



Is Sago the Answer to Food Security in West Papua, Indonesia?

Fathir Fajar Sidiq

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Newcastle University

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Abstract

Indigenous peoples and their access to food resources are a major concern in regard to the global food security issue. The indigenous peoples of West Papua, Indonesia have recently become dependent on imported rice, which has replaced locally produced sago as an important component of their diet. The aim of the research presented in this thesis was to study the indigenous peoples of West Papua and their traditional food resource; sago (*Metroxylon sagu* Rottb.) and to understand if there is a need to promote and preserve traditional food knowledge of sago based on local culture and agronomic practices, as well as in relation to food security.

An initial systematic review focused on the role of traditional diets for food security for the indigenous peoples in Low-and Middle-Income Countries (LMICs) was conducted. Given that the review indicated a knowledge gap in relation to indigenous peoples, sago, and food security in West Papua, a further, and broader, review was conducted explicitly focusing on this issue. The results indicated that there is a need to promote and preserve traditional food knowledge within indigenous peoples in order to reduce reliance on imported food, promote local biodiversity, and improve food security.

Qualitative interviews were applied to explore the motivating factors, and barriers related to sago consumption amongst the indigenous peoples of West Papua. Various stakeholders: politicians, local and national civil servants, academics, sago farmers, and food activists, were interviewed (n=18). The results recommended that sago consumption culture must be maintained and preserved for the Papuan people.

A quantitative analysis, building on the results of the systematic review and the interviews, was conducted to determine predictors of sago consumption behaviour among indigenous peoples of West Papua. The data was obtained by distributing questionnaires to 250 respondents. Results show that perceived facilitating external conditions made the greatest contribution to sago consumption intentions and self-reported sago consumption propensity.

Finally, a photovoice study was conducted with younger participants (n=8, age range 18 years old – 22 years old) of West Papuans concerning their understanding of sago as traditional food. The findings established a shared knowledge and appreciation for sago as a staple food and for their cultural identity. In addition, this study demonstrated that the family is the primary source of early knowledge transmission regarding sago consumption. Taken together, the results of the research are used to develop policy recommendations regarding the continuity of sago consumption practices is essential to improve the food security system in West Papua, Indonesia.

Acknowledgement

In the name of God, the Merciful, the Compassionate, and praise be to God, Lord of all worlds; prayers and peace be upon our master, Muhammad, and on all his house and companions,

Nūn. By the pen and what everyone writes! (Quran 68:1)

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List of Abbreviations

AKNESS	Akademi Komunitas Negeri Sorong Selatan
AMOS	Analysis of Moment Structures
ANJ	Austindo Nusantara Jaya
AREA	Anticipate, Reflect, Engage, and Act
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
COREQ	The consolidated criteria for reporting qualitative research
COVID-19	coronavirus disease 2019
CR	Construct Reliability
CSR	Corporate Social Responsibility
FAO	The Food and Agriculture Organization
FGD	Focus Group Discussion
FSVA	Food Security and Vulnerability Atlas
GHG	Greenhouse Gas
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immunodeficiency Syndrome
IDR	Indonesian rupiah
IPCC	Intergovernmental Panel on Climate Change
kgCO ₂ eq	Kilogram of carbon dioxide equivalent
LMIC	Low-and Middle-Income Country
MRP	Majelis Rakyat Papua
MtC	Metric Tonnes of Carbon
NEP	New Ecological Paradigm
OECD	Organisation for Economic Co-operation and Development
Perhutani	Perusahaan Hutan Negara Indonesia
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
Raskin	Beras untuk Rumah Tangga Miskin (subsidised rice for poor households)
RMSEA	Root Mean Square Error of Approximation
SDG	Sustainable Development Goal
SEM	Structural Equation Modelling
SRMR	Standardised Root Mean Square Residual
TLI	Tucker-Lewis index
UNDP	The United Nations Development Programme
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UNPFII	The United Nations Permanent Forum on Indigenous Issues
USD	United States dollar
VE	Variance Extracted
WFP	World Food Programme

List of Publications

- Sidiq, F. F., Coles, D., Hubbard, C., Clark, B., & Frewer, L. J. (2021) 'Sago and the indigenous peoples of Papua, Indonesia: A review', *Journal of Agriculture and Applied Biology*, 2(2), 138-149. <https://doi.org/10.11594/jaab.02.02.08>
- Sidiq, F. F., Coles, D., Hubbard, C., Clark, B., & Frewer, L. J. (2022) 'The role of traditional diets in promoting food security for indigenous peoples in low- and middle-income countries: A systematic review', Paper presented at the *IOP Conference Series: Earth and Environmental Science*, 978(1) <https://doi.org/10.1088/1755-1315/978/1/012001>
- Sidiq, F. F., Coles, D., Hubbard, C., Clark, B., & Frewer, L. J. (2022) 'Factors Influencing Consumption of Traditional Diets: Stakeholder Views regarding Sago Consumption among the Indigenous Peoples of West Papua', *Agric & Food Secur* 11, 51 (2022). <https://doi.org/10.1186/s40066-022-00390-5>

Chapter 1. Introduction

1.1 Introduction

Food insecurity is problematic for many indigenous people globally (Tuturoop *et al.*, 2022; Sidiq *et al.*, 2022a; Bogdanova *et al.*, 2020a; Utomo, 2019; Kuhnlein, 2017; Islam & Berkes, 2016). Despite comprising about 5% of the world's population, indigenous peoples represent 15% of the poorest people on earth (United Nations Development Programme, 2019). Indigenous peoples are also affected by the *nutrition transition* (Popkin, 2006) phenomenon, which finds people shifting from consuming traditional to western diet. This transition may be less healthy or be associated with negative impacts on the environment, including in relation to ecosystems and biodiversity. Traditional food contributes to food security by providing various health benefits, such as the essential nutrients needed to maintain health, while some have potential medicinal values (Jia *et al.*, 2023; Kennedy *et al.*, 2022; Sidiq *et al.*, 2022a). Furthermore, traditional foods contribute to the development of sustainable ecosystems as they have evolved to thrive local ecological contexts; their production and consumption may reduce reliance on fertiliser and water inputs and may be resilient to adverse local environments (Kennedy *et al.*, 2022; Mavhura *et al.*, 2013; Sambo, 2014). Despite the indigenous community's awareness of the advantages of indigenous food sources, consumption of traditional foods is reducing as a result of the people's preference for the convenience of modern foods (Ghosh-Jerath *et al.*, 2018; O'Meara *et al.*, 2019). Traditional foods may be reducing in diets because of three factors: the amount of time available to mothers for cooking, new food preferences on the part of children for ultra-processed foods, and changes in the increase of income which means such ultra-processed foods become affordable (Amaya-Castellanos, 2022). Overall, there is evidence that the production and consumption of traditional diets have an important role in our food system by contributing to the resilience of local food systems and promoting biodiversity.

The indigenous populations in West Papua are affected by nutrition transition. There is currently a trend towards the consumption of rice as the staple component of diets over sago, which has been traditionally consumed (*Metroxylon sagu* Rottb.) (Sidiq *et al.*, 2021). Sago is a multi-purpose crop that has long been known as the primary carbohydrate source consumed and processed for generations in this region

(Hasibuan *et al.*, 2018; Ondikeleuw *et al.*, 2020). As well as representing an important food source, the sago palm can be used for various purposes, such as thatching, and to make industrial products, including bioethanol (Bintoro, 2011; Flach *et al.*, 1997; Konuma, 2018; Toyoda, 2018). In addition, there is evidence that environmental impacts of sago production are less negative than for non-traditional equivalent foods when grown locally. For example, the greenhouse gas (GHG) emissions produced in the manufacture of 1 tonne of sago (17.9 kgCO₂eq) are significantly less than those produced to create corn starch (2700 kgCO₂eq), potato starch (2402 kgCO₂eq), and cassava starch (4310 kgCO₂eq) (Yusuf *et al.*, 2019). In addition, waste streams can also help the circular bioeconomy. Sago palm waste has been used to produce a variety of products, including fermentable sugar, enzyme, mushroom compost, animal feed, and adsorbent. Utilising sago residue has the dual benefits of lowering the pollution caused by the sago processing industry and adding economic value (Awg-Adeni *et al.*, 2010).

According to the Food Security and Vulnerability Atlas (FSVA), which was released by the Ministry of Agriculture of the Republic of Indonesia (2021), some regions of Indonesia—in particular, the provinces of Papua and West Papua—need additional attention in terms of food security, while at the same time conserving the abundance in biodiversity and cultural diversity. There were no statistical data available on sago production and consumption in either province (FSVA 2021). Despite these many uses and advantages of sago, the Indonesian national programme for sago palms; sago industry development, sago industry supporting infrastructure, and research related to sago, and its potential benefits to food security, lacks sufficient funding, which potentially contributes to sago resources being neglected as one of Indonesia's potential crops (Winarno & Hariadi, 2017).

At the same time, it is recognised that sago is one of the underutilised traditional food resources in Indonesia (Food and Agriculture Organization, 2014). Approximately 1.128 million ha of sago palm, or 51.3% of the 2.291 million ha of sago worldwide, are grown in Indonesia, the country with the largest sago palm growing areas globally (Konuma, 2018). As a result, understanding the role of sago in local, national, and regional food systems becomes important, as the potential annual production of sago in the Papua and West Papua provinces is projected to be 12.7 million tonnes of dry starch (Djoefrie *et al.*, 2013). However, data from the Indonesian Ministry of

Agriculture shows a decrease in sago production. Sago production in 2021 was 381,065 tonnes, a 11.9 percent decrease from 2017 of 432,913 tonnes (Rizaty, 2021).

Local consumers in West Papua and Papua consume less sago in comparison to other commodities, such as rice and wheat, which are not produced locally and highly dependent on supplies from other regions in Indonesia. Hence, sago is more resilient against supply disruptions caused by natural disasters in the form of crop failure due to climate change, supply chain disconnectivities, and during the COVID-19 pandemic (Hariyanto *et al.*, 2013; Sidiq *et al.*, 2022b). Sago is consumed annually at a rate of 0.36 kg per person. In contrast, 18.2 kg of wheat are consumed annually per person, and 97.1 kg of rice are consumed annually per person (Ministry of Agriculture, 2018). Changes can be linked to improved incomes. For example, for every 1 percent increase in Indonesian people's income, the amount spent on food made from wheat rises by between 0.44 and 0.84 percent (Fabiosa, 2006). Whole sago is consumed by 1.8% of Indonesians nationally and is less frequently consumed than wheat flour (30.2%) and cassava (19.6%) (Damayanthi, 2020).

Previous research on sago has focused on the plant's physical and chemical characteristics (Nisar & Hussain, 2022; Ahmad *et al.*, 2022; Ghalambor *et al.*, 2022). Less is known about food choices and sago consumption among the indigenous population. Furthermore, stakeholder perspectives on the importance, or otherwise, in local diets is limited. Thus, in the context of understanding local food systems and the management of local food insecurity, it is important to investigate the significance of sago for the indigenous peoples of West Papua to address these gaps. This is particularly important if policymakers are to have evidence to be able to formulate appropriate policies regarding sustainable sago management in Indonesia.

1.2 Research aims and objectives

The overall aim of the research presented in this thesis is to study the indigenous peoples of West Papua and their traditional food resource; sago (*Metroxylon sagu* Rottb.) and to understand if there is a need to promote and preserve traditional food knowledge of sago based on local culture and agronomic practices, as well as in relation to food security. Research objectives and associated research questions will be used to achieve this as highlighted in Table 1.1.

Research objectives	Research Questions
Chapter 2: The role of traditional diets in promoting food security for indigenous peoples in Low-and Middle-Income Countries (LMICs): A systematic review	
To review the role of traditional diets and food security for indigenous peoples in Low-and Middle-Income Countries (LMICs)	<ul style="list-style-type: none"> • What are the roles of traditional foods in food security and cultural and ecosystem preservation for indigenous peoples? • What are the potential barriers to and facilitators of promoting traditional diets for indigenous peoples? • Is there a need to promote and preserve traditional food knowledge and agronomic practices among indigenous peoples?
Chapter 3: Sago and the indigenous peoples of Papua, Indonesia: A review	
To review the role of sago in relation to food security in West Papua, including in relation to local diets, environmental impacts and culture	<ul style="list-style-type: none"> • Is sago important to the indigenous peoples of West Papua? • What are the food security benefits of sago to the indigenous peoples of West Papua? • What are the environmental benefits of sago in West Papua? • What role does sago have in local culture in West Papua?
Chapter 4: Factors influencing consumption of traditional diets: Stakeholder views regarding sago consumption among the indigenous peoples of West Papua	
To investigate the various factors perceived by stakeholders that influence sago consumption among the indigenous peoples of West Papua	<ul style="list-style-type: none"> • What are the factors that motivate the indigenous peoples of West Papua to produce and/or consume sago? • Are strategies needed to increase Papuans' sago consumption? If yes, what form might these take? • What are the barriers to producing and consuming sago? • What are stakeholders understandings of sago eating culture?

-
- What are the implications for future sago policies regarding sago production and consumption in West Papua?
-

Chapter 5: Predictors of sago consumption behaviour among indigenous peoples of West Papua

To determine psychological predictors of sago consumption behaviour among indigenous peoples of West Papua

- What are the psychological, social, and contextual factors that influence sago consumption behaviour among the indigenous peoples of West Papua?
 - What are the implications of this research for policymakers?
-

Chapter 6: Understanding the role of sago as traditional food among a group of young indigenous people of West Papua: A photovoice study

To develop a methodology for understanding how a group of young indigenous West Papuans perceive sago as a traditional food

- What are the perceptions of younger people in West Papua regarding sago?
 - What is the significance of intergenerational transmission of traditional food knowledge for younger generations?
 - What are the barriers to consuming sago for younger people in West Papua?
-

Chapter 7: Discussion, research limitations, policy recommendations, future research, and conclusions

- To interpret the research results with respect to the overall objectives of the original research question
 - To identify research gaps and make recommendations for future research
 - To identify policy evidence and the implications for policy development
 - To discuss the limitations of research
 - What are the policy implications of the research?
 - What are the research limitations and implications for future research?
-

-
- To identify overall conclusions
-

Table 1. 1: Research objectives and questions for the thesis

1.3 Research Methods and COVID-19

This research, as initially proposed, was associated with significant alterations in the approaches adopted as a consequence of the COVID-19 pandemic. Initially, the intention was to use ethnographic methodologies (Creswell and Poth, 2017) to explore the daily lives of the indigenous peoples of West Papua as shown in their behaviour, language, and interactions with one another, and in relation to agronomic practises and dietary choices, with a focus on sago consumption. However, the limitations on social interaction necessitated by the COVID-19 pandemic resulted in the adoption of alternative methodological approaches (see also Bogdanova *et al.*, 2020b; van Vliet, 2022), in particular those that enabled remote data collection. The primary method for gathering data from participants in the research was by establishing communication using WhatsApp and Zoom, in particular with gatekeepers who helped complete the data collection procedure (chapters 4, 5, and 6).

As a government official conducting research, my positionality potentially influenced my findings in various ways that deserve reflexive examination (Patnaik, 2013). Due to my role, participants may have emphasised certain issues while omitting or downplaying others due to perceived alignment with national government agendas (Harrington, 2003).

My identity as a government researcher may have led participants to present themselves strategically through "identity claims" and view me differently than if I was from outside government (Harrington, 2003). As recommended by Patnaik (2013), I need to address how my background "influences various aspects of the study like topic choice, data collection and interpretation."

Ideally, in my role as a researcher, I should have been able to establish deeper trust with research participants through longer-term fieldwork (see, e.g. Hagues 2021). However, this was not possible due to the COVID-19 pandemic, which required me

to return to Depok City. As a researcher, it is also important to benefit from discussions with outside research partners to check the reactions and interpretations of the findings (Hagues, 2021) by using local translators and collaborators. In addition, researchers may collaborate with those having the role of gatekeeper, especially in finding informants or bridging communication with informants who need trust, given that researchers are viewed as “outsiders” to the communities and the community members who are participating in the research. Greater reflexivity regarding the researcher role could have helped produce research more empowering for participants rather than reinforcing any perceived oppression, by allowing their voices and perspectives to be more authentically represented and centering their interests in the research process (Hagues, 2021).

Moving forward, critical self-reflection on how cultural context and my own positionality shaped this research encounter remains important (Bayeck, 2021). This can help expand understanding of the phenomena under investigation.

This thesis used mixed research methods in which qualitative and quantitative data were collected sequentially and data integrations occurred during the research process (Creswell, 2013). The work began with a systematic review of the literature on traditional diets for indigenous peoples in Low-and Middle-Income Countries (LMICs) (Chapter 2, published as Sidiq *et al.*, 2022a). Given that the review indicated a knowledge gap in relation to indigenous peoples, sago, and food security in West Papua, a further, and broader, review was conducted explicitly focusing on this issue. In order to comprehend the many factors that a chosen group of stakeholders believes affect the consumption of sago among the indigenous peoples of West Papua, qualitative methodology (semi-structured interviews) was used. These participants (n = 18) comprised politicians, local and national civil servants, academia, sago farmers, and food activists. The use of qualitative methodology can help researchers gain access to research participants' opinions and emotions and create an understanding of the meaning that people attribute to their experiences (Sutton & Austin, 2015). The stakeholder research enabled understanding of stakeholder views, which is important because stakeholders influence production and consumption practices throughout the supply chain. However, their views may not align with those held by consumers.

