdeeling Handel (1919)

Accijnzen. Hoeveelheid in 1000 K.G.

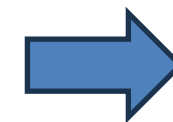
Bestemmingen	1913		1914		1915		1916		1917	
	Java	Buitenb.	Java	Buitenb.	Java	Buitenb.	Java	Buitenb.	Java	Buitenb.
Sago, n.a.g.										
Penang	0	43	—	—	—	1.377	—	—	—	2
Singapore	—	5	—	—	—	—	—	—	—	—
Malakka	—	—	—	—	—	—	7	—	—	—
Br. Borneo	—	16	—	11	—	8	—	4	1	4
Naar elders	—	—	—	—	—	—	—	—	—	—
Totaal	0	68	—	12	—	1.385	—	11	15	6
Sagomeel, gez.										
Nederland	—	560	3	78	11	—	79	—	—	—
Gr. Britannië	—	393	—	521	—	99	—	403	31	240
Duitsland	—	2	—	—	—	—	—	—	—	—
V.S. v. N. Amerika	—	—	—	—	—	51	—	429	—	—
Singapore	219	3.586	31	4.455	11	7.348	10	8.361	6	5.115
Hongkong	—	—	2	—	—	—	—	—	—	—
Japan	—	—	—	—	—	—	—	—	11	56
Naar elders	1	11	—	—	—	1	11	15	13	3
Totaal	220	4.552	36	5.054	22	7.499	100	9.208	61	5.414
Sagomeel, ruw										
Malakka	—	—	—	8	—	—	—	—	—	8
Br. Borneo	—	—	—	11	—	—	—	—	—	—
Singapore	23	9.099	—	26.433	—	8.938	—	10.037	—	7.985
Naar elders	—	83	—	32	—	97	—	103	—	139
Totaal	23	9.182	—	26.484	—	9.035	—	10.140	—	8.132

Data on sago exports from the Dutch East Indies (Indonesia) in 1913-1917.



- Melaka
- Penang
- Singapore
- Netherlands
- Great Britain

Nakamura, Japanese soldier who hid for 30 years in the Morotai Forest (1944-1974) lived on sago



Sagu Indonesia Untuk Dunia, Riau Ekspor Sagu ke Jepang

Selasa, 7 Agustus 2018 05:56 WIB



CHARACTERISTICS OF SAGO



IPB University
— Bogor Indonesia —



thornless sago



thorny sago

CHARACTERISTICS OF SAGO



IPB University
— Bogor Indonesia —



genetic resemblance analysis showed that the **morphological characters** of thorny or thornless on sago palm could not be used as a benchmark to distinguish one individual from others for naming sago palm

CHARACTERISTICS OF SAGO



IPB University
— Bogor Indonesia —



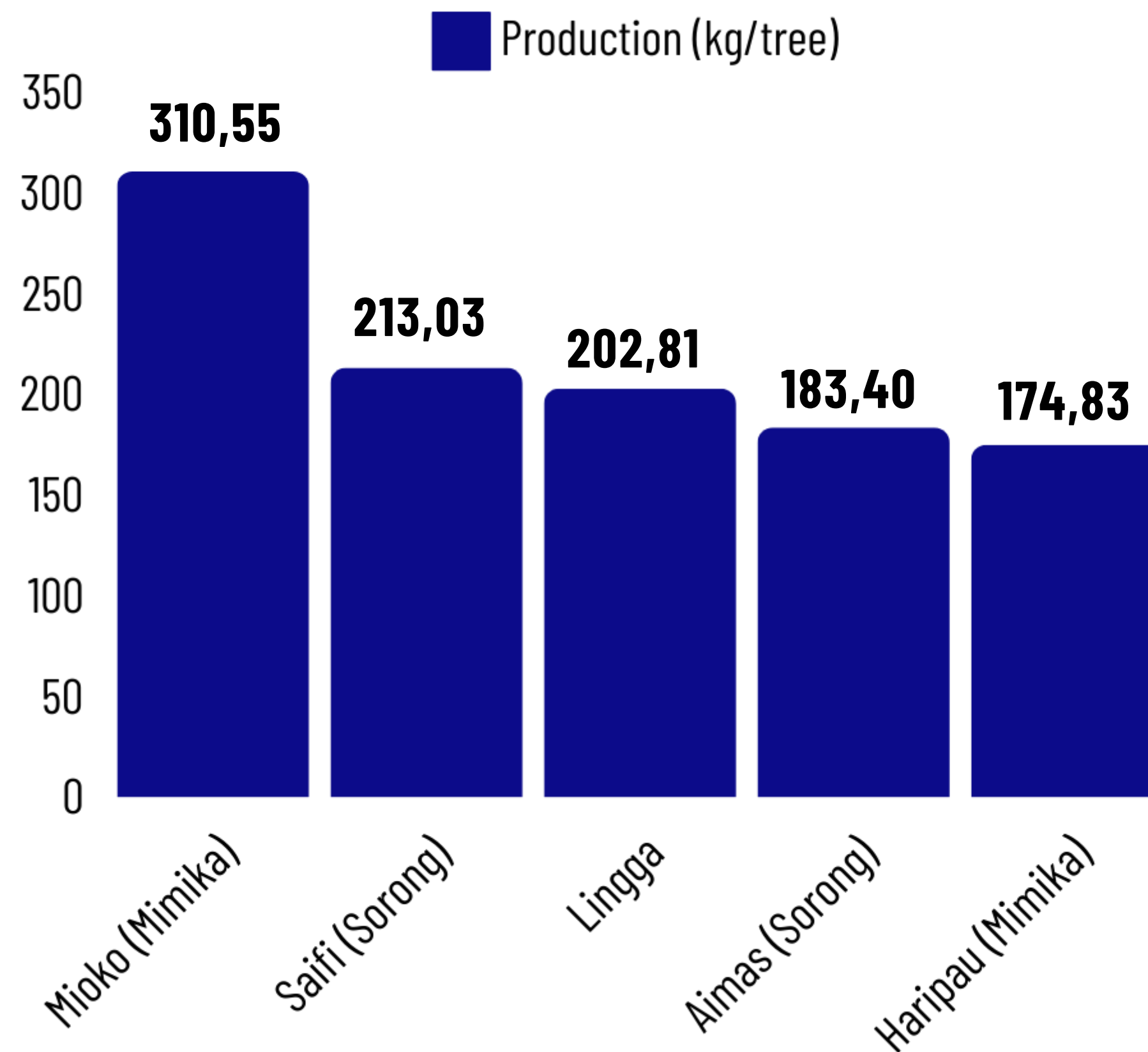
- Sago palm is resistant to tropical acidic soil, preventing erosion with a root structure capable of trapping silt. It can also withstand strong isolation, typhoon winds, drought, and protracted flooding.
- Sago palm is a potentially advantageous alternative crop because **the climate does not heavily impact its production.**

SAGO PRODUCTION POTENTIAL



IPB University
— Bogor Indonesia —

- The sago palm produces a significant amount of starch, approximately **150–300 kg** of dry starch per tree
- **Starch production** is influenced by several factors, including **height, diameter, moisture content, and yield** of sago stems
- Sago starch production was **positively correlated with stem weight**



Comparison of Rice and Sago in Supporting Food

Parameters	Rice	Sago
Consumption (kg/capita/year)	130	135
Productivity (ton/ha) ^a	3	25
Required harvest area (ha/people/year)	0.043	0.0054
Indonesian population in 2010 (million people)	230	230
Indonesia's consumption needs (tons)	29.900.000	33.750.000
Indonesia's harvest area requirements (ha)	9.890.000	1.350.000
Area requirements (ha/year) ^b	4.945.000	1.350.000
Assumed population in 2030 (million people)	270	270
Land area requirements 2030 (ha)	5.805.000	1.584.000

^aWith intensive cultivation

^bThe assumption is that rice is harvested twice/year and sago is 40 trees/ha/year.

Sago has many advantages regarding convenience, productivity and costs required to develop and increase production.