Quantitative methodology, using a survey of 250 respondents, was applied to investigate the factors that influence sago consumption by the indigenous people of West Papua, which allowed understanding of differences between different (groups of) consumers and could be used to assess significant differences between these groups well as identifying psychological factors driving food choices associated with sago, which was assessed in terms of their behavioural intentions to consume sago. Other facilitating external conditions regarding sago consumption, environmental concern and engagement, identification with collectivist and individualist culture, perceptions of economic factors driving food choices in relation to sago, barriers to sago consumption, and self-reported sago consumption were assessed as drivers of behavioural intention.

Finally, participatory research using photovoice methodology was used to study how younger people in West Papua perceived and used sago as a traditional food. Participants' ages ranged from 18 to 22 years of age ($n = 8$). This research was represented a methodology which could address the issue of how the indigenous younger people thought about sago production and consumption in relation to intergenerational knowledge transmission and perceived knowledge gaps, issues identified as relevant in the literature reviews in Chapters 2 and 3.

Research Phase	Methods	Data Collected
Systematic Review (Chapter 2)	<ul style="list-style-type: none"> • Systematic review with PRISMA 	<ul style="list-style-type: none"> • Studies included (n=37) from five databases: Scopus, ProQuest, Web of Science, EBSCOhost (CAB Abstracts), and Google Scholar
Literature Review (Chapter 3)	<ul style="list-style-type: none"> • Standard literature review 	Review concerning:

		<ul style="list-style-type: none"> • Indigenous peoples and food security • Indonesia context • Sago, the underutilised indigenous food resource • Future of sago
Qualitative methodology (Chapter 4)	<ul style="list-style-type: none"> • Semi-structured interviews with a selected number of stakeholders (n= 18) • Stakeholders included politicians, local and national civil servants, academia, sago farmers, and food activists • Zoom Call and WhatsApp 	<ul style="list-style-type: none"> • Text data (interview transcripts, documents) • Digital recording
Qualitative Data Analysis	<ul style="list-style-type: none"> • Coding and thematic analysis, NVivo R1 	<p>Codes</p> <p>Themes and sub-themes</p> <p>Thematic analysis</p>
Quantitative Data Collection (Chapter 5)	<ul style="list-style-type: none"> • Survey questionnaires for 250 respondents • Secondary statistical data 	Quantitative data
Quantitative Data Analysis	<ul style="list-style-type: none"> • Data screening • Using appropriate statistical analysis, AMOS V23.0. 	The prediction potential of variables related to sago consumption using Structural Equation Modelling

Qualitative Data Collection (Chapter 6)	<ul style="list-style-type: none"> • Photovoice methodology (n= 8) • Participants photographed sago-related activities • Zoom Call 	<ul style="list-style-type: none"> • Text data (interview transcripts, documents) • Photograph • Digital recording
Qualitative Data Analysis	Coding and thematic analysis, NVivo R1	Codes Themes and sub-themes Thematic analysis
Integration and Interpretation of Results	Interpretation and explanation of qualitative and quantitative data results	Discussion Limitations Implication Future research

Table 1. 2: Research phases and methods applied in this thesis

Table 1.2 summarises the different research phase, methods applied, and data generated. There are two qualitative studies conducted: selected stakeholder views regarding sago consumption among the indigenous peoples of West Papua and the perspectives of younger West Papuans in relation to sago, local cultural, and agronomic contexts. Although the two studies used the same approach, both used different methods in their implementation. Research with stakeholders only uses semi-structured interviews in collecting primary data, while research involving young West Papuans, the photovoice methodology is used as an initial step in collecting data, considering this method has been found to be a particularly effective method for including younger participants to share their observations and understanding (Strack *et al.*, 2004).

1.4 Thesis outline

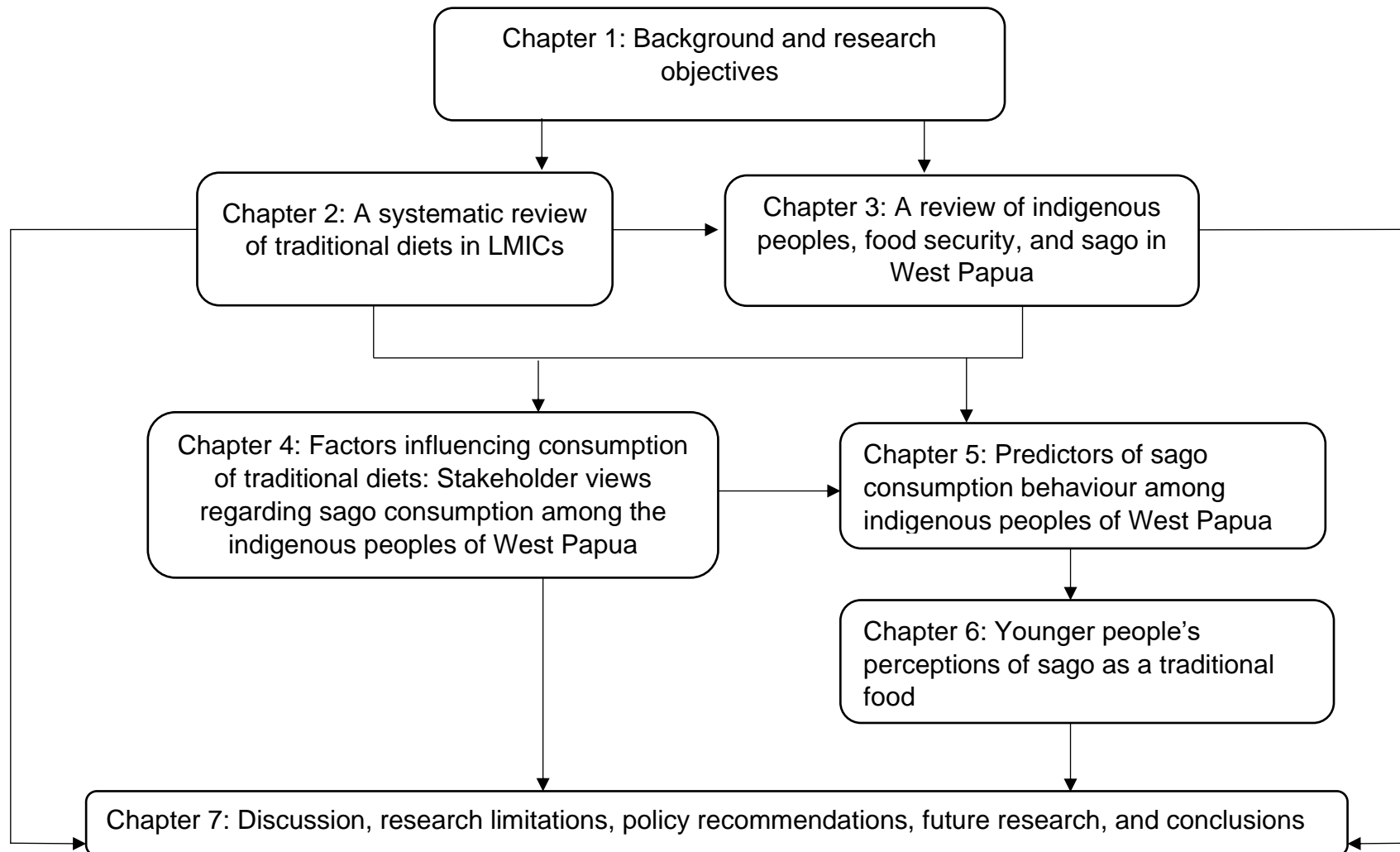


Figure 1.1: An overview of the thesis

An overview of the thesis is provided in figure 1.1. Following on from the introduction, Chapter 2 describes the systematic reviews that were conducted to address the role of traditional diets in ensuring food security for indigenous peoples in low- and middle-income countries. Chapter 3 further details a review focused on the role of sago in the diets of the indigenous people in West Papua. Chapter 4 then discusses the motivating factors, and barriers related to sago consumption amongst the indigenous peoples of West Papua from the perspective of various stakeholders. Chapters 5 and 6, building on the results of the systematic review and the interviews, describe the predictors of sago consumption behaviour among indigenous peoples of West Papua and a photovoice case study with younger West Papuans focused on their understanding of sago as a traditional food. Finally, Chapter 7 draws together and summarises the conclusions from the preceding five chapters, including research limitations, wider policy implications, and future research implications.

Chapter 2. The Role of Traditional Diets in Promoting Food Security for Indigenous Peoples in Low- and Middle-Income Countries: A Systematic Review

2.1 Introduction

To date, there has been no universally recognised definition of “indigenous people” by scholars or international institutions. Based on the United Nations Permanent Forum on Indigenous Issues, Indigenous peoples are defined as “inheritors” who inhabited a country or geographical region at the time when people of different cultures or ethnic origin arrived. Indigenous peoples have unique culture relating to people and the environment. Another definition is provided by Cobo's work on the Problem of Discrimination against Indigenous Populations (UNPFII, 2010). The working definition is as follows: *“Indigenous communities, peoples, and nations are those which, having a historical continuity with pre-invasion and pre-colonial societies that developed on their territories, consider themselves distinct from other sectors of the societies now prevailing on those territories, or parts of them. They form at present non-dominant sectors of society and are determined to preserve, develop and transmit to future generations their ancestral territories, and their ethnic identity, as the basis of their continued existence as peoples, in accordance with their own cultural patterns, social institutions and legal system”*. It has been noted that many indigenous peoples are the guardians of their local environment, natural resources, and the associated biodiversity linked to ecosystems (Mamo, 2020).

There are about 476 million indigenous people worldwide, representing more than 6 per cent of the world's population (World Bank, 2020). They have custodial responsibility for conserving 80 per cent of the planet's biological diversity (FAO, 2021). As part of this, most indigenous peoples are linked to traditional food systems, each of which contain between 70 and 100 or more traditional plant species (Kuhnlein *et al.*, 2006). Traditional food systems are socially, culturally, and economically important, particularly in maintaining the well-being and health of indigenous people (Bhat, 2012). Traditional food crops tend to be less destructive to the environment compared to some of the environmental impacts associated with conventional food production, which may be linked, among other things, to activities which result in deforestation, water pollution, and global climate change (FAO, 2017).

Importantly, these traditional foods meet cultural needs in preserving traditional cuisine and ways of life, and maintain local communities' cultural heritage (Durst *et al.*, 2014). Indigenous peoples have been witnesses to climate change since the beginning of the Anthropocene era. Consequently, they have developed effective solutions and practices for the conservation of biodiversity and climate change mitigation in relation to conservation of plant species included within traditional diets (Mamo, 2020). At least 54.6 million metric tonnes of carbon (MtC), or 24 per cent of the total carbon contained in the world's tropical forest, is protected by indigenous peoples and communities (Rights and Resources Initiative, 2016). Notably, indigenous peoples are frequently among the first to experience the direct impacts of climate change, although they themselves make little contribution to greenhouse gas emissions (United Nations, 2008).

Over the last twenty years, the world has recognised that indigenous peoples require mechanisms and structures to accommodate their rights to improve the quality of their life. An example includes establishing the United Nations Permanent Forum on Indigenous Issues (UNPFII) in 2000, and the 2007 United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (World Bank, 2020). These are significant steps in ensuring the world is aware of the problems faced by indigenous peoples and have contributed to an essential aspect of the Sustainable Development Goals (SDGs), such as *leaving no one behind*. Attaining, for example, SDG 2 (zero hunger) and SDG 15 (life on land) are contingent on conserving traditional diets (United Nations, 2021). Food security and the acquisition of food resources represent a significant concern for many indigenous peoples. Recent data suggest that indigenous peoples account for 15 per cent of the poorest people globally (UNDP, 2019). Despite the richness of traditional knowledge of their food systems, which has been established over thousands of years (Johns *et al.*, 2013), indigenous peoples still face food shortages, poor diets, and, as a consequence, chronic diseases, such as obesity and diabetes (Egeland *et al.*, 2013).

Research has suggested that there have been massive dietary shifts across the globe in relation to diets. This phenomenon has been described as “*nutrition transition*” (Popkin, 2006), and refers to a shift away from traditional diets toward more westernised diets that are higher in sugar, salt, and saturated fats, and are more energy dense. In many regions of the world, increased consumption of the

latter has contributed to rising obesity and overweight rates (Popkin *et al.*, 2012). Despite indigenous peoples' awareness of the health benefits of traditional diets, traditional foods are rarely consumed due to locals' desire for the ease of modern cuisine (Ghosh-Jerath *et al.*, 2018; Kasimba *et al.*, 2018; O'Meara *et al.*, 2019). Furthermore, traditional foods are now perceived to be, for many indigenous peoples, "poor people's food", with most people having established a preference for processed carbohydrates and fatty foods, which may further compromise public health (Kuhnlein *et al.*, 2013; Sidiq *et al.*, 2021). Thus, a challenge in the field of promoting traditional foods for indigenous peoples is not only to ensure the availability of the foods for their daily consumption, but also to revitalise the awareness and knowledge of indigenous people about the health benefits, environmental benefits, and the sense of identity and belonging of their own traditional food sources.

This chapter aimed to establish, through the application of a systematic review, the extent to which traditional foods may have a role to play in food security and cultural and ecosystem preservation for indigenous peoples, and to identify barriers to, and facilitators of, their promotion and adoption.

2.2 Methods

To find relevant literature, a search method was created that was adapted to the search criteria of five databases: Scopus, ProQuest, Web of Science, EBSCOhost (CAB Abstracts), and Google Scholar. Table 2.1 presents the relevant keywords and keyword combinations considered for used in the searches. All searches included papers published between 2000 to 2020. All articles with a publication date before 2000 were excluded to ensure that the current state of the art in relation to the research question (within a timeframe of 20 years) was assessed. The year 2000 was considered as appropriate, as it coincides with the establishment of UNPFII. For pragmatic reasons, only articles published in English were included. The Appendix contains a complete list of the search phrases used to find each database.

Keywords	Synonyms
<i>Traditional diets</i>	Traditional food, indigenous food
<i>Indigenous Peoples</i>	Aboriginal
<i>Food security</i>	Food resilient*, food safety, food availability, food sufficiency, food insecurity

Table 2. 1: Keywords considered for the searches

Inclusion	Exclusion
<i>Empirical (qualitative and quantitative) study, published in a journal</i>	Conference abstracts or proceedings, review papers, letters to the editor, reports, news articles, dissertations
<i>English Language</i>	Language of publication other than English
<i>Articles from 2000 – 2020</i>	All articles before 2000
<i>Articles describing research conducted within Low- and Middle-Income Countries (LMICs) based on the list from World Bank (2019)</i>	Articles describing research conducted outside LMICs
<i>The study population are the Indigenous Peoples in LMICs</i>	The study population does not include indigenous peoples in LMICs
<i>The study focuses on traditional foods, at least mention one type of traditional food; plants or animals</i>	The focus of study is inclusively non-traditional foods
	Duplicate Study

Table 2. 2: Inclusion and Exclusion Criteria

This review was based on journal articles, (the “peer-reviewed” literature) and books, research reports, and conference papers (the “grey” literature) (Table 2.2). The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Statement served as the basis for the selection criteria (Moher *et al.*, 2009) and modified PICO framework for qualitative questions (Population: Indigenous peoples; Interest: traditional diets to promote food security; Context: Low- and Middle-Income Countries) (Murdoch University, 2021). The primary goal of the search was to map the existing literature on the traditional foods of the indigenous peoples in social, agricultural, biological, and environmental sciences. After duplicates were deleted, a total of 1,799 records were identified. The search focused on Low- and Middle-Income Countries (LMICs) using the World Bank definition of 2019. Thus, an article that focused on the role of traditional foods in the diets of indigenous peoples from countries that did not meet the definition for LMICs was excluded. The article titles and abstracts were screened to verify the academic literature was of sufficient quality

and relevance to be included in the subsequent stage of the review process. Following that, each research paper was subjected to a thorough evaluation. Following the initial screening of titles and abstracts, 1,664 articles were excluded, with 135 full-text articles reaching the full screening stage. After each of these 135 articles were assessed against the inclusion and exclusion criteria, 31 articles remained. Six additional records from the grey literature were identified through other sources by contacting key authors in the field and publications related to the review. A thematic analysis was done using NVivo R1 software to identify themes that highlighted the various dimension of indigenous people's food and food security. The Prisma diagram (Figure 1) summarises inclusion and exclusion criteria applied at every stage. The items selected for review are provided in Table 2.3.