SAGO PRODUCTION POTENTIAL



IPB University
— Bogor Indonesia —

Indonesia's strategic food consumption and needs 2019-2023

Beras

(lokal, kualitas unggul, impor dan beras ketan)

Konsumsi (kg/kap/tahun)

78,71	78,75	81,83	81,35	81,23
Tahun 2019	Tahun 2020	Tahun 2021	Tahun 2022	Tahun 2023

21.008.460	21.230.140	22.312.976	22.431.155	22.639.224
Tahun 2019	Tahun 2020	Tahun 2021	Tahun 2022	Tahun 2023

Kebutuhan Konsumsi Rumah Tangga (ton/tahun)

Rice

22,6 million tons

Flour

818,034 tons

Konsumsi (kg/kap/tahun)

2,54	2,45	2,85	2,75	2,94
Tahun 2019	Tahun 2020	Tahun 2021	Tahun 2022	Tahun 2023

676.761	661.692	776.259	758.124	818.034
Tahun 2019	Tahun 2020	Tahun 2021	Tahun 2022	Tahun 2023

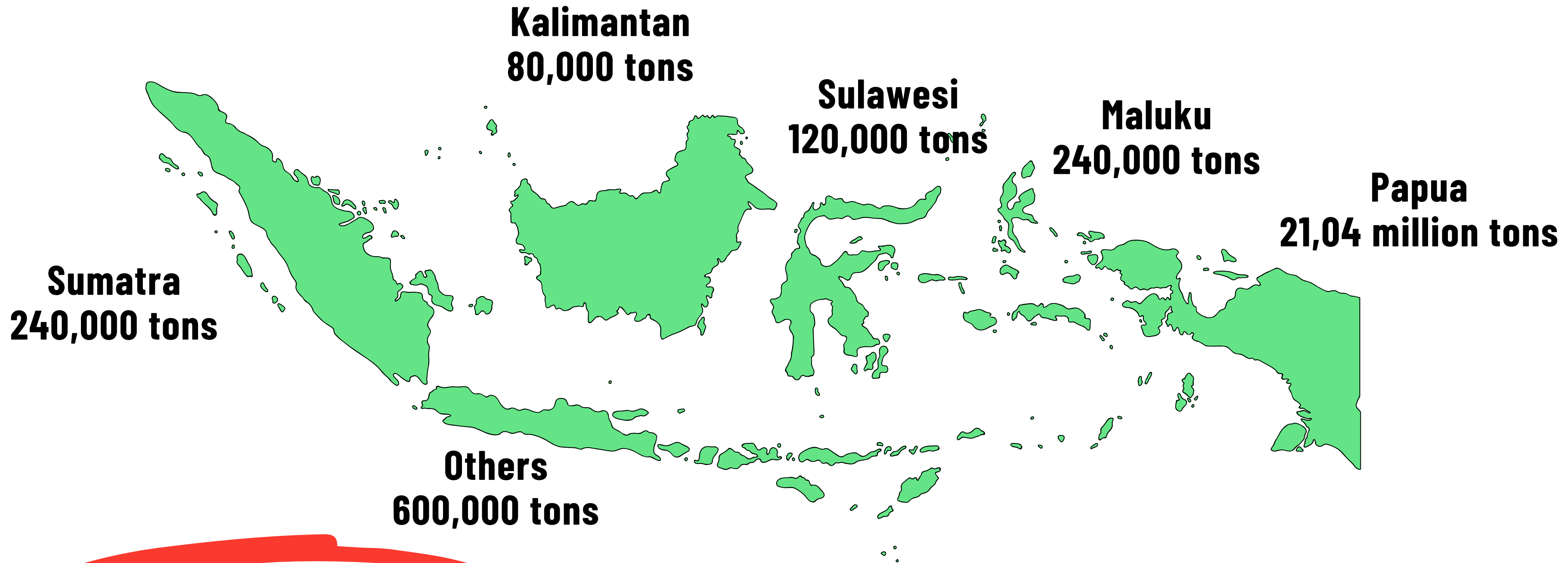
Kebutuhan Konsumsi Rumah Tangga (ton/tahun)

Tepung Terigu

SAGO PRODUCTION POTENTIAL



IPB University
— Bogor Indonesia —



22,3 milion tons annually*)



11,07 billion USD

*) estimated production

UTILIZATION OF SAGO



IPB University
— Bogor Indonesia —



Firewood and Fertilizer



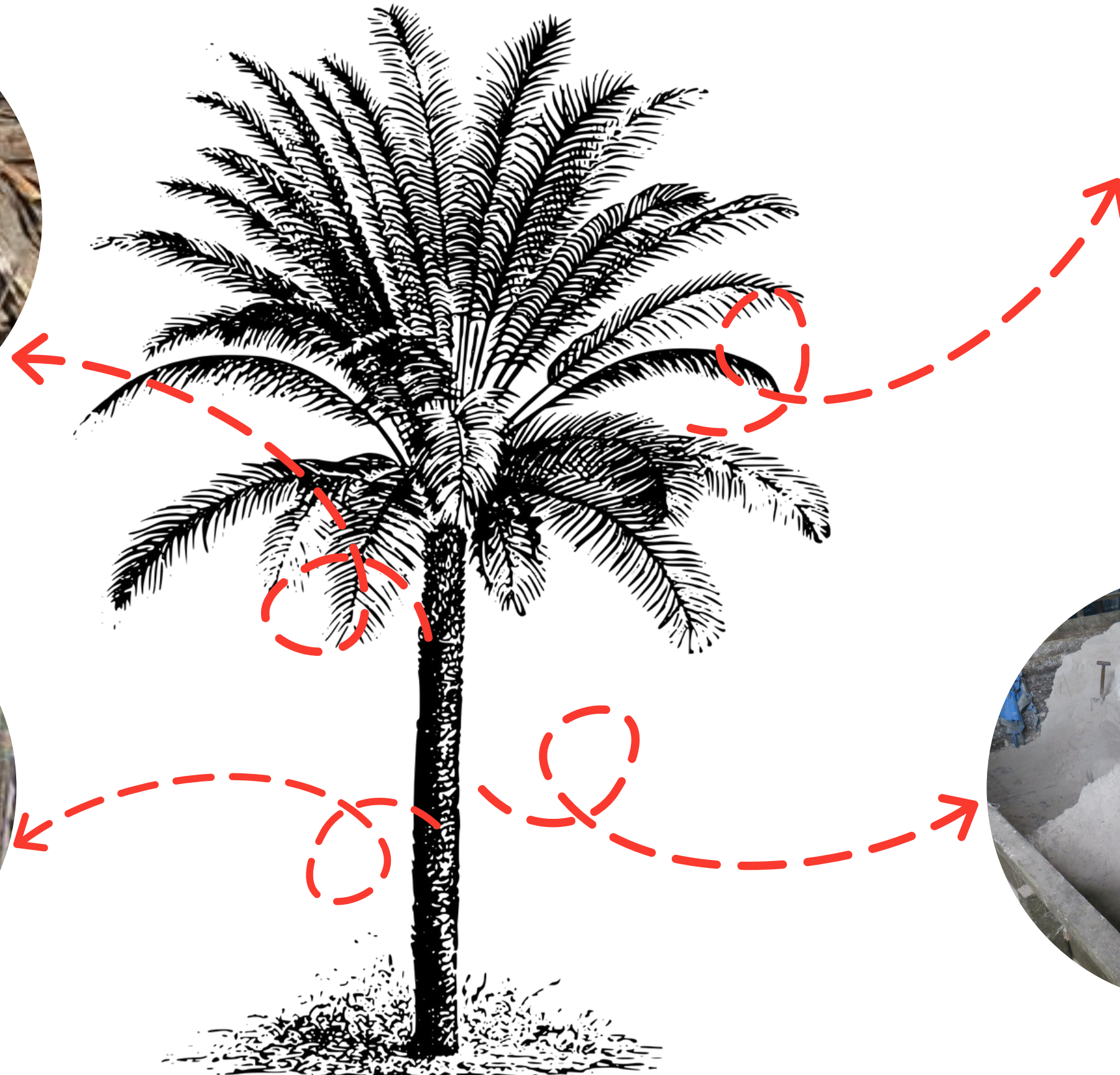
Roof



Fence



Starch



UTILIZATION OF SAGO



IPB University
— Bogor Indonesia —



Papeda



Sagu Lempeng



Gubal sagu



Lambok



Kapurung



Ongol-ongol



Bagea



Sinoli

Results of chemical analysis of sago roots



Sago root

Chemical compounds	Result
Alkaloids	+
Tannin	+
Saponin	+

- Antidiabetic (Andrade et al. 2020)
- Fever, backache, gout and impotence (Syahdima et al. 2013)
- Antimalarial, digestive and colon cancer (Budiarti et al. 2020; Kadir et al. 2022)