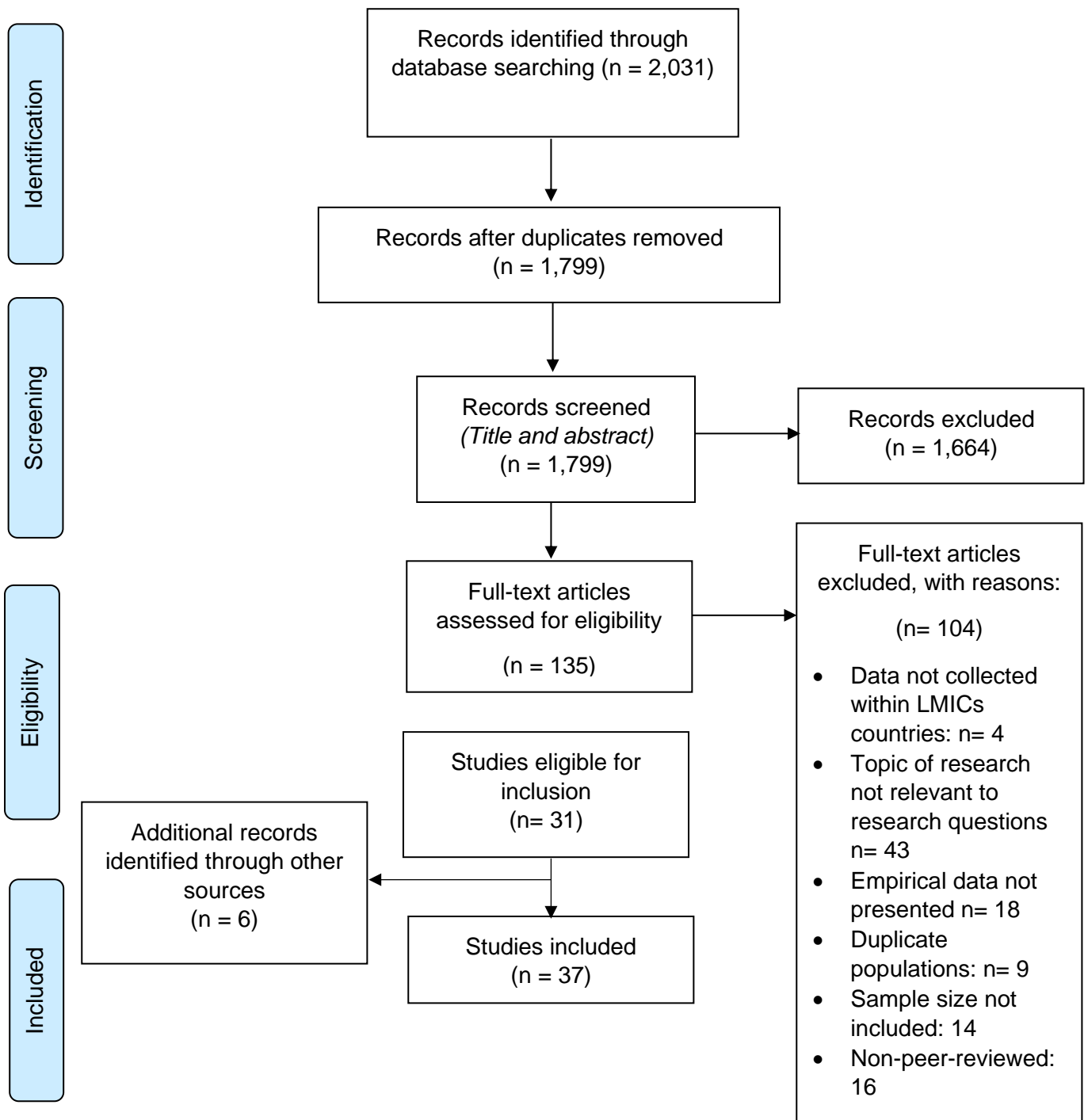


Figure 2.1: Prisma Diagram

Source	Number of Peer-Reviewed Articles
<i>Scopus</i>	5
<i>ProQuest</i>	9
<i>Web of Science</i>	5
<i>Google Scholar</i>	5
<i>CAB Abstract</i>	7
<i>Additional References (Books)</i>	6
<i>Total</i>	37

Table 2. 3: Number of papers included in the review by database searched

2.3 Results

Through thematic analysis, six overarching themes were identified following the in-depth assessment of the articles and materials included following the initial screening. The most frequently coded theme was *the promotion of traditional food resources*, with 62 per cent of articles (n = 23) exploring this subject. The *contribution of traditional food to food and nutrition security* was investigated in 57 per cent of articles (n = 21), while issues related to the *role of women in the indigenous peoples* were investigated in 35 per cent (n = 13) of the articles. The *role of traditional foods in preserving ecosystems and biodiversity* was studied in 35 per cent (n = 13) of articles, while articles focusing on issues related to the *use of traditional food as medicine* were studied in 30 per cent (n = 11) of articles. Lastly, 24 per cent (n = 9) of articles *investigated the role of traditional foods in preserving indigenous people's culture*. The articles included in each theme are summarised in Table 2.4. Table 2.5 summarises the studies that were included. Figure 2.2 illustrates the total number of the articles in the included studies by year of publication. Overall, it can be seen that the trend remained fairly constant. However, there is an increased number of articles in 2009 and 2018 in which the themes discussed were food security and the promotion of traditional foods.

Theme/Focus	Number of Articles
A. The promotion of traditional food resources	23
B. The contribution of traditional food in food and nutrition security	21
C. The role of women in the indigenous community	13
D. The role of traditional foods in preserving ecosystems and biodiversity	13
E. The use of traditional food as medicine	11
F. The role of traditional foods in preserving the culture of indigenous peoples	9

Table 2. 4: Results of thematic coding

No	Paper	Country	Sample Size	Method	Traditional Foods	Publication Type	Peer-Reviewed
1	Swanepoel <i>et al</i> (2020)	Kiribati	49	Structured interviews	Seaweed	Journal article	Yes
2	Ravera <i>et al</i> (2019)	India	330	Ethnographic; in-depth interview, survey	Millets, maize	Journal article	Yes
3	Mwema and Crewett (2019)	Kenya	201	Household survey	African Indigenous Vegetables (AIVs): spider plant, African nightshade, Cowpeas, vegetable Amaranth, Pumpkin leaves	Journal article	Yes
4	Gewa <i>et al</i> (2019)	Kenya	220	Longitudinal study	Sorghum, millet, cassava, Amaranthus leaves, spider-plant leaves, jute mallow, sweet potato leaves, cassava leaves, African nightshade leaves, cowpea.	Journal article	Yes
5	Duthie-Kannikkatt <i>et al</i> (2019)	India	38	Interviews, FGD, participatory field-research	Indigenous millets, pulses, oilseeds, and vegetable seeds	Journal article	Yes
6	Reyes-Garcia <i>et al</i> (2018)	Bolivia, Congo, Indonesia	405	Mixed method	Fruits and green leafy vegetables, legumes	Journal article	Yes
7	Paul <i>et al</i> (2018)	India	13	Survey	Dioscorea (Yam)	Journal article	Yes
8	Padhan <i>et al</i> (2018)	India	8	Minerals and heavy metals content analysis	Dioscorea (Yam)	Journal article	Yes

9	Meldrum <i>et al</i> (2018)	Bolivia	193	Mixed method; Household survey	Oca, papalisa, isano, bitter potatoes, wild relatives of quinoa and canahua	Journal article	Yes
10	Ghosh-Jerath <i>et al</i> (2018)	India	143	Household and dietary survey	Indigenous varieties of green leafy vegetables	Journal article	Yes
11	Rinya (2017)	India	180	Cross-sectional survey	Edible leafy, leafy vegetables, herbs, berries	Journal article	Yes
12	Moyo <i>et al</i> (2017)	Zimbabwe	10	In-depth interview	Wild vegetables; mushrooms, green leaves, pumpkin leaves and wild fruits such as uxakuxaku, umtshwankela, umviyo, umnyi, and marula fruit	Journal article	Yes
13	Longvah <i>et al</i> (2017)	India	1201	Community-based cross-sectional descriptive study; FGD, Food Insecurity Experience Scale	137 cereals and millets, 97 fruit and vegetable crops	Journal article	Yes
14	Chyne <i>et al</i> (2017)	India	1103	Community-based cross-sectional study	Job's tears (<i>Coix lacryma</i>), millets, sohphlang (<i>Flemingia vestita</i>), jalynniar, sohshang (<i>Eleagnus caudate</i>), tit syiar (<i>Clavvulina sp</i>), tit tyndong (<i>Gomphus floccus</i>)	Journal article	Yes
15	Vunyingah and Kaya (2016)	Cameroon	80	Participatory and case study	Sorghum	Journal article	Yes

16	Anankware <i>et al</i> (2016)	Ghana	2000	Interviews, FGD, participant observation	Palm weevil, termites, ground cricket, grasshopper, scarab beetle, field cricket, shea tree caterpillar, house cricket, locust	Journal article	Yes
17	Noack and Pouw (2015)	Kenya	215	Semi-structured interviews, household survey, FGD, community timeline	Ugali, sorghum, millet, cassava	Journal article	Yes
18	Nandal and Bhardwaj (2015)	India	205	Survey, interview	Aonla, Date palm, Sitaphal, Ber, Khirani, Jamun, Pilu, Ker, Kachri, Khejri pods, Phog, Bael, Tamarind	Journal article	Yes
19	Lyana and animbulu (2014)	Tanzania , Congo	5	Documentation analysis, in-depth interview, FGD	Fumbwayiyaka, Kikongo, lingala, young wild yam stems, wild amaranthus, fungus, mushrooms, cassava	Journal article	Yes
20	Singh <i>et al</i> (2013)	India	531	FGD, interview, “recipe contest”	55 plant species; 34 plant species as part of ethnomedicinal practices	Journal article	Yes
21	Singh <i>et al</i> (2012)	India	25	Interview, FGD	Onger, poi, dhenki saag, marsang, ongin, kalmu, rori	Journal article	Yes
22	Singh and Singh (2011)	India	260	Interview, FGD	Kair (<i>Capparis decidua</i>)	Journal article	Yes
23	Shava <i>et al</i> (2009)	Zimbabwe	6	Ethnography study; in-depth unstructured interviews	Maize, pumpkin, marrow, squash, Indian or Chinese mustard, Rape, Okra, Sweet cane, Sorghum, Calabash, sweet potato, pearl millet, Pigweed, cowpea, bamabara groundnut	Journal article	Yes
24	Shashidhar and	India	114	Participatory rural appraisal,	Finger millet	Journal article	Yes

25	Kumaraswamy (2009) Singh <i>et al</i> (2007)	India	140	personal observations Interviews, FGD	soybean, bamboo shoot, <i>lai patta</i> , tree bean, <i>rai</i>	Journal article	Yes
26	Narayanan and Kumar (2007)	India	366	Interviews	102 species of wild edible greens	Journal article	Yes
27	Finnis (2007)	India	104	ethnographic fieldwork; semi-structured interviews, participant observations	minor millets; samai, thenai, varagu, cambu, ragi	Journal article	Yes
28	Wane (2003)	Kenya	177	Interviews, questionnaire	millet vegetables and legumes such as cowpeas, pigeon peas, garden peas, kidney beans, white beans, and lentils	Journal article	Yes
29	Donn <i>et al</i> (2015)	Democratic Republic of Congo, Cameroon, Gabon	724	Questionnaire, interviews	wild green leafy vegetables, legumes, yam	Journal article	Yes
30	Ellena and Nongkynrih (2017)	India	228	ethnographic and ethnobotanical research tool; FGD, interviews	millets, pickled bamboo shoots, sohphie	Journal article	Yes

31	Finnis (2006)	India	54	semistructured interviews, dietary diversity focus groups, conceptual mapping exercises, one-day dietary recalls, mealtime observations, and participant-observation.	Tapioca, millets	Journal article	Yes
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Six Additional References

No	Author	Country	Title	Traditional Foods	Publication Type
1	Kuhnlein <i>et al</i> (2009)	Worldwide with specific case study from LMICs: India, Federated States of Micronesia, Nigeria, Kenya	Indigenous peoples' food systems: the many dimensions of culture, diversity and environment for nutrition and health	Giant swamp taro, banana, seeded breadfruit, yam cultivar, green leafy vegetables, nut, finger millet, barley, foxtail millet, sorghum, amaranth, Bambara groundnut, whistling thorn, yellow maize, African breadfruit	Book
2	UNPFII (2010)	Worldwide	State of the World's Indigenous Peoples	Local taro plant, fish, ringed seal and caribou (First Nations)	Book

3	Kuhnlein <i>et al</i> (2013)	Worldwide with specific case study from LMICs: India and Federated States of Micronesia	Indigenous Peoples' Food Systems & Well-being: Interventions & policies for healthy communities	Sorghum, chickpea, lentil, black gram, green leafy vegetables, banana, fish, breadfruit, giant swamp taro, coconut products	Book
4	Durst and Bayasgalanbat (2014)	Worldwide with specific case study from LMICs: Bhutan, Vietnam, Cambodia, Lao PDR, Indonesia, Philippines, India,	Promotion of underutilized indigenous food resources for food security and nutrition in Asia and the Pacific	Indian gooseberry, moringa oleifera, garlic, onion, soy bean, sago, <i>Esomus metallicus</i> , millets, fresh pomelo, <i>Garcinia indica</i>	Book
5	Erni (2015)	Asian countries with specific articles from LMICs: Bangladesh, Cambodia, India, Indonesia, Lao PDR,	Shifting Cultivation, Livelihood and Food Security	Fruit and cashew orchards, rubber gardens, various vegetables and herbs, ginger, turmeric, barley, fox tail millet, sorghum, yam, sesame	Book
6	Mamo (2020)	Worldwide	The Indigenous World 2020	Local crops, fish	Book

Table 2.5: List of included studies

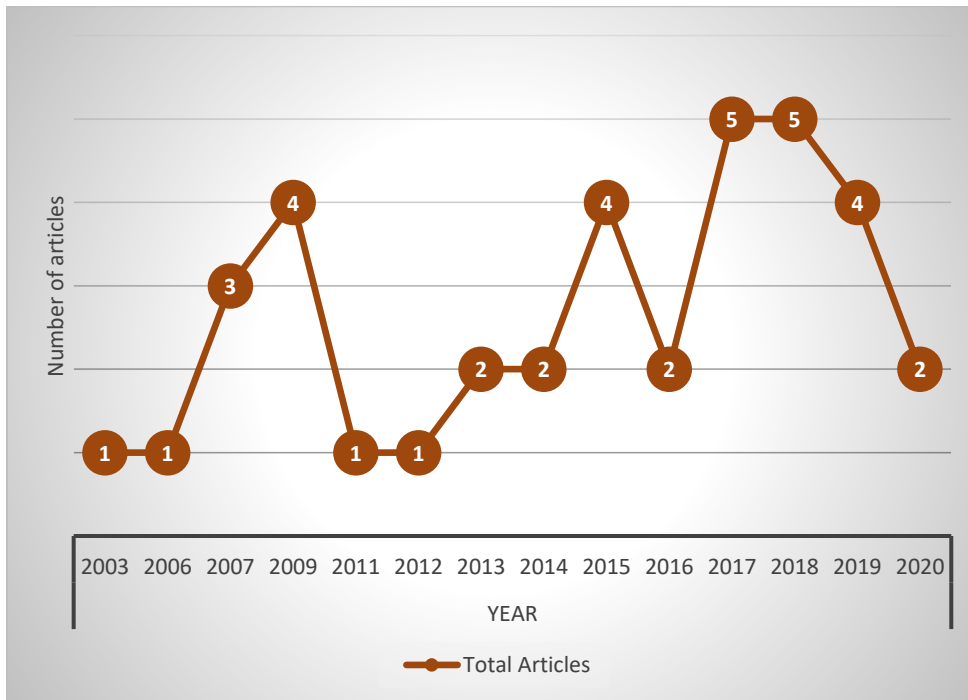


Figure 2.2: Total articles in the included studies by year of publication

2.3.1 The promotion of traditional food resources (n=23)

Most of the articles that included research falling within this theme emphasised the need to increase indigenous peoples' awareness, in particular in the case of younger people, about the types and variety of traditional food resources, food consumption patterns, and the importance of local food systems to the environment, and the inclusion of traditional foods in diets. Despite that indigenous peoples are well aware of the importance of traditional food resources, the consumption of these foods is low (FAO, 2017; Popkin *et al.*, 2012; Gewa *et al.*, 2019) and potentially regarded by the members of indigenous peoples as the 'food of poor people' (FAO, 2017; Ellena & Nongkynrih, 2017; Mwema & Crewett, 2019). There are many traditional food resources that are included in the communities' diets. Examples include green leafy vegetables in Africa and India (Popkin *et al.*, 2012; Mwema & Crewett, 2019; Shava *et al.*, 2009; Singh *et al.*, 2012; Singh *et al.*, 2007); Ugali (The "meat of Africa" is a term that is sometimes used) (Noack & Pouw, 2015); Yams or Wild Dioscorea (Padhan *et al.*, 2018; Pau *et al.*, 2018), Kair and minor millets in India (FAO, 2017; Rinya, 2017; Shashidhar & Kumaraswamy, 2009; Singh & Singh, 2011; Vunyingah & Kaya, 2016), edible insects in Ghana (Anankware *et al.*, 2016), and seaweeds throughout the Pacific region (Swanepoel *et al.*, 2020). However, there is evidence of a transition from a varied traditional based diet to a more limited number of foods (Ellena & Nongkynrih, 2017; Donn *et al.*, 2015), which has also negatively affected

the nutritional quality of diets of people with communicable diseases such as HIV/AIDS in Zimbabwe (Moyo *et al.*, 2017). It has been argued that traditional food-based knowledge must be safeguarded and maintained (Duthie-Kannikkatt *et al.*, 2019) by continuously educating younger members of the community regarding the importance of traditional food systems (Ellena & Nongkynrih, 2017; Kuhnlein *et al.*, 2009)]. This is mainly because indigenous people and their children may remain heavily dependent on forest resources and subsistence farming for their diet, with locally produced fruits, vegetables, and animal-sourced food comprising an important part of their diet (Reyes-Garcia *et al.*, 2018).

A common element that emerged from the analysis conducted within this theme was that traditional food resources were essential for indigenous peoples because they provided source of essential micronutrients. However, in spite of the fact that many traditional foods are nutrient-dense, people did not consume these foods, which subsequently led to inadequate nutrient intake. Consequently, the literature indicates that there is a need for the preservation and promotion of indigenous peoples' capacity to continue to consume their traditional foods and maintain traditional diets and their traditional food practices (UNPFII, 2010).

2.3.2 The contribution of traditional food in food and nutrition security (n=21)

This theme identified arguments relating to how traditional foods positively correlate with indigenous peoples' food and nutrition security. The articles indicate that, in the past, traditional foods have played an important role in dietary diversity and household food security (Shava *et al.*, 2009; Finnis, 2007; Longvah *et al.*, 2017; Singh *et al.*, 2013). Various traditional foods have been shown to contain essential micronutrients, such as calcium, missing from the diets of some people in the global south (Popkin *et al.*, 2012; Shava *et al.*, 2009; Singh *et al.*, 2012; Padhan *et al.*, 2018; Paul *et al.*, 2018; Vunyingah & Kaya, 2016; Longvah *et al.*, 2017; Nandal & Bhardwaj, 2015). Undernutrition in children and micronutrient deficiencies are two issues that have arisen among indigenous peoples despite the region's abundance of cultivated and wild food resources (Nandal & Bhardwaj, 2015; Chyne *et al.*, 2017). This suggests that the impacts on indigenous people's children eating habits should be carefully evaluated (Reyes-Garcia *et al.*, 2018). There is evidence that younger people are deprived of traditional foods and diets, and they increasingly depend on western processed foods (Kuhnlein *et al.*, 2009). Another problem is related to the

incidence of HIV/AIDS, which has threatened community-based resources by limiting the transmission to young generations of agricultural knowledge and food security practices. As community knowledge owners die of AIDS, their local knowledge and experiences are taken with them, thus eroding the foundation of sustainable food security for the community and the household (Lyana & Manimbulu, 2014). Whether the Covid-19 pandemic will have similar impacts remains a topic for future research.

Food security and the value of healthy nutrition lies in improving physical and emotional health (Noack & Pouw, 2015; Moyo *et al.*, 2017). Food security for indigenous peoples has been affected by various environmental changes such as contamination, degradation, climate change, urban growth, and modern agricultural practices (Finnis, 2007; Erni, 2015; Kuhnlein *et al.*, 2013; Meldrum *et al.*, 2018). Another important issue which has emerged from this literature is related to land rights. There is a strong connection between land rights and food security, where the displacement of indigenous peoples from their land of origin can disrupt household food security, and act as a barrier to attaining livelihoods and accessing resources (Mamo, 2020). Several studies have found that traditional food crops are especially resistant to harsh local conditions, which suggests that they play a critical role in ensuring food and nutrition security, especially during natural disasters (Gewa *et al.*, 2019; Shava *et al.*, 2009; Meldrum *et al.*, 2018). The continuation of indigenous people's traditional knowledge represents an important priority to ensure food and nutrition security.

2.3.3 The role of women in the indigenous community (n=13)

The importance of women within indigenous communities as potential promoters of traditional foods in diets emerged as an important theme in the analysis. Women are primarily responsible for passing on knowledge of wild edible plants and small crops, as well as their cultivation, use, preparation for food, and processing, to future generations (Ellena & Nongkynrih, 2017; Singh *et al.*, 2012; Singh *et al.*, 2013; Lyana & Manimbulu, 2014; Narayanan & Kumar, 2007; Ravera *et al.*, 2019). Women are also generally responsible for marketing the traditional food products which they produce, and for deciding what foods their children consume (FAO, 2017). Women may perceive that traditional foods are an important component of children's diets partly because traditional foods are perceived to be natural, with no chemical additives (Kuhnlein *et al.*, 2013). In many parts of the world, women have supported

the conservation and domestication of culturally important plant species used in food and medicine (Singh et al., 2007). However, despite their important role in cultivating the land, planting crops, harvesting, and preserving food, women, in general, have limited rights to land ownership in many communities (Vunyingah & Kaya, 2016), and do not “own” food since men control its production and distribution. Despite women having knowledge relevant to promoting food security (Wane, 2003), women were often not acknowledged or were undervalued in relation to attaining and maintaining food security and traditional food for diets (UNPFII, 2010; Kuhnlein *et al.*, 2013). Recognizing the importance of women's roles in food supply chains, as well as removing barriers and facilitating enablers to women's full economic participation, is critical to developing sustainable food systems and achieving food and nutrition security (Swanepoel *et al.*, 2020).

2.3.4 The role of traditional foods in preserving ecosystems and biodiversity (n=13)

The contributions of indigenous peoples to ecosystem management and sustainable development are increasingly understood and appreciated, particularly in relation to their knowledge about the natural environment and time-proven practices of hunting, gathering, fishing, pastoralism and agriculture (Erni, 2015). The dietary diversity and resilience of the ecosystem are enhanced by local wild foods (Gewa *et al.*, 2019; Paul *et al.*, 2018; Chyne *et al.*, 2017; Meldrum *et al.*, 2018). For example, Kair has the soil-binding capacity and can improve the soil fertility of sand dunes and reduce soil alkalinity, thus contributing to environmental sustainability (Singh & Singh, 2011). Climate change, on the other hand, is posing a serious threat to indigenous peoples, and there is a need to diversify the food base to a broader range of food crops to increase system resilience (Mamo, 2020; FAO, 2017; Shava *et al.*, 2009). At the same time, a large number of traditional and sustainable agricultural practices and food species are being lost as intensification and monoculture are introduced (Finnis, 2006). Deforestation of indigenous people's territories is tied to carbon dioxide emissions associated with the destruction of natural habitats (Mamo, 2020). Human generational changes are one of the most serious threats to local seed diversity. Young people as well as older generations must take responsibility for protecting and preserving their land rights and the local seeds they hold (Duthie-Kannikkatt *et al.*, 2019; Ravera *et al.*, 2019).

2.3.5 The use of traditional food as medicine (n=11)

Indigenous peoples recognise the nutritional value and health benefits that their traditional crops can provide (FAO, 2017; Padhan *et al.*, 2018; Paul *et al.*, 2018; Moyo *et al.*, 2017; Nandal & Bhardwaj, 2015; Narayanan & Kumar, 2007). However, traditional foods are being replaced by less healthy, processed foods in the diet (UNPFII, 2010; FAO, 2017; Singh *et al.*, 2007; Moyo *et al.*, 2017), driving increases in obesity (UNPFII, 2010), heart disease, stroke, diabetes, and other ailments (Singh *et al.*, 2007). Some traditional foods are still consumed in order to cure disease and improve health, such as leaves from *Banko* (*Solanum spirale*) that are used in curing malaria, balancing blood sugar, and high blood pressure (Singh *et al.*, 2012), cardiac and gastric illness (Paul *et al.*, 2018; Singh & Singh, 2011), and cosmetic medicine from flowers, such as the moringa tree (FAO, 2017). It is important to recognize that there are many aspects of traditional food as medicine which can be incorporated into modern healthcare (UNPFII, 2010). However, in some cases, reliance on traditional foods may result in nutritional deficiencies. For example, frequent consumption of traditional foods such as Pike Pila and Tap, a local version of sodium bicarbonate, may neutralise the nutrition and micronutrients of other food items because of their alkaline properties. Hence, overreliance on some traditional foods may also be problematic from a nutritional perspective (Rinya, 2017).

2.3.6 The role of traditional foods in preserving the culture of indigenous peoples (n=9)

Food has both practical and cultural functions. Food that affects people's growth and development, (and has nutritional value) may also contribute to socio-cultural activities, and spiritual life (Singh *et al.*, 2007; Rinya, 2017; Anankware *et al.*, 2016; Duthie-Kannikkatt *et al.*, 2019; Lyana & Manimbulu, 2014). The consumption of insects in Ghana (Anankware *et al.*, 2016), Ugali in Kenya (Noack & Pouw, 2015), and other traditional foods are not dependent on only taste and nutritional value (Anankware *et al.*, 2016), but also represent a foundation on which people's cultural identity and adaptive practices associated with traditional foods are built (Duthie-Kannikkatt *et al.*, 2019). Cultural diversity is a factor that has been identified as one of the primary drivers of traditional biodiversity (Singh *et al.*, 2013).

2.4 Discussion

This analysis provides a comprehensive, systematic review of the available literature on traditional diets and food security for indigenous peoples in LMICs. Thirty-seven studies were identified within the existing literature, and thematic analysis has led to identifying six major themes. The study found that traditional foods have a significant role in promoting and maintaining food security, and the cultural and environmental preservation of indigenous cultures. The review suggests there is a need to promote and preserve the knowledge held about traditional foods by indigenous peoples, within communities and beyond, and that this is becoming more urgent as knowledge and skills are decreasingly passed down through generations.

The issue of traditional food security for indigenous peoples is not only an issue for LMICs. Indigenous peoples in the United States and Australia, for example, may face similar food security issues as a result of the loss of traditional foods. Indigenous peoples of Australia have higher rates of food insecurity and diet-related disease than other Australians (Lee & Lewis, 2018), while in the United States they face chronic illnesses associated with inadequate nutrition, including obesity and diabetes (Banna & Bersamin, 2018). There is no single answer to the problem of food insecurity. It is important to promote traditional food species, not only for the cultural purposes but also because of their potential to contribute to maintaining food security and the balance of the ecosystem in indigenous peoples and the resources which they manage.

Climate change is major problem faced by indigenous peoples globally. One of the main concerns is the rapid loss of biodiversity around the world, which has negative impacts on human well-being (Howard & Pecl, 2019). Even though indigenous peoples are particularly vulnerable to climate change, indigenous communities lead the way in adapting to climate change through novel and traditional practices, such as the Climate-Ready Tribes Initiative in India (Schramm *et al.*, 2020). According to recent Australian research, collaboration between scientific and indigenous knowledge has aided in the development of adaptation pathways for indigenous peoples who are enslaved to their traditional lands and thus vulnerable to climate change (Hill *et al.*, 2020).

The relationship between food security and indigenous peoples can be understood through their way of living. This is reflected in the concept of cultural relativism, which holds that an individual's beliefs, virtues, and behaviours should be understood through the lens of that individual's culture and not through the lens of another (The Union of International Associations, 2017). Thus, non-indigenous peoples should be aware of the differences and the uniqueness of the culture and values; therefore, they can understand and appreciate more of the abundant knowledge of the indigenous peoples, curated by both men and women, and how this can be used to promote food security.

2.5 Conclusion

The continuity of traditional food practices is important for indigenous peoples in LMICs, and elsewhere. This is due to the role traditional diets have in maintaining and promoting food and nutrition security, preserving ecosystems and biodiversity, as medicine, and preserving culture of indigenous peoples. Women in indigenous people's community play a significant role in ensuring the transfer knowledge about the variety of traditional crops to the young generation, and this requires greater recognition. Greater cooperation between international agencies and indigenous peoples globally may be needed to develop effective policies to promote traditional foods for diets, due to the complexity of the associated issues, and impact pathways.

2.6 Future Research

While the analysis recognises the significance of traditional foods and food security for indigenous peoples. However, various themes emerged during the analysis, but were not included in the initial search terms, including those relating to biodiversity, gender analysis, and traditional food as medicine. These are topics that are interrelated with our research and are connected to the SDGs on biodiversity and gender, but were not systematically addressed in this review, representing a limitation of the research. There is therefore an opportunity for future research to be conducted in these areas specifically, which would deliver evidence for policymakers and communities to develop comprehensive policies and impact pathways regarding the role of traditional foods across multiple targets, including gender equality and conservation of biodiversity. Further, there is infrequent comparison between indigenous people in LMICs and developed countries with respect to traditional diets. A greater understanding of the role of traditional diets in general, and the contribution

these make to the SDGs will improve scholars and policy makers' understanding of the importance of the role of traditional diets globally.

2.7 Limitations of Study

There are limitations to this review. *First*, the search only returned items from English-language databases. Although the indigenous people represent less than 6 per cent of the global population, they speak over 4,000 languages (United Nations, 2019). Research published in languages other than English has been excluded from this study for pragmatic reasons, but the authors recognise that the English language is not the only available source of information. *Second*, studies on the subject are extensive, but the report was limited to 20 years to ensure the relevance of the results to current issues in food security was addressed. Extending the timeframe might reveal more relevant information, for example about how traditional diets which have now disappeared have contributed to biodiversity, food security and culture.

Chapter 3. Sago and the Indigenous Peoples of Papua, Indonesia: A Review

3.1 Introduction

The Food and Agriculture Organization (FAO) of the United Nations estimates that the number of people affected by undernourishment has increased from around 804 million in 2016 to nearly 821 million in 2017 (Food and Agriculture Organization, 2018). Moreover, recent findings from the Intergovernmental Panel on Climate Change (IPCC) of the United Nations regarding the average global temperature have identified that for each 1 degree of temperature increase, grain yields decline by about 5 percent. Maize, wheat, and other major crops have experienced significant yield reductions at the global level of 40 megatons per year between 1981 and 2002 due to a warmer climate (Intergovernmental Panel on Climate Change, 2018). Hence, global food production needs to increase by at least 50 percent to feed 9.5 billion people in 2050 (Gardner, 2013). Therefore, innovative research regarding food security will be essential to offer innovative solutions to address this challenge.

3.2 Indigenous Peoples and Food Security

A significant concern with the food security issue is that of indigenous peoples and their food resources. According to Kuhnlein *et al.*, (2009), indigenous peoples are defined as those who retain the knowledge of the land and food resources rooted in historical continuity within their region of residence. In the context of this study, *Orang Asli Papua* is a term that has the same meaning as indigenous peoples according to the law of the Republic of Indonesia on Special Autonomy for the Papua Province (No. 21 of 2001). Many indigenous peoples are changing from traditional locally sourced foods to imported foods. The traditional knowledge of indigenous peoples' food systems has been recognised for thousands of years, not only for its physical and spiritual aspects but also for its balanced relationship with the natural environment, including healing and protection from disease (Johns *et al.*, 2013). However, despite the richness of traditional knowledge of healthy eating and living in rural communities, the 370 million indigenous peoples globally are still very vulnerable to food insecurity, unhealthy diets, and prolonged illnesses (Egeland and Harrison, 2013). Recent data suggest that although indigenous peoples make up

approximately 5 percent of the world's population, they account for 15 percent of the poorest (United Nations Development Programme, 2019).

Research suggests that there have been massive dietary shifts across the globe. This *nutrition transition* phenomenon (Popkin, 2006) from the use of traditional diets toward the consumption of westernised diets, which are more energy-dense, with high contents of sugar, salt, and saturated fats, contributes to the observed increase in the rates of obesity and overweight in many parts of the world (Popkin *et al.*, 2012). More recent evidence shows that despite the awareness of the community about the health benefits of indigenous food resources, the consumption of these foods is low due to local people's preferences for the convenience of modern foods (Ghosh-Jerath *et al.*, 2018; O'Meara *et al.*, 2019). Furthermore, a threat to traditional food's existence is identified in research in South Africa, where the people have labelled their traditional food crop as "poor people's food" with negative connotations (Cloete and Idsardi, 2013). Thus, a challenge in the field of promoting traditional foods for indigenous peoples is not only to ensure the availability of foods for their daily consumption but also to raise the awareness and knowledge of the people about the health benefits, environmental benefits, and sense of identity and belonging of their own traditional indigenous food sources.

Traditional foods are the cultural products of indigenous peoples passed down from previous generations. A growing body of literature has examined culture as an essential aspect in food security analysis, specifically through indigenous peoples' perspective (Kuhnlein *et al.*, 2009; Demi, 2016; Huambachano, 2018). Food security is not just about the agricultural practices to produce sufficient food for the world (Huambachano, 2018) and the indigenous ways of thinking about the relations and connections between people and their natural environment (Ratima *et al.*, 2019). Furthermore, concerning passing on traditional knowledge and values about traditional foods, culture, and identity, several studies found that elders and community members played a crucial role for young generations (Demi, 2016; Islam *et al.*, 2016). Hence, the core problem of food security for indigenous peoples is preserving their cultural values and identity to ensure availability and sustainability for the next generations.

The cultural values of indigenous peoples are closely connected with the cultural values from outside the community, and industrial products are one of the challenges that need to be addressed carefully. The research on indigenous peoples has raised some concerns about the emergence of industrial food products that replaced traditional food consumption and production (Egeland and Harrison, 2013; Kuhnlein *et al.*, 2013). Research on underutilised crops shows that only about 30 crops provide 95% of human food energy needs, four of which (rice, wheat, maize, and potato) are responsible for more than 60% of our energy consumption globally (Konuma, 2018). However, despite the emergence of public health issues among indigenous children because of the decline in the consumption of their traditional foods and their unhealthy diets (Seto and Associates, 2006; Popkin *et al.*, 2012), Lemke and Delormier (2017) suggest that there is a need to bridge indigenous and western approaches to mitigating this phenomenon to develop a comprehensive understanding of indigenous peoples' food systems, while at the same time equally valuing both knowledge systems. Therefore, despite the influx of industrial food products to the indigenous community from the global market, a better understanding of the western food system is essential to ensure food security, adequate food resources, nutrients, and nutritional implications are to be ensured worldwide.

In the literature, many studies suggest that women use indigenous knowledge to a greater extent than men in achieving household food security (Kuhnlein, 2017; Lemke and Delormier, 2017; Aluko, 2018). However, despite their significant contributions to household food security, indigenous women in many countries face discrimination regarding their gender and ethnicity (Food and Agriculture Organization, 2015). This continuing gender-based discrimination negatively impacts indigenous women's health, nutritional status, and the overall well-being of households and communities (Lemke and Delormier, 2017). In nearly two-thirds of countries, women are more likely than men to report food insecurity, and 330 million women and girls live in poverty (United Nations Women, 2018). Recent data suggest that, globally, the prevalence of food insecurity is higher among women than men, 25.4 percent and 24.0 percent, respectively (Food Agriculture Organization, 2019). Therefore, promoting indigenous women's empowerment is fundamental to preserve the indigenous knowledge of food security in society and contribute to achieving goal number five in SDGs, which is gender equality and empowerment of all women and girls (United Nations Women, 2018).