Results of chemical analysis of sago leaves

Compound class	Reagent name	Result	Information
Alkaloids	Mayer	-	No yellowish precipitate was formed
	Dragendorff	+	An orange precipitate is formed
Phenol	FeCl ₃	+	A bluish-green or dark blue colour is formed
Flavonoids	HCl	+	Yellow colour is formed
Saponin	HCl	+	Foam is formed
Tannin	FeCl ₃	+	A blackish-blue or blackish-green color is formed
Triterpenoids	H ₂ SO ₄	-	No brownish or violet rings are formed
Steroids	H ₂ SO ₄	+	A bluish-green ring colour is formed



Sago leaves

SAGO FOR GLOBAL FOOD SECURITY



IPB University
— Bogor Indonesia —

MAP 0.1 Food-crisis countries/territories included in the GRFC 2024

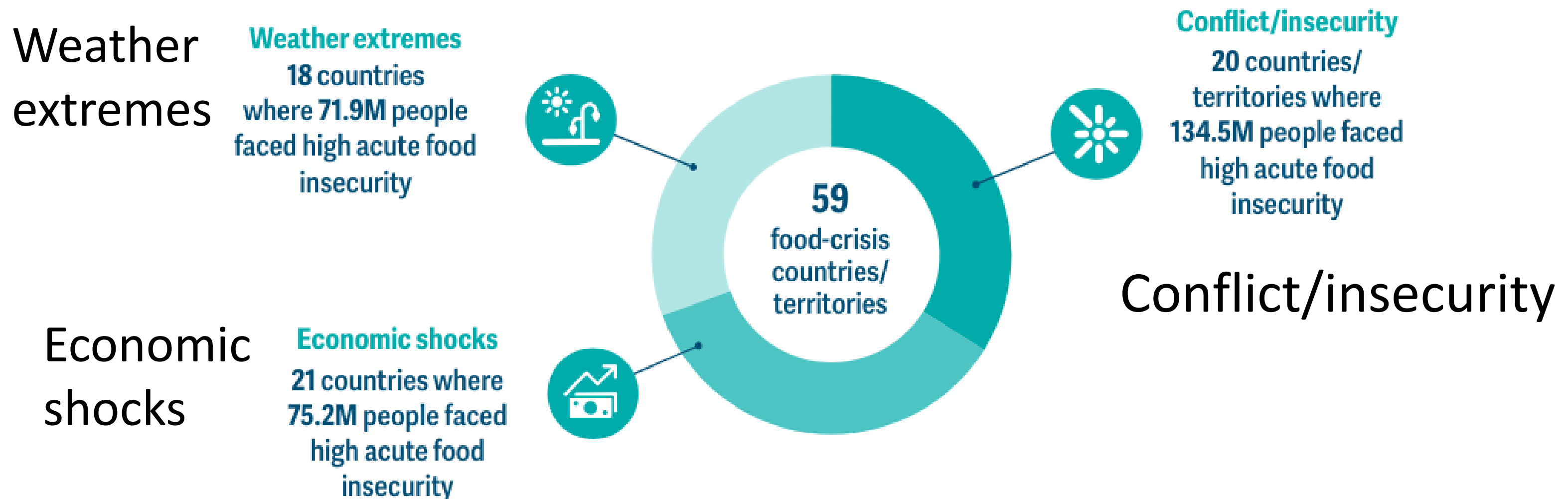
Food-crisis countries



Over **281.6 million people** in the **59 countries/territories** requirements faced high levels of acute food insecurity in 2023.

Data source: Global Report on Food Crises (2024)

Primary drivers of acute food insecurity in countries/territories with food crises, 2023



Food crises are the result of multiple drivers. The GRFC has based this infographic on the predominant driver in each country/territory.