Overall, this section has provided a substantive discussion regarding food security for indigenous peoples: from traditional foods and rich indigenous food culture to the emergence of external factors such as industrial products that bring different values to local food resources' traditional knowledge. The international community now recognizes that special measures are required to protect indigenous peoples' rights and maintain their distinct cultures and way of life (United Nations, 2019). Therefore, research on indigenous peoples should address elements of the local food system and demonstrate how these local foods contribute to food security, nutrition, health, and local culture (Kuhnlein *et al.*, 2009).

3.3 Indonesia Context

Tanah Papua (Land of Papua) has enormous potential. It consists of two Indonesian provinces: Papua and West Papua. The two provinces contain half of Indonesia's total biodiversity, particularly its endemic flora and fauna (Marshall and Beehler, 2007), and the cultural diversity of Tanah Papua comprises at least 250 indigenous ethnic groups, each with their language or distinctive dialect, and their traditional ecological knowledge (Indrawan *et al.*, 2019). However, according to the Food Security and Vulnerability Atlas (FSVA) published by the Food Security Agency of the Ministry of Agriculture of the Republic of Indonesia (2018), some areas of Indonesia, despite its rich area of biodiversity and cultural diversity, in particular, Papua and West Papua provinces, need more attention in terms of food security. Unfortunately, sago (*Metroxylon sagu* Rottb.), as one of the traditional crops, is still poorly evaluated as a food resource by the government. As pointed out in the FSVA 2018, there was no statistical data on sago production and consumption. The report only shows data regarding the production of rice, maize, cassava, and sweet potato. These crops were selected because they provide almost 50 percent of the daily calorie intake in the average Indonesian diet (WFP, 2015). Hence, sago is still not considered as a potential crop to promote local food security.

Another factor that contributes to food security in Indonesia relates to the rice policy. Rice is a staple food and Indonesia's single most valuable commodity (McCulloch and Peter Timmer, 2008). Since the early 1970s, Indonesia's government has focused on rice-centred policy (McCulloch and Peter Timmer, 2008). A recent study shows that wheat imports have been increasing over the past two decades (Booth *et*

al., 2019). Furthermore, Pingali (2007) suggests that Indonesia experienced the westernisation of Asian diets: the slowing of per capita consumption of rice and the increased per capita consumption of wheat-based products. Rice availability is crucial for Indonesian people because the poor still spend about 26% of their expenditure on rice and 65% on all foods, tobacco, and beverages (Booth *et al.*, 2019). According to Statistics Indonesia (2019a), about 26 million people live below Indonesia’s poverty line. A person is considered poor when the expenditure per capita per month is below the poverty line. The poverty line of West Papua is equal to 516,362 IDR (Indonesian rupiah) or approximately 36 USD. Although Indonesia is considered the leading producer of paddy rice, as number three producers in the world after China and India, Indonesia must import rice each year to fulfil national consumption. In 2018, the value of rice imports to Indonesia was approximately 1.037 billion USD (Statistics Indonesia, 2019b) or ranked third with 38 million metric tons of rice consumption worldwide (United States Department of Agriculture, 2019a). Also, wheat flour consumption keeps increasing each year (Table 3.1), with an average growth of 25.3% within the period of 2014–2018 (OECD, 2019). Indonesia cannot produce wheat and is entirely dependent on wheat imports to fulfil the demand for wheat flour-based food and wheat products, with total wheat imports of 10.5 million tons in 2018 (United States Department of Agriculture, 2019b) or rank second in the world with approximately 2.57 billion USD in 2018 (Statistics Indonesia, 2019c; United States Department of Agriculture, 2019b).

Food Item	Year				
	2014	2015	2016	2017	2018
Wheat (kg/capita/year)	24.72	24.94	25.66	25.98	25.37
Rice (kg/capita/year)	134.36	134.83	133.82	133.10	134.58

Table 3.1: Consumption per capita of wheat and rice in Indonesia
Source: Organisation for Economic Co-operation and Development (2019)

These data suggest that Indonesian people’s food consumption is very much dominated by rice, a staple food, and the increasing consumption of wheat, which is

highly dependent on imports. Booth *et al.* (2019) argued that Indonesia's food security problems centre around rice policy and a broader food availability issue, which leads to greater reliance on food imports. At present, the potential of local food resources such as sago is neglected regarding food security. It may be particularly relevant for the people in the eastern part of Indonesia, especially in Papua.

3.4 Sago, the Underutilised Indigenous Food Resource

“Underutilised” is commonly applied to refer to resources whose potential has not been fully realised. Indigenous food synonymous with used signifies food naturally existing, originating, or prepared in a place or country rather than arriving from another area (Food and Agriculture Organization, 2014). Many underutilised crops were once more widely grown but today face many social, economic, environmental, agronomic, and policy challenges (Padulosi *et al.*, 2013). Despite all of the challenges and the current state of food insecurity worldwide, sago palm was identified as one of the most promising underutilised food resources with a high potential for contributing to global food security (Konuma, 2018).

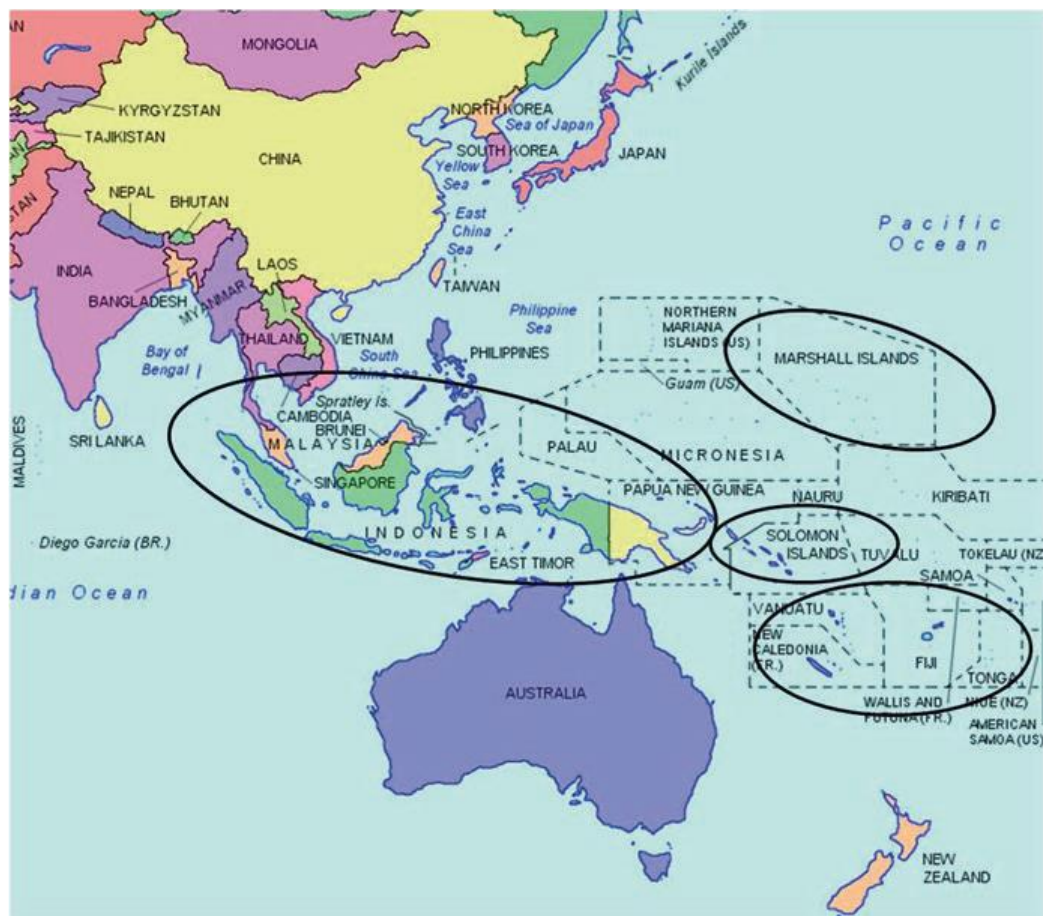


Figure 3.1: Map of sago palm-growing countries (Black circle countries)
Source : Konuma (2018)

Flach *et al.* (1997) suggested that the word *sago* is originally Javanese and means starch-containing palm pith. The scientific name is *metra* meaning pith or parenchyma and *xylon* meaning xylem (Singhal *et al.*, 2008). Sago palm (Figure 3.2) is a species of the genus *Metroxylon* belonging to the *Arecaceae* family and is a socioeconomically important crop in Southeast Asia (Flach *et al.*, 1997). Figure 3.1 shows that sago palm is grown between latitude 10° north and 10° south in Southeast Asia and Pacific Island countries (Konuma, 2018), and it includes most of Indonesia Malaysia, southern Philippines, southern Thailand, Papua New Guinea, Solomon Islands, Vanuatu, Fiji, and Samoa (Toyoda, 2018).

According to Konuma (2018), Indonesia has the largest sago palm-growing areas, with approximately 1.128 million ha of sago palm or 51.3% of 2.291 million ha of sago worldwide. About 90% of sago is estimated to be in Papua and Maluku (Flach *et al.*, 1997). However, a previous study suggested that in the Papua area alone, sago occupies 2.8 million ha, and 369,382 ha in West Papua. It is estimated that the potential of sago production in the provinces of Papua and West Papua is around 12.7 million tons of starch dry every year. Still, only about 0.34% is used, and an estimated 6 million tons of dried starch is wasted because it was not harvested every year (Djoefrie *et al.*, 2013). In the context of Papua, sago is a multi-purpose crop used by indigenous peoples in Papua's coastal and lowland areas as the primary carbohydrate source consumed and processed for generations. (Hasibuan *et al.*, 2018; Ondikeleuw *et al.*, 2020). However, the analysis of community acceptance of rice and sago commodities reveals that rice has become the community's staple food, with sago serving as a food interlude. The findings indicate that rice is more accessible due to the subsidy program. In contrast, sago is more challenging to obtain due to a declining sago tree population and can only be harvested at certain times (Hasibuan *et al.*, 2018).



a



b



c

Figure 3.2: (a) Sago palm trees on the bank of a river (b) Sago palm trees that flourish; (c) Wet sago flour wrapped in pandan leaves
Source: IndiTheater (no date), Ambarsari (2013)

The Ministry of Agriculture/Government of Indonesia (2018) reported that sago starch consumption was 0.36 kg/capita/year or -0.12% of average growth from 2014 to 2018 (Table 3.2). It is hypothesized that sago production in the eastern part of Indonesia could empower the acceleration policy on diversifying food consumption based on local sources as mandated in Presidential Decree No. 22 Year of 2009. The regulation is one of the policies to promote food diversification consumption of local food such as cassava, corn, sorghum, and sago. In addition, the current food policy in Indonesia is Laws of the Republic Indonesia No. 18 of 2012 concerning food. Specific policy on Papua is Government Regulation No. 65 of 2011 concerning the Acceleration of the Development of the Provinces of Papua and West Papua. By

having local raw material as a basis, Indonesia’s food security could become more resilient against supply disruptions caused by natural disasters in the form of crop failure due to climate change, war impact, etc. (Hariyanto *et al.*, 2013). Several studies have found that indigenous food crops are exceptionally resilient to adverse local environments, highlighting their role in ensuring food and nutrition security, particularly during and after the occurrence of a natural disaster (Mavhura *et al.*, 2013; Sambo, 2014). In the context of climate change, recent research suggests that the impact of greenhouse gas (GHG) emissions generated to produce 1 ton of sago (17.9 kgCO₂eq) is much lower compared with corn starch (2700 kgCO₂eq), potato starch (2402 kgCO₂eq), and cassava starch (4310 kgCO₂eq) (Yusuf *et al.*, 2019). Moreover, Bintoro *et al.*, (2018) argued that there are two roles for sago production to environmental improvements: water conservation and the absorptions of CO₂. Sago palms can conserve soil water because the plants require high soil humidity and compared with other major crops such as corn and rice, sago palms have the highest CO₂ absorption (Bintoro *et al.*, 2018). However, despite sago’s multiple uses and benefits, the sago palm national program is not supported by adequate funding, resulting in sago resources being neglected as one of Indonesia’s potential crops (Winarno and Hariadi, 2017).

Food Item	Year					Average Growth
	2014	2015	2016	2017	2018	
Sago Flour (kg/capita/year)	0.388	0.469	0.417	0.334	0.366	-0.12

Table 3.2: Average per capita consumption of sago flour
Source: Ministry of Agriculture/Government of Indonesia (2018)

It is also important to note that the use of sago palms is very diverse. It represents an important food source and can be used for various purposes such as thatching and to make industrial products, including bioethanol (Figure 2) (Bintoro, 2011; Flach *et al.*, 1997; Konuma, 2018; Toyoda, 2018). Palms are primarily used as building materials. The leaves are used for thatching, brushes, and baskets; the petioles and rachises are used to construct fences, toys, and walls; and the bark is occasionally used as the flooring material. (Toyoda, 2018). Sago can produce dry starch at 20 tons per ha, more than the starch provided by rice or corn, 6 tons and 5 tons per ha,

respectively. In addition, waste streams can support the circular bioeconomy. The residue of sago palms has been made to produce several products such as fermentable sugar, enzyme, compost for mushroom, animal feed, and adsorbent. The utilisation of sago residue reduces the polluting effects of by-products from the sago processing industries and provides economic value (Awg-Adeni *et al.*, 2010).

However, there are some drawbacks to the use of sago as a staple food. First, it lacks nutritional value, other than carbohydrates, particularly protein (Table 3.3). Second, the sago crop needs an initial eight years of unproductive time to get starch after the first planting if planted from seed (Flach *et al.*, 1997; Toyoda, 2018). Fortunately, Maluku, Papua, and South Sulawesi people eat fish as part of their diets, so they are not protein deficient (Bintoro *et al.*, 2010). Furthermore, although the high yield level of sago can only be obtained after eight years, sago is considered a perennial crop, which means it can produce for many years once planted, compared with other crops that need to be replanted regularly (Flach *et al.*, 1997).

Nutrient	Maize	Rice	Wheat	Potato	Cassava	Sago
Water (mL)	10.83	11.89	12.42	6.52	59.68	12.8
Calories	364	366	332	357	160	349
Protein (g)	8.75	5.95	9.61	6.90	1.36	0.6
Carbohydrate (g)	73.89	80.13	74.48	83.10	38.06	86.3
Fat (g)	5.09	1.42	1.95	0.34	0.28	0.2

Table 3.3: Nutritional value per 100 g of an edible portion
Source: Institute of Nutrition, Mahidol University (2014) and USDA (2018)

There is considerable literature that suggests sago is one of the traditional indigenous staple food sources (Flach *et al.*, 1997; Girsang, 2017; Bintoro *et al.*, 2018). As one of the oldest crops, the sago palm is not only a food source but is also related to many aspects of livelihood in sago-growing areas, such as rituals, feasting, and many other cultural activities (Toyoda, 2018). Unfortunately, although Indonesia has the largest sago palm-growing areas worldwide (Konuma, 2018), Human Rights Papua and van de Pas (2018) have indicated that the conversion of forest into palm oil plantations has led to the destruction of sago forests and hunting grounds.

Furthermore, indigenous communities are forced to change their food habits and depend on commercial food products such as rice and instant noodles (Human Rights Papua and van de Pas, 2018). This phenomenon clearly shows how human and natural capital disruptions significantly influence the traditional food systems of indigenous peoples (Torres-Vitolas *et al.*, 2019). Moreover, a challenging area in food security in Indonesia is the lack of awareness from the stakeholders regarding the local traditions that exist within the communities. Thus, it is time for locally driven initiatives that will involve all stakeholders to bring benefits to the local health, social, cultural, and economic development of the indigenous peoples of Papua to utilise the abundance of the cultural diversity of Tanah Papua (Indrawan *et al.*, 2019). Overall, this section has provided a sufficient understanding of sago and its potential, not only for the livelihood of indigenous peoples but also for ensuring the sustainability of the underutilised food resources worldwide.