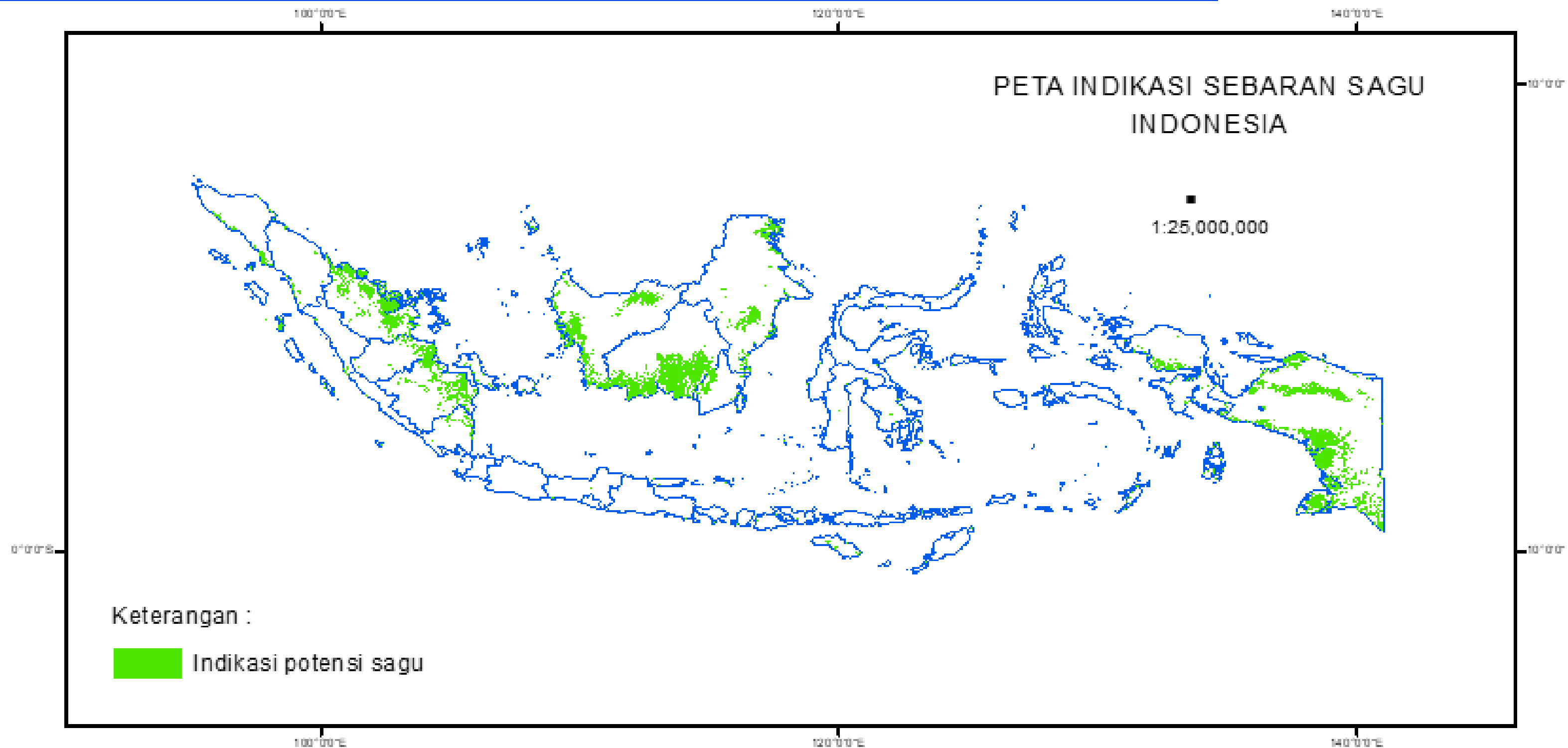
Source: GRFC Food Security TWG, 2024.

Data source: Global Report on Food Crises (2024)

SAGO FOR GLOBAL FOOD SECURITY



IPB University
— Bogor Indonesia —



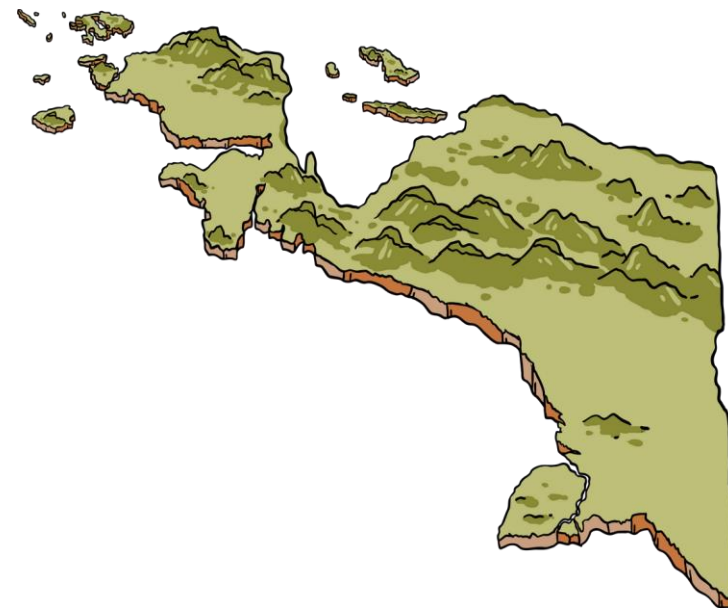
The potential habitat of sago in Indonesia : 23,627,516 ha

Data source: Land Cover Interpretation from Landsat Satellite Imagery, Ministry of Forestry of the Republic of Indonesia (2011)

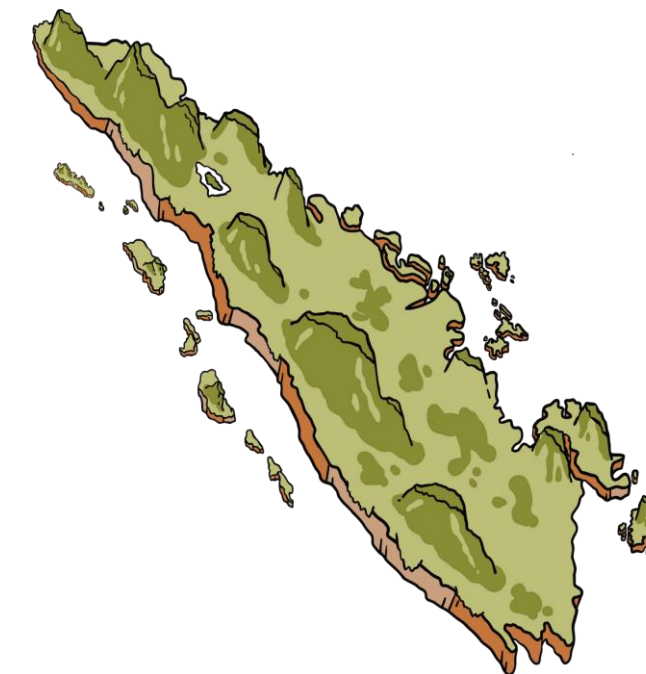
The area of land is indicated as a place for sago to grow in each region in Indonesia



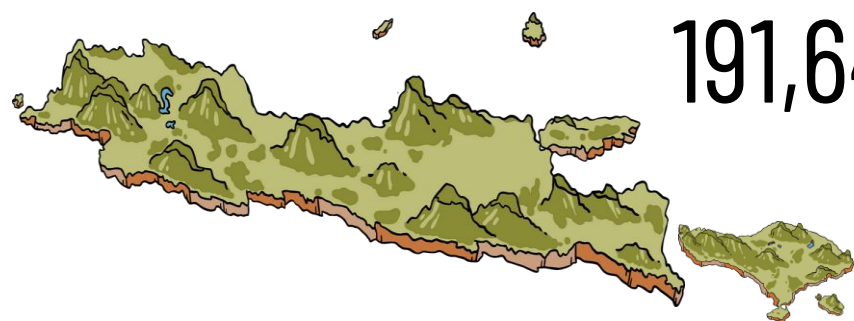
Kalimantan
9,207,172 ha



Papua
7,722,286 ha



Sumatra
6,166,400 ha



Java & Bali
191,645 ha



Sulawesi
173,198 ha



Maluku
166,815 ha

Potential Production of Sago Starch

23,627,516 ha



**236 million
tons annually*)**

*) estimated production (10 tons/ha/year)

- **Sago has been the staple food of the Indonesian people since ancient times**, as evidenced by the relief of the palm of life since the 8th century.
- **Sago is a plant species that is adaptive to global climate change**, so it has the potential to be developed as a staple food during the global climate crisis.
- **Sago has high production and economic potential** if developed as a sustainable food industry commodity.
- **Indonesia can be a carbohydrate food supplier** for the world's population by developing potential habitats for sago.