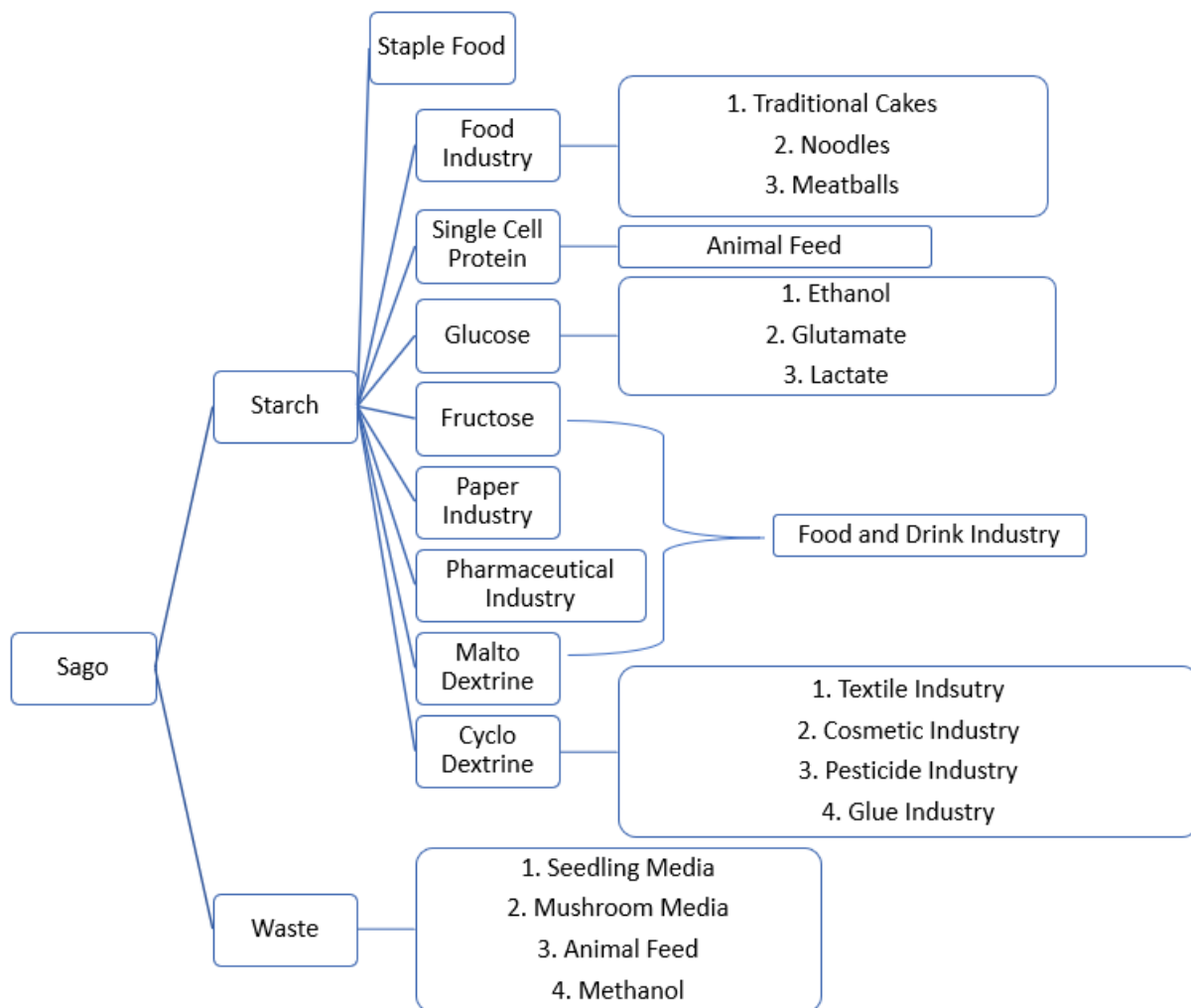


Figure 3.3: Sago utilisation
Source: Bintoro (2011)

3.5 Future of Sago

Despite sago palm's enormous potential, little has been accomplished in cultivation, processing, and marketing (Jong, 2018). In the context of sago consumption in Papua, the local and national government, academicians, and private sectors need to work together to promote awareness about the importance of sago consumption as a staple food. The global pandemic teaches us that we can not only depend on relatively small numbers of crops for our food security. Data show that only about 30 crops currently provide 95 percent of human food energy needs, with four of them (rice, wheat, maize, and potato) accounting for more than 60 percent of our energy intake (Food and Agriculture Organization, 1995). Hence, sago as one of the underutilised crops can be an alternative solution. Recent research shows that sago can be processed into analog rice (a mixture of sago starch and brown rice flour) with good nutritional value and used as a staple food to complement rice (Hariyanto *et al.*, 2020). The development and application of agri-food technologies to achieve 'sustainable intensification' of agri-food production has the potential to improve local and national food security. (Frewer, 2017). Another research in China shows that introducing agricultural modernisation policies will enhance food security while simultaneously promoting environmental protection (Clark, *et al.*, 2018). Thus, the research and development of sago are considered essential for the indigenous peoples of Papua and the possibility of introducing sago to the world.

3.6 Conclusion

This chapter has reviewed the concept of local food security and indigenous peoples and the importance of sago as one of the traditional foods for Papua, Indonesia. However, to realize sago's full potential, the research agenda must devote significantly more time and resources to better understanding the crop. Furthermore, there is an urgent need to shift perceptions of sago away from traditional, poor people's food connotations toward accepting how its benefits and the associated knowledge can be critical to the local food system's resilience.

Chapter 4. Factors influencing consumption of traditional diets: Stakeholder views regarding sago consumption among the indigenous peoples of West Papua

4.1 Introduction

Food insecurity remains a global problem, with 690 million people being malnourished even before COVID-19 disrupted supply chains (FAO, 201). The current global crisis in the supply of wheat due to the conflict in Ukraine (FAO, 2022), shows just how fragile food security can be and points to the importance of a reliable and resilient local food source that is independent of circumstances elsewhere. A significant concern relates to food insecurity in indigenous populations, where indigenous people are defined as those who retain the knowledge of the land and associated food resources (Kuhnlein *et al.*, 2019). Indigenous peoples comprise approximately 5% of the world's population, at the same time accounting for 15% of the poorest people on earth (UNDP, 2019). Food insecurity in these groups is exacerbated by the "nutrition transition" (Popkin, 2006) from the use of traditional diets relying on local resourcing to the consumption of westernised diets, which are less healthy and more energy-dense, with high contents of sugar, salt, and saturated fats (Popkin *et al.*, 2012). The consumption of these foods is increasing due to indigenous people's preferences for the convenience of modern foods (Ghosh-Jerath *et al.*, 2018); O'Meara *et al.*, 2019). In addition, reliance on imported foods increases the vulnerability of local supply chains to system shocks caused by climate change or geopolitical turbulence (Sidiq *et al.*, 2022). Traditional diets may also be repositories of cultural knowledge or form the basis of biodiverse, local ecological systems (Sidiq *et al.*, 2022). This suggests that increased reliance on local, traditional food production systems will be associated with multiple health and environmental advantages concerning the promotion of food security. Consequently, it is important to understand the barriers to, and facilitators of, the consumption of traditional diets by indigenous peoples.

Stakeholders with interests in food security (e.g., policymakers, educators and extension specialists, members of civil society groups, and those within the food industry) play an important role in shaping access to healthy and sustainable diets (Godrich *et al.*, 2022). Hence, stakeholders' views on what constitutes healthy

practices and the role of traditional foods in promoting food security are important, as they will shape food availability and hence consumers' food choices in the supply chain (Godrich *et al.*, 2022). Stakeholders' perspectives are important as one of the approaches applied to the development of community empowerment where stakeholders have different roles and responsibilities (Bintoro *et al.*, 2016). This research aims to assess the views of different, potentially influential stakeholders on the adoption or otherwise of traditional food, sago, in the diets of the indigenous people in West Papua. A case study approach was adopted, which provides information about the potential factors that motivate local consumers to adopt sago in their diets. The case study approach adopted also enables the identification of other facilitators and barriers to improved local food security. The results will contribute to improved food security policies in the region.

The research was conducted in Tanah Papua (Land of Papua), which comprises two Indonesian provinces: Papua and West Papua. Both provinces account for more than half of Indonesia's total biodiversity, particularly endemic flora and fauna (Marshall & Beehler, 2007). Tanah Papua's cultural diversity comprises at least 250 indigenous ethnic groups, each with its own language and rich traditional ecological knowledge (Indrawan *et al.*, 2019). The Food Security and Vulnerability Atlas (FSVA), published by the Food Security Agency of the Ministry of Agriculture of the Republic of Indonesia (Ministry of Agriculture, 2018) indicates that some regions of Indonesia are food insecure, including the Papua and West Papua provinces, despite the availability of traditional foods to local peoples. This is partly because of increased local adoption of, and reliance on, imported foods such as rice (Sidiq *et al.*, 2021). Sago, a traditionally produced local food (*Metroxylon sagu* Rottb.), has the potential to reduce reliance on imported grains such as rice within local communities, improve the sustainability of locally produced foods, and contribute to the preservation of local ecosystems and the ecosystem services which they deliver (Sidiq *et al.*, 2021). The sago palm (*Metroxylon sagu* Rottb) is found in the tropical lowland forest and freshwater wetlands across Southeast Asia and New Guinea. It is one of the oldest crops and was the staple food in those areas. It is the primary source of sago, which is the food derived from it. In general, sago is a food derived from sago palm, which is the plant which can be described as the originating crop (Singhal *et al.*, 2008; Toyoda, 2018). Indonesia has the world's largest sago palm plantations, with around 1.1 million hectares (ha) of sago palm, or 51.3% of the global total of about 32 million

ha (Konuma, 2018). Around 90% of Indonesian sago is grown in Papua and Maluku (Flach, 1997). Official data (Ministry of Agriculture, 2020) shows that there is 5.4 million ha of Indonesian sago forests, with more than 95% in the Papua region. Sago production capacity in the provinces of Papua and West Papua is projected to be over 13 million tonnes of dried starch per year. Sago starch yield per unit area is potentially about 3 to 4 times higher than that of rice, corn, or wheat, and about 17 times higher than that of cassava (Karim *et al.*, 2008). However, only less than half a percent is utilised, and an estimated 6 million tonnes of dried starch is not used in diets due to inadequate harvesting (Djoefrie *et al.*, 2013). Due to the sago distribution chain's inefficiency and lack of market awareness, sago farmers have a poor bargaining position (Trisia *et al.*, 2021). At the same time, smallholder farmers are gradually shifting from sago production to oil palm plantations that attract higher returns (Awang *et al.*, 2021).

Sago consumption by local consumers is very low in comparison to other commodities. Sago is consumed at a rate of 0.36 kg per capita per year. In comparison rice is consumed at a rate of 97.1 kg per capita per year, and wheat is consumed at a rate of 18.2 kg per capita per year (Ministry of Agriculture, 2018). Only 1.8% of Indonesians consume sago. Sago is less popular than cassava (19.6%) and wheat flour (30.2%) (Damayanthi, 2020). Food diversification is considered an appropriate approach to ensure national food security. Artificial¹ rice production using local natural resources may help to provide food security, using sago as one of the main ingredients.

Research into local production has focused on the attitudes and priorities of farmers who directly produce sago, which indicated that diversification of sago products within this supply chain has beneficial economic consequences for primary producers (Pramana *et al.*, 2021). There is a research gap regarding the opinions of other supply chain actors and interested stakeholders in West Papua. Hence, the aims of the research were to investigate the various factors perceived by a selected number of stakeholders that influence sago consumption among the indigenous peoples of West Papua. This research aims to assess the views of different, potentially influential stakeholders on the adoption or otherwise of traditional food, sago, in the

¹ Artificial rice is non-paddy rice that looks like rice and is made from high-carbohydrate local resources such as potatoes, cassava, corn, and sago.

diets of the indigenous people in West Papua, as these stakeholders will directly shape the sago supply chain (see also, *inter alia* (Neef *et al.*, 2011). While the authors recognise that broader community members not involved in the sago food chain other than via consumption of products are an important stakeholder at the end of the value chain, and as a driver of demand, this is beyond the scope of the present study and will be investigated in future research using survey methodology. The views of stakeholders were solicited regarding:

- What are the factors that motivate the indigenous peoples of West Papua to produce and/or consume sago?
- Are strategies needed to increase Papuans' sago consumption? If yes, what form might these take?
- What are the barriers to producing and consuming sago?
- What are the stakeholders understandings of sago eating culture?
- What are the implications for future sago policies regarding sago production and consumption in West Papua?

4.2 Methods

4.2.1 Study Design

A qualitative approach was applied to understanding the factors influencing sago consumption among the indigenous peoples of West Papua from the perspective of various stakeholders: politicians, local and national civil servants, academics, sago farmers, and food activists. The perspectives of consumers will be evaluated in a separate study in relation to stakeholder views (Chapter 5).

Semi-structured interviews were used to investigate stakeholder's perspectives on sago production and consumption behaviour among indigenous peoples of West Papua. This will provide an in-depth understanding of the viewpoints, experiences, and practises of important stakeholders regarding definition and identification of research gaps. Examining the perspectives of various key stakeholders will ensure that the issue is not viewed through a single lens (Yin, 2009). The consolidated criteria for reporting qualitative research (COREQ) checklist for interviews was used to guide reporting (Tong *et al.*, 2007). This study adopted the Global Code of Conduct for Research in Resource-Poor Settings from the four TRUST values: *fairness, respect, care, and honesty* (Trust Project, 2018). These four values were the foundation throughout this research process.

The lead author contacted several gatekeepers² who assisted the author at the case study site. The role of the gatekeeper was to access the appropriate key informants. The research questions were provided to gatekeepers in draft form for further co-design. Ethical approval was obtained from the University of Newcastle, UK ethics committee, Project #: 19-SI-014, on the 28th of February 2019, prior to data collection.

4.2.2 Research Setting

The research was conducted in Sorong Selatan Regency, West Papua Province, Indonesia. Sorong Selatan Regency is located between 01°00' - 02°30' North Latitude and 131°00' - 133°00' East Latitude. The total area of Sorong Selatan Regency is 8,424.165 km², consists of a land area of 6,891.551 km² (95.1%) and an ocean area is 1,532.614 km² (4.9%). The topography of most areas of this regency is a valley (The Central Bureau of Statistics of Sorong Selatan Regency, 2018). Data were collected in four districts, namely Teminabuan, Matemani, Saifi, and Seremuk. Data collection was also carried out in Jakarta, Bogor, and Yogyakarta *via* Zoom calls. The total area of the sago plantation is 311,591 ha or 45% of the total area of Sorong Selatan Regency (Haryanto, 2015).

4.2.3 Participant Sampling and Recruitment

A purposive recruitment of politicians (n=1; 5.6%), sago farmers (n=5; 27.8%), academics (n=2; 11.1%), and local civil servants (n=5; 27.8%) was conducted by the gatekeepers. The lead author recruited the national civil servants (n=3; 16.7%) and food activists (n=2; 11.1%). These stakeholders were chosen to ensure that all various interests in the management of sago in South Sorong, West Papua were covered. Academics who act as innovators, local and national governments as facilitators, and activist groups were included as potential policy implementers (Bintoro *et al.*, 2016). Eighteen participants (n=18) were interviewed in total. N=18 is an appropriate size for such a stakeholder analysis, where there is a requirement to investigate local expert knowledge in an in-depth way, rather than solicit opinions from a much larger area, but including participants with less local agronomic and cultural expertise (Gupta *et al.*, 2012; Van Putten *et al.*, 2010). Furthermore, previous

² Two gatekeepers were involved in the research: a civil servant in the Sorong Selatan Regency and an environmental activist.

research recommended that qualitative studies require a minimum sample size of at least 12 to reach data saturation (Guest *et al.*, 2006; Clarke & Braun, 2013).

Therefore, a sample of 18 was deemed sufficient for the thematic analysis of this research. During the data collection process, the gatekeeper facilitated identification of, and access to, the key informants. Participant information is summarised in Table 4.1.

Participant	Position	Roles	Gender	Location
#01	Politician	Policy maker	Male	Teminabuan
#02	Local Civil Servant	District leader	Male	Teminabuan
#03	Local Civil Servant	District leader	Male	Matemani
#04	Local Civil Servant	District leader	Male	Matemani
#05	Local Civil Servant	Food security officer	Male	Teminabuan
#06	Local Civil Servant	Food security officer	Female	Teminabuan
#07	Academia	Lecturer	Female	Teminabuan
#08	Academia	Sago researcher	Male	Bogor
#09	Farmer	Sago Farmer	Female	Saifi
#10	Farmer	Sago Farmer	Male	Saifi
#11	Farmer	Sago Farmer	Male	Seremuk
#12	Farmer	Sago Farmer	Male	Seremuk
#13	Farmer	Sago Farmer	Male	Teminabuan
#14	National Civil Servant	Special autonomy officer	Male	Jakarta
#15	National Civil Servant	Food security officer	Male	Jakarta
#16	National Civil Servant	Coordinating Ministry of Economic Affairs	Male	Jakarta
#17	Food Activist	Sago enthusiast	Male	Bogor
#18	Food Activist	Sago enthusiast	Male	Yogyakarta

Table 4. 1: List of Participants

Female stakeholders are underrepresented in the stakeholder sample (3 of 18 participants), which represented academia, sago farming, and the local civil service. This was because, first, in the local context of sago farming, males have a cultural role as the head of family. As such, men have additional responsibility to answering matters related to daily life. Second, local and national officials, most directly involved in handling sago, were predominantly male.

4.2.4 Data Collection

Each semi-structured interview lasted between 30-60 minutes. Interviews were performed in Indonesian language (Bahasa) and were conducted by the gatekeepers or the lead author. The gatekeepers provided access to several key figures in the

local government, community members, and academics with relevant interests. They helped the lead author and conducted twelve interviews. Interviews were either audio-recorded (n=4), recorded in writing (n=10), or recorded on zoom (n=4), and transcribed *verbatim* where applicable.

During the pandemic Covid-19, in-person data collection became problematic due to travel restrictions. Hence, the initial plan for data collection had to change given the partial lockdown in West Papua. Given the social distancing restrictions in place, all data collection took place online via zoom or phone call. However, online data collection was associated with some problems. For example, internet connections in West Papua were not always optimal, and some respondents were reluctant to complete the interview questions in the form of a survey, which made data collection more complex. Communication with the gatekeepers became more challenging with distance, despite the researcher maintaining regular contact through a WhatsApp group. Nonetheless, the range and depth of opinions identified suggests that alternative methods of data collection were rigorous and the results robust.

4.2.5 Data Analysis

A thematic analysis was performed using Nvivo (QSR International Pty Ltd, 2020) to facilitate data coding, analysis, and organisation, and applied to the interview transcripts. Thematic analysis allows a flexible approach for reporting the perspectives of different research participants and summarising key features of a large dataset (Nowel *et al.*, 2017). In this research, the meaning unit of analysis was an entire phrase taken from the interviews (Graneheim & Lundman, 2004). The meaning units were labelled with codes that were sorted and collated into themes. A theme in this context represented a group of codes that captured something important about the data in relation to the research questions (Braun & Clarke, 2006). The lead author examined the transcripts independently and identified *a priori* themes based on the research questions, as well as new themes that emerged from the data. These were discussed by the lead author and the rest of the research team until any contradictions were thoroughly checked and themes were established. The final set of themes and illustrative quotes from participants are reported. Quotes have been translated from the local language used (Bahasa Indonesia) in the interviews into English.

4.3 Results

Interviews were collected between March 2020 to June 2021. The main themes and sub-themes identified are presented in Table 4.2. The number of times the sub-themes mentioned by the stakeholders were coded in descending order are as follows: economic factors (n=10), role of stakeholders in the sago supply chain (n=10), policy and promotion (n=9), cultural identity (n=8), emergency food (n=5), potentially healthy food (n=4), infrastructure (n=4), social and political factors (n=3), price (n=2), qualified human resources (n=2), changes in consumption trends (n=2), and environmental concern (n=1). These are discussed in the remainder of the results section and supported with relevant quotes.

Themes	Sub-Themes	Description
Motivators to Produce and Consume sago	Economic Factors	a. Sago will provide more financial benefit when processed and sold
		b. Every part of sago is useful
		c. Sago is beneficial for local economy
		d. Sago enables economic relationships with sago companies to be established
	Emergency Food	a. Sago provided food stability during Covid-19 pandemic
		b. When food security improves, people choose rice as the first dietary option
	Potentially Healthy Food	Food to prevent colon cancer and diabetes
Environmental Concern	Heavy machinery used by the sago companies has caused environmental damage	
Strategies from Stakeholders to Increase the Awareness of Sago Consumption	Role of stakeholders in the sago supply chain	a. Government is entirely responsible for sago and its development
		b. Collaboration between community, government, and private sector is required to promote sago
		c. Too many stakeholders involved in sago management is problematic
	Policy and promotion	a. The national government and local government policies are not synchronised

		b. Promotion of sago consumption through social activities and festivities
Barriers to Sago consumption	Infrastructure	a. Distance and lack of supporting infrastructure
		b. Sago processing is time and energy consuming
	Price	a. Low selling price
		b. Raskin's (subsidised rice for poor households) policy in remote locations
	Qualified human resources	Lack of qualified human resources
	Social and political factors	a. Sociocultural issues (regionally specific)
b. Certain parties exploit the issue of sago for their own political gain		
Sago Eating Culture	Cultural Identity	Sago is not only as staple food, but is embedded in local cultural practices
	Changes in consumption trends	Rice has become the Papuan people's staple food

Table 4.2: Themes and Sub-Themes

4.3.1 Motivators to Produce and Consume Sago

The main themes that influence the indigenous peoples of West Papua to produce and consume sago were identified, namely economic factors, the use of sago as valuable food in an emergency context, and potential benefits of sago to human health, as well as environmentally beneficial food production. Most stakeholder participants believed that sago has an economic value which benefits the families of those growing it, and/or after the sago has been processed and sold, and which had a positive impact on the local economy.

Sago has long been a source of revenue for the region. Sago has a high economic value. Derivative products can be a variety of products, from cakes to cosmetics. (participant #01, politician, male).

The economic value was described in terms of the relation between the local community and the sago processing company in Sorong Selatan.

Sago may be processed into two economically valuable products: wet and dry sago starch, both of which give benefits to the family (participant #11, sago farmer, male).

The economic value of sago starch sold in the market can be used to meet family needs (participant #12, sago farmer, male).

During the factory trial, one family meticulously collected sago from their own land and earned 16 million rupiahs in 20 days (participant #18, food activist, male).

Every part of the sago tree and its derivatives were thought to be economically valuable and beneficial in daily life for most households.

“... every part of the sago tree has a variety of applications, including roofing, arrows, house walls, and food items, even sago caterpillars may be consumed. Indeed, it is possible to consume the mushrooms that grow on the roots of the sago palm (participant #04, local civil servant, male).

However, in the context of community interaction with sago companies, some aspects were unfavourable to the community, such as low selling prices and community poverty levels, that require immediate attention.

In relation to ANJ³, the low sago selling price remains an impediment and inhumane practice. This is where the government's role in assisting the community comes into play. One sago tree may sustain a household for two months if it is cut down. Ironically, the majority of people with low incomes own sago villages⁴ (participant #07, academia, female).

In addition to its economic value, sago was perceived to play a critical role in ensuring food availability at the local level, and, according to stakeholders, particularly during the Covid-19 pandemic. An increasing number of people were relying on sago consumption to achieve their daily nutritional requirements.

Sago consumption increased significantly during Covid-19, owing to the fact that sago is the easiest crop to obtain without spending money, in comparison to rice (participant #12, sago farmer, male).

During the Covid-19 pandemic, sago re-established itself as a staple food, and consumption increased (participant #01, politician, male).

While sago consumption increased during the pandemic, stakeholders argue that sago consumption will reduce as people's incomes improve.

When we have money, we eat rice. Without money, sago becomes a viable choice for survival (participant #04, local civil servant, male).

Two other factors influenced a person's decision to consume sago, namely health and environmental concerns.

³ PT ANJ Agri Papua Barat (ANJAP) is one of the sago companies in West Papua operating since September 2007.

⁴ Sago villages is a forest that is naturally overgrown by sago, inherited based on customary law by their respective parents in each tribe, and managed from generation to generation.

One of the [potential] benefits of sago is that it has a low glycaemic index, which helps prevent colon cancer and diabetes. According to my research, if people consume sago or sago rice daily, their health would be preserved (participant #08, academia, male).

The sago company is causing havoc on the environment by using heavy machinery without regard for sago and other flora (participant #04, local civil servant, male).

4.3.2 Strategies from Stakeholders to Increase the Awareness of Sago

Consumption

Given that stakeholders generally supported maintaining or increasing sago consumption within the local population, primarily to promote food security in relation to food availability and nutrition, it follows that strategies may be needed to enhance public awareness about the potential benefits of sago consumption. The majority of stakeholder participants believed that the government is primarily responsible for sago consumption promotion.

The government is responsible for sago (participant #01, politician, male).

Local governments must take a proactive role in safeguarding community rights regarding sago forests (participant #02, local civil servant, male).

However, it was thought that sole dependence on the government to support sago production and consumption within local diets, would not be effective. Effective collaboration between the community, government, and private sector was thought to be needed to jointly increase public awareness of the importance of sago in everyday life.

The community and local government are responsible stakeholders (participant #05, local civil servant, male).

If people are not accustomed to eating sago, no matter how strict the government's local laws are, they will fail. We must first love what we have. Akness⁵, ANJ, and Perhutani⁶ are the backbones of Sorong Selatan, as no one else in Papua is capable of managing sago as well as we are (participant #07, academia, female).

⁵ Akness (Akademi Komunitas Negeri Sorong Selatan) is a vocational education institution based on the Community Academy which was established to prepare human resources in Sorong Selatan for the development of sago in the future.

⁶ Perhutani is a state forest enterprise that established a sago factory in Sorong Selatan

Whilst involving different stakeholders in sago management was thought to be important by stakeholders, participants expressed the view that having too many stakeholders involved in policy development and the supply chain may also be problematic, potentially because this would slow the policy process down because of lack of consensus across stakeholder groups. It should be noted that, the existing literature on stakeholder engagement does not support this contention.

One of the challenges that has existed in the past and continues to exist today is that there are too many agencies that handle it, resulting in an underdeveloped sago [value chain] (participant #08, academia, male).

After gaining a thorough understanding of stakeholder priorities and perspectives an effective policy and promotion plan is required. As a result, policy synergy between the national government and local governments is necessary. Yet the national government and local government policies are not synchronised.

The government is involved in fostering the development of the infrastructure as part of national strategy. Road infrastructure in order to make distribution lines more efficient. Additionally, the regional government develops regional regulations governing the price of sago (participant #01, politician, male).

Until today, Sorong Selatan has lacked a dedicated sago policy, despite the advantages of the sago hectare area (participant #05, local civil servant, male).

There is no local legislation governing, for example, the distribution of rice and sago to employees, where out of 10 kg of rice, 3 kg is sago (participant #07, academia, female).

In practice, sago promotional activities carried out by local and national government continue to be limited to ceremonial occasions, such as social events and food festivals.

The local government's policy in terms of promoting sago is limited to festivals that promote sago culture/traditions (participant #02, local civil servant, male).

Social events, courses, and instruction on how to prepare sago-based foods (participant #03, local civil servant, male).

A call from West Papua's province administration that whenever there is an activity, local food options such as sweet potatoes, taro, bananas, and sago

must be provided, including for families and in churches (participant #07, academia, female).

4.3.3 Barriers to Consume Sago

Participants believed that there are numerous difficulties and challenges in the area of sago (production) management that affect sago consumption. One obstacle is the distance to and a lack of supporting infrastructure for farmers to go to the sago forest, not to mention the sago processing which requires considerable time and energy from those involved.

Apart from the manual process, I believe that the distance to the sago location is one of the problems encountered (participant #03, local civil servant, male).

Obstacles related to the harvesting process which requires close proximity to rivers for transportation of harvested sago (participant #12, sago farmer, male).

Processing sago into starch involves a great deal of labour and time, making this activity tough (participant #01, politician, male).

Sago rice took a long time to develop [research and development process]; for me, it took 20 years for sago to be processed into the sago rice that exists today (participant #08, academia, male).

After harvesting sago, an additional problem may be the unfavourable selling prices. Sago has a low selling value, especially if compared to the efforts expended in the harvesting process which takes a long time and is labour intensive. In addition, Raskin's policy (subsidised rice for poor households) has been applied to households in remote locations. People therefore prefer to consume rice rather than sago, given its convenience and accessibility.

The market practice of purchasing and selling sago continues to be destructive to us. For instance, the price of a single stick of Surya cigarette [one of the local cigarette brands] is higher than the price of sago. This makes no sense at all (participant #04, local civil servant, male).

Raskin's policy [subsidised rice for poor households] has applied to remote locations, and families and farmers have lost interest in planting or cultivating sago in the forest (participant #01, politician, male).

The lack of skills in relation to sago processing has contributed to sago's underdevelopment as a commodity. The two main issues in terms of resources are

the inaccessibility of technical equipment and trained value chain workers who can manage sago from planting to harvesting.

The difficulty is in obtaining the necessary equipment for sago production, but the government has aided in this endeavour (participant #05, local civil servant, male).

In terms of sago cultivation, the community still lacks the competence necessary to manage the crop using qualified practices, from seedling to harvest (participant #07, academia, female).

Finally, managing sago cultivation is not just a technical concern; it also requires motivation on the part of farmers and producers to engage in, and manage, production effectively. One of the socio-cultural aspects that hinder the development of sago is related to customary land ownership in the forest owned by the indigenous people, as well as the perceived problem of a relatively low work ethic. Stakeholders recognise that there is a need to ensure (economic and agricultural) policies are linked to sago production, and that indigenous people are engaged in the policy (and sago production) processes. For example, contributing local knowledge, skills and expertise complement those held by workers from outside the area.

The issue with sago development is not technical, but rather socio-cultural (participant #16, national civil servant, male).

The difficulty arises solely from a lack of will to manage the sago (participant #18, food activist, male).

Economic management is still closely linked to the political process in relation to sago. When a large number of the workers are from outside Papua, the situation becomes political. Indigenous Papuans are merely observers, despite the fact that investment also requires specific skills and expertise (participant #14, national civil servant, male).

4.3.4 Sago Eating Culture

The majority of participants agreed that sago is embedded in a cultural and ancestral identity that must be protected, and indicated that at present, the visible form of preserving sago eating culture has become largely limited to cultural and food festivals. Traditional food may be included in diets more generally and also contributes to cultural identities.

Sago continues to play a significant role today, employs the indigenous system, and is an ancestral tradition. Sago is a defining feature of the Papuan

people that cannot be lost across generations (participant #02, local civil servant, male).

Sago Papeda⁷ has been my staple diet from childhood, passed down from generation to generation, enabling me to attend school, read, and write. When sago is not available, the Papuan people perish, as our existence is dependent on sago (participant #04, local civil servant, male).

Sago is the primary diet of the Papuan people, and we have known it since we were born (participant #13, sago farmer, male).

Consumption trends, however, appear to have changed, potentially as a consequence of various other factors, such as the increased availability and accessibility of rice (compared to sago), and policies which subsidise rice for consumption in poorer households (i.e., Raskin's policy), resulting in rice having become the Papuan people's staple food.

When we discuss staple foods, we will remark that sago is the Papuan people's staple food. However, if we look at daily life, we see that rice is the staple food that has developed into its own lifestyle. This is in contrast to the rural areas, where sago is more readily available for consumption (participant #07, academia, female).

When it comes to the Papuan people's food, rice remains the primary staple, followed by sago (participant #01, politician, male).

4.4 Discussion

The aim of this qualitative case study was to understand the perspective of a selected number of different stakeholders regarding sago consumption in terms of both agronomic practices and dietary choices. The results indicate that stakeholders consider that the majority of the Papuan people regard sago as a traditional food that is important to, and inseparable from, every aspect of their lives, although this requires further confirmation with Papuan consumers themselves. Although sago has long been known as the staple food of the Papuan people, holding a special place in Papuan culture as one of the prerequisites for certain tribal traditional ceremonies (Kadir *et al.*, 2022), there is evidence from stakeholders that sago consumption within the general diet of Papuans is declining. This reduces the resilience of local food systems to system shocks as there is increased reliance on imported foods. In addition, other aspects of sago production and consumption require further consideration. For example, these results suggest that sago contributes to the

⁷ Papeda is a traditional Indonesian dish made with sago that is frequently referred to as the local porridge variety for the indigenous peoples of Papua and Maluku.

economic well-being of local farmers by increasing their income, promoting the local circular economy, through reuse of sago residues, which reduces the polluting effects from sago processing industries, and also provides an economic solution for waste management systems (Awg-Adeni *et al.*, 2010; Abu Hasan *et al.*, 2021). Sago farming also contributes to the maintenance or restoration of local ecological systems (Karim, 2021). The results confirm previous research findings which indicate that indigenous foods have the potential to promote food security, including during times of crisis such as the Covid-19 pandemic (Suwardi, 2021). In Papua, stakeholders perceive that this is because sago is a food source that is locally grown and adapted to local agronomic and climatic conditions, which has potential to significantly reduce the Papuan people's reliance on imported food supplies, such as in the case of the Covid-19 pandemic which has disrupted the food supply chain.

All of the stakeholders participating in this research expressed the view that sago is a healthy food. However, environmental issues were not a primary focus of stakeholders' interest. Indeed, discussion was limited to the negative environmental impacts of sago production, for example, in relation to the sago companies that harm the environment during the production process, such as harvesting sago without regard for the surrounding. This particular situation requires immediate remediation. However, the environmental profile of sago production is relatively positive. For example, recent research indicates that the greenhouse gas (GHG) emissions associated with producing 1 tonne of sago (17.9 kgCO₂eq) are significantly less than those associated with corn starch (2700 kgCO₂eq), potato starch (2402 kgCO₂eq), and cassava starch (4310 kgCO₂eq) (Yusuf *et al.*, 2019). This means that sago production has strategic value in terms of reducing the local negative environmental impacts of agriculture, especially when compared to the palm forestations.

In the context of national policy, it is important to consider sago production based on Law Number 2 of 2021 concerning the Second Amendment to Law Number 21 of 2001 concerning Special Autonomy for the Province of Papua. The main objectives of this law are to improve the quality of public services as well as sustainable development in the Papua region. This is also supported by the establishment of the Papuan People's Assembly (MRP) which is the cultural representation of the indigenous peoples of Papua who have certain authorities in the context of protecting the rights of the indigenous peoples based on respect for customs and culture,

empowerment of women, and ensuring a harmonious religious life. In the context of sago management, the ambition is that existing regulations at the national level can also be implemented properly with local regulations in the regions. This study demonstrates that the local government has not yet established comprehensive sago management policies for the community's benefit.

In addition, there is a disagreement between academics and local government in terms of whether or not to improve the quality of human resources in sago management through the education sector. Academic stakeholders expressed the view that the local government should pay more attention to Akness as the only sago academy in West Papua that focuses on developing sago as a leading commodity, improving the effectiveness of extension services and policies. Regardless of the differing political agendas of each regional leader, local government must immediately prioritise the education sector, particularly sago in whatever shape it takes. It is anticipated that the synergy between the local administration and academics will enhance support for initiatives to restore sago as a cultural asset of the Papuan people that must be protected.

Some of the stakeholders interviewed were civil servants with a direct influence on policy development and implementation. The engagement of other stakeholders (e.g. representatives of civil society) are recognised as being an important part of the development of policy (Blok *et al.*, 2015). Taken together, the results have provided evidence which will help understanding of the barriers to, and facilitators of, increased production and consumption of sago in the regions included in the research, and potentially within a broader geographic area.

Stakeholders emphasised the important roles of local government in promoting sago production and consumption. There is stakeholder awareness that local government policies to promote sago production will not be successfully implemented without the engagement of local communities in relation to sago production, inclusion in diets, and as part of the cultural wealth of the Papuan and Indonesian people. At the same time, stakeholders recognised that the community wants clearer rules for professional sago management efforts. Therefore, the collaboration of indigenous peoples and local governments is very important to consider within policy development and implementation, especially as regional autonomy prioritizes regional independence

and innovation. Currently, although policies at the national level have provided general guidelines to preserve cultural tradition, local governments need to formulate policies that are able to accommodate specificities of particular traditions at the local level. The policy must be formulated to anticipate the various obstacles that exist locally, including addressing barriers to sago production and consumption, such as the introduction of more efficient and less time-consuming sago production practices, and policies which encourage consumption by local people.