REFERENCES



IPB University
— Bogor Indonesia —

- Afdeeling Handel. 1919. *Publicates Van De Afdeeling Handel No.2: Sago en Sago Producten*. Weltevreden: Papyrus.
- Agustin MD, Djoefrie MHB, Santosa E, Zuhud EAM. Genetic diversity of sago (*Metroxylon* spp.) in Lingga District, Kepulauan Riau, Indonesia. Proceedings The 14th International Sago Symposium.
- Al Manar P, Zuhud EAM, Andarwulan N, Bintoro MH. 2023. Morphological characteristics and potential of sago (*Metroxylon* spp.) in Lingga Regency, Riau Islands, Indonesia. *Jurnal Manajemen Hutan Tropika*. 29(1):11-21.
- Andrade C, Gomes NGM, Duangsrissai S, Andrade PB, Pereira DM, Valentao P. 2020. Medicinal plants utilized in Thai Traditional Medicine for diabetes treatment: Ethnobotanical surveys, scientific evidence and phytochemicals. *Journal of Ethnopharmacology*. 263:1-54. doi:10.1016/j.jep.2020.113177.
- Bantacut T. 2011. Sagu : sumberdaya untuk penganeekaragaman pangan pokok. *Pangan*. 20(1):27-40.
- Bantacut T. 2014. Indonesian staple food adaptations for sustainability in continuously changing climates. *J Environ Earth Sci*. 4(21):202-216.

REFERENCES



IPB University
— Bogor Indonesia —

- Budiarti M, Maruzy A, Mujahid R, Sari AN, Jokopriyambodo W, Widayat T, Wahyono S. 2020. The use of antimalarial plants as traditional treatment in Papua Island, Indonesia. *Heliyon*. 6:1-10. doi:10.1016/j.heliyon.2020.e05562.
- Ehara H. 2009. Potency of sago palm as carbohydrate resource for strengthening food security program. *Jurnal Agronomi Indonesia*. 37(3):209-219. doi:10.24831/jai.v37i3.1255.
- FSIN and Global Network Against Food Crises. 2024. *Global Report on Food Crises 2024*. Rome: FSIN.
- Kadir A, Suharno, Reawaruw Y, Komari, Mahuze A. 2022. Ethnobotanical knowledge of Marind-Anim Tribe in utilizing sago (*Metroxylon sagu*) in Merauke, Papua, Indonesia. *Biodiversitas*. 23(1):264-272. doi:10.13057/biodiv/d230132.
- Konuma H, Rolle R, Boromthanarat S. 2012. Color characteristics of sago starch as they relate to the growth environment of the sago palm (*Metroxylon sagu* Rotbb). *Journal of Agricultural Technology*. 8(1):273-287.

REFERENCES



IPB University
— Bogor Indonesia —

- Nurlila RU, Sudiana, Fua JL. 2021. Efek antibakteri daun sagu (*Metroxylon sagu* Rottb.) terhadap pertumbuhan *Staphylococcus aureus* dan *Escherichia coli*. *Jurnal Mandala Pharmacoon Indonesia*. 7(2):285-322. doi:10.35311/jmpi.v7i2.141.
- Putri AAK, Fatriani, Satriadi T. 2019. Pemanfaatan pohon sagu (*Metroxylon* sp) dan kualitas pati sagu dari Desa Salimuran Kecamatan Kusan Hilir Kabupaten Tanah Bumbu Kalimantan Selatan. *Jurnal Sylva Scientiae*. 2(6):1082-1093.
- Syahdima, Yuniati E, Pitopang R. 2013. Kajian etnobotani tumbuhan sagu (*Metroxylon* spp. Arecaceae) pada masyarakat Desa Radda Kecamatan Baebunta Kabupaten Luwu Utara Provinsi Sulawesi Selatan. *Biocелеbes*. 7(1):17-26.

OUR TEAM

Bioprospecting and Plant Utilization Laboratory,
Division of Bioprospecting and Sustainable Wildlife Utilization, Department of Forest Resources Conservation and Ecotourism, Faculty of Forestry and Environment, IPB University, Bogor, Indonesia 16680



IPB University
— Bogor Indonesia —



Prof. Ervizal Amzu
Professor at IPB Univ.

Conservation of Tropical Plants
Medicinal Plants
Ethnobotany



Primadhika AM, M.Si
PhD Student at IPB Univ.


Food Plants (Palmae)
Plants Biopropecting
Ethnobotany

THANK YOU

FOR YOUR ATTENTION

June 2024

 eamzuhud@apps.ipb.ac.id

 primadhikaa@gmail.com