The effectiveness of developing such an approach is illustrated by recent developments in Sorong Selatan which demonstrate the strong synergy between indigenous peoples and local government. The regent of Sorong Selatan is currently facing lawsuits from two palm oil companies whose licenses have been revoked (Delegasi Papua, 2022). The revocation of this business licence is based on an assessment of the licencing policy conducted by the West Papua province and the local government, as well as indigenous peoples' aspirations for welfare, safety, and the long-term viability of the environment's sustainability. This illustrates how the conversion of sago forest into oil palm plantations has become a new problem for indigenous peoples in Sorong Selatan.

This research represents the first qualitative research, to our knowledge, that has examined stakeholder's perceptions of the motivators, strategies, and barriers to sago consumption in West Papua, Indonesia. We were able to engage participants in rich discussion relevant to the research questions by using semi-structured interviews. Furthermore, the research adhered to COREQ's guidelines for conducting and reporting qualitative research, demonstrating rigor in data collection and analysis. However, the research has a number of limitations. The small sample size, which has resulted in only a few stakeholders in each stakeholder category being represented means that the results may not have reached "saturation" where no additional information is being identified. The lack of female participants, a consequence of the gatekeepers' limited ability to facilitate their recruitment, may have introduced a gender-related bias to the interpretation of the results. The data quality *may* have been richer had personal face-to-face interviews been conducted, which reflects the difficulty of collecting interview during the Covid-19 pandemic. Finally, while generalisation is not a goal of qualitative research, our findings should be interpreted within the context of the data collection, which consisted of a small

sample of participants from a single geographic area. As a result of the limitations of the studies in this research area, future studies should be considered whether consumer studies align with stakeholder views regarding sago consumption. Future research might also consider using alternative approaches to understanding stakeholder, consumer and other supply chain actor perspectives combining qualitative, quantitative and ethnographic approaches, which will allow for the triangulation of results to further inform the research question. Further research into the sago food system might bring in expertise in biodiversity, human nutrition and economics, which will address environmental, nutritional and fiscal perspectives using appropriate methodologies.

4.5 Conclusion

The evidence presented here suggests a diverse range of local stakeholders support the continuation of sago production and consumption, both from the perspective of improved food security, and in order to conserve cultural associations and activities within local communities. According to the stakeholders interviewed, this can be best achieved through improved engagement of local communities with sago production policies, innovation in current practices, and agronomic management. Local policies should be developed to ensure that sago remains an integral component of the Papuan people's culture and develops into a significant commodity with economic value which simultaneously contributes to environmental targets. The results indicate that local stakeholders are positive about the inclusion of sago in the diets of indigenous people, not only to improve food security in West Papua but also as a foundation for developing future food security policies.

Chapter 5. Predictors of sago consumption behaviour among indigenous peoples of West Papua

5.1 Introduction

The Food Security and Vulnerability Atlas (FSVA) published by Food Security Agency of the Ministry of Agriculture of the Republic of Indonesia (2021), states that some regions of Indonesia, despite their rich biodiversity and cultural heritage, are associated with potential challenges in relation to food security, including in particular the provinces of Papua and West Papua. Papua and West Papua are two of Indonesia's 34 provinces and are the provinces most vulnerable to food security problems. At the same time, with 5.4 million hectares (ha) of sago forests, Indonesia has the largest sago palm plantations in the world, with more than 95% in the Papua region (Ministry of Agriculture, 2020). Hence, Papua is an excellent place to start if sustainable sago production and consumption are to be achieved.

Sago has made an important contribution to the diets of the indigenous population of West Papua for many generations (Chapter 3, published as Sidiq *et al.*, 2021). Despite sago's multiple uses and benefits (Konuma, 2018), when compared to other commodities, local consumption of sago is quite low, at a rate of 0.36 kg per person per year. In contrast, each person consumes 18.2 kg of wheat and 97.1 kg of rice, on average, annually (Ministry of Agriculture, 2018). There is, however, evidence that Indonesian indigenous peoples prioritise consumption of wheat flour (30.2%) and cassava (19.6%) over sago (1.8%) (Damayanthi, 2020). This may reflect the psychological and sociocultural contexts that influence indigenous peoples' dietary choices in West Papua. The aim of the research in this chapter is to identify, and evaluate the predictive capacity of self-reported, intended sago consumption among the indigenous population of West Papua. As Indonesia has great potential for sago production and consumption (Konuma, 2018), understanding the factors that influence sago consumption can help with the development of strategies to address consumers' food choices. Furthermore, given the close connection between indigenous peoples and nature (see chapter 2), it is predicted that socio-environmental conflicts, deforestation, and displacement, on their ancestral lands, will all lead to a decline in the wellbeing of indigenous people and their communities (Drissi, 2020). Sago, which serves as a staple food and also serves as the identity of

a community known as Tanah Papua, is crucial for the indigenous people to understand in this setting (Sidiq *et al.*, 2021).

A systematic review on traditional diets and food security for indigenous peoples in Low- and Middle-Income Countries (LMICs) examined the role of locally produced, traditional diets in relation to food security (Chapter 2, published as Sidiq *et al.*, 2022a). The review concluded that traditional foods play an important role in promoting and maintaining food security, including in relation to cultural preservation of local peoples and the ecological systems in which production is embedded. Furthermore, in order to lessen dependency on imported food, foster local biodiversity, and enhance food security, it is important to develop and conserve traditional food knowledge among indigenous peoples (Kuhnlein, 2017; Sidiq *et al.*, 2022a).

Qualitative interviews with a range of stakeholders (politicians, local and national civil servants, academics, sago farmers, and food activists) suggested that sago consumption culture must be safeguarded for the indigenous people of West Papua, despite some barriers to continued production and consumption, such as lack of supporting infrastructure for farmers to go to the sago forest, and for sago processing which requires considerable time and energy from those involved. The stakeholder interviews also indicated that stakeholders considered it to be potentially important to develop the economic value of the sago palm as a local crop, which would increase demand within the local sago supply chain. Thus, local policies to develop production and consumption should be prioritised (Chapter 4, published as Sidiq *et al.*, 2022b). Previous research has assessed stakeholder views regarding the barriers to, and facilitators of, sago consumption among the indigenous people of West Papua. What has not yet been examined is the predictors of sago consumption from the indigenous peoples of West Papua themselves, and this is what this chapter aims to address.

5.1.1 Self-reported sago consumption propensity

Despite the fact that Papua is the largest sago-producing region (Konuma, 2018), research on sago consumption and its processed products is primarily conducted elsewhere in Indonesia (Dewayani *et al.*, 2022; Rusli *et al.*, 2022; Yusuf *et al.*, 2022).

This is mainly because the consumption of sago for the indigenous peoples of West Papua is regarded as old fashioned (Sidiq *et al.*, 2022b), thus make it less appealing. However, research related to the factors that affect sago consumption becomes pertinent and significant as a result of the phenomena of declining levels of sago consumption among the indigenous peoples of West Papua, particularly following the Covid-19 pandemic (Sidiq *et al.*, 2021).

Previous research has focused more on the physical characteristics of sago as a plant (Sondari *et al.*, 2022; Timisela *et al.*, 2022), sago as an industrial raw material (Marta *et al.*, 2022; Thangavelu *et al.*, 2022), and sago processed into artificial rice (Sumardiono *et al.*, 2022). Research which has focused on the consumption of sago has more frequently discussed the consumption of processed sago and less on traditional preparation practices, such as *Kapurung* and *Sinole* in South Sulawesi (Humaerah *et al.*, 2020).

Following the systematic review (Sidiq *et al.*, 2022a) and the qualitative interviews with key stakeholders (Sidiq *et al.*, 2022b), this chapter examines the impact of economic factors, subjective norms, facilitating external conditions, environmental concern and engagement, identification with collectivist and individualist culture, and barriers to sago consumption intentions and self-reported sago consumption propensity among indigenous peoples of West Papua. The conceptual framework for the study is shown in Figure 5.1.

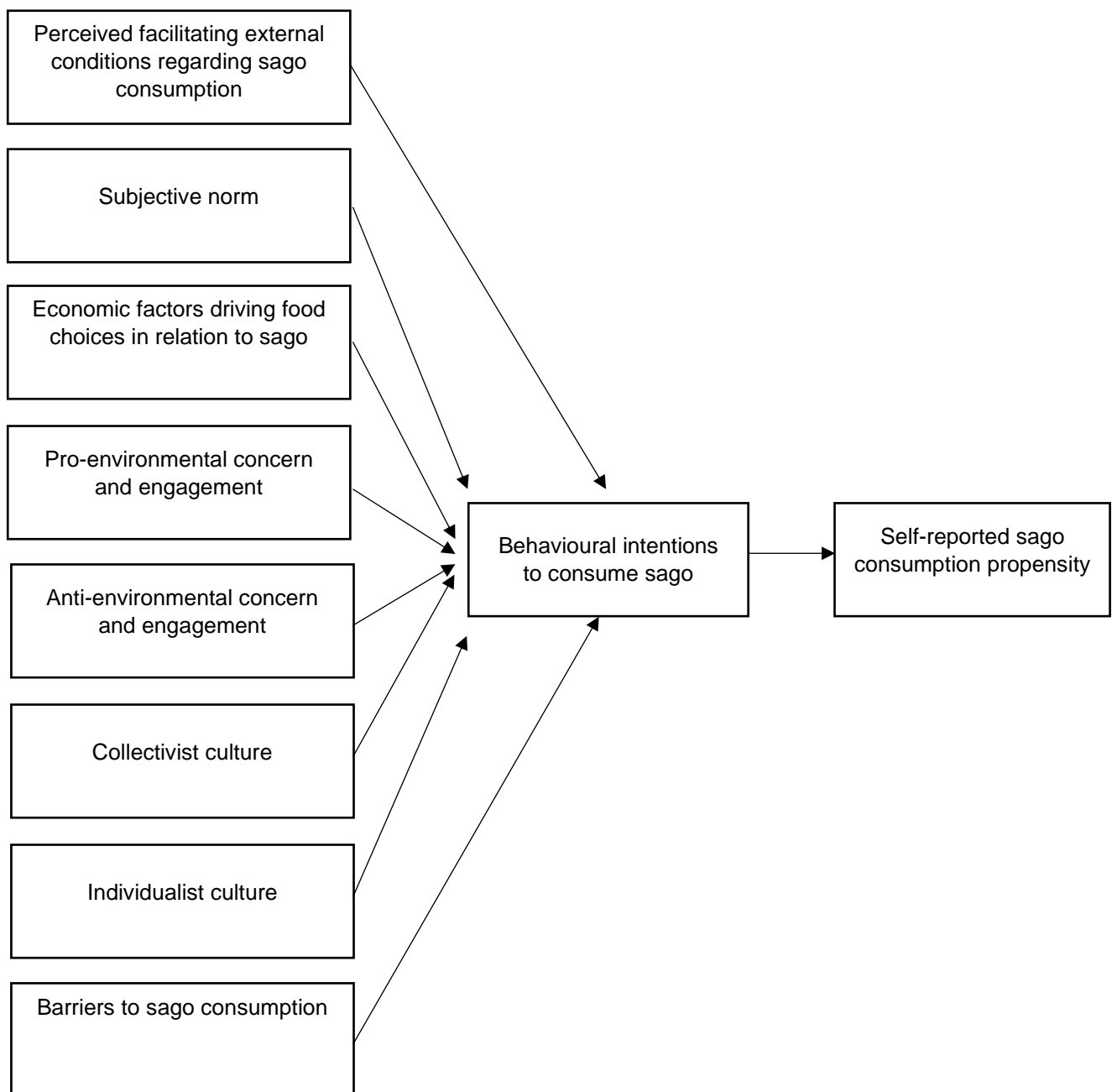


Figure 5. 1: Conceptual framework

5.1.2 Behavioural intentions to consume sago

A significant factor influencing behaviour, including food choices, is behavioural intention (Caldwell, 2018). Here, self-reported behavioural intention, broadly derived from the scale used in the Theory of Interpersonal Behaviour (Triandis, 1980), to consume sago was used as a proxy for actual consumption. The formation of behavioural intention is significantly influenced by social and emotional factors, attitude, and past behaviour (also known as habits), and externally favourable contextual elements are known as "facilitating conditions" which potentially influence a person's behaviour (Triandis, 1980). Thus, we hypothesised:

H1. The higher an individual's intentions to consume sago, the higher the self-reported sago consumption propensity.

5.1.3 Perceived facilitating external conditions regarding sago consumption

An important facilitator of behaviours may be the perceived ease of engaging in that behaviour. Facilitating conditions affect the cost, convenience, and level of difficulty of engaging in specific behaviours such as food choice (Caldwell, 2018). When people engage in certain behaviours, they typically seek easy and convenient ways to accomplish their objectives. In the context of sago consumption, previous research indicated that people would consume sago where sago is always available during emergencies (Sidiq *et al.*, 2022b). Thus, we hypothesised:

H2. The higher the perceived facilitating external conditions, the higher the intention to consume sago.

5.1.4 Subjective norm

Subjective norm refers to an individual's perception of the expectations and norms of relevant others regarding a particular behaviour. Subjective norm is believed to influence an individual's behaviour by providing social pressure or motivation to conform to the expectations of others (Ajzen, 1991). For example, if an individual believes that their friends and family expect them to engage in a particular behaviour, they may be more likely to have a strong intention to engage in that behaviour. On the other hand, if an individual perceives that the relevant others do not expect them to engage in a particular behaviour, they may be less likely to have a strong intention to engage in that behaviour. Thus, we hypothesised:

H3. The higher the perceived subjective norm to consume sago, the higher the intentions to consume sago.

5.1.5 Economic factors driving food choices in relation to sago

The systematic review and stakeholder interviews (Sidiq *et al.*, 2022a; Sidiq *et al.*, 2022b) indicated that economic factors are the main motivators for the indigenous peoples of West Papua to consume sago. The majority of stakeholder suggested that sago had economic value that helped the families of people who grew it, as well as

when the sago was processed and sold, and that this value had a positive effect on the local economy. Thus, we hypothesised:

H4. The higher the perceived economic gains from eating sago, the higher the intentions to consume sago.

5.1.6 Pro and Anti-environmental concern and engagement

The review and stakeholder interviews (Sidiq *et al.*, 2022a; Sidiq *et al.*, 2022b) indicated that, maintaining and potentially increasing sago cultivation may have positive benefits for local biodiversity and ecosystem services, and that this might be a driver of increased consumption (and production) by individuals who are concerned about environmental challenges linked to agronomic practices. Environmental attitudes of participants were measured by the New Ecological Paradigm (NEP) scale (Dunlap *et al.*, 2000). The scale is frequently used to assess environmental orientations and ecological worldviews. The scale consists of 15 items that explore different ecological worldviews and convey people's attitudes toward the environment by focusing on how people and nature interact. The eight odd items, measure endorsement of the new environmental paradigm or in this thesis we call it by the term "*pro-environmental concern and engagement*". The seven even numbered items, represent statements endorsed by the dominant social paradigm or in this thesis, we refer to it as "*anti-environmental concern and engagement*". Through the NEP scale, the survey assessed indigenous people's environmental values with emphasis on sago consumption. It has been validated in a range of cultural contexts (Hsu and Lin, 2015; Jancius and Gavenasukas, 2022; Joshi *et al.*, 2022), although to our knowledge the scale validity has not been assessed in West Papua. Thus, we posit:

H5. The higher the pro-environmental concern and engagement expressed by participants, the higher the intentions to consume sago.

H6. The higher the anti-environmental concern and engagement expressed by participants, the higher the intentions to consume sago.

5.1.7 Collectivist and Individualist culture

The systematic review and qualitative interviews (Sidiq *et al.*, 2022a; Sidiq *et al.*, 2022b) suggested that the indigenous peoples of West Papua must preserve sago

consumption culture despite the many challenges encountered. The intention of the indigenous peoples of West Papua to uphold this custom was measured by an individualism and collectivism scale (Triandis, 2018). The scale is widely utilised to evaluate the relationship between cultural individualism and collectivism. The scale consists of 16 items designed to measure four dimensions of collectivism and individualism. In this thesis, individualism and collectivism scales are calculated separately into two variables. Eight statements represent “*collective culture*”, while the other eight represents “*individualist culture*”. Thus, we propose:

H7. The higher the collectivist culture expressed, the higher the intentions to consume sago.

H8. The higher the individualist culture expressed, the lower the intentions to consume sago owing to the group collaboration needed in harvesting and preparing sago.

5.1.8 Barriers to sago consumption

The review and qualitative interviews (Sidiq *et al.*, 2022a; Sidiq *et al.*, 2022b) suggested that there are various obstacles and difficulties encountered in the process of managing sago (production) that have an impact on the level of sago consumption. The distance to market and lack of transportation infrastructure that prevent farmers from travelling to the sago forest, as well as the processing of the sago, and home preparation, which takes a lot of time and effort from those engaged, are some of the potential perceived barriers. Thus, we hypothesised:

H9. The higher the perceived barriers, the lower the individual intention to consume sago.

5.2 Methods

The development of the survey instrument required the integration of components taken from scales offered by earlier studies. The questions were translated into simple Indonesian language (Bahasa Indonesia) so that respondents could understand them easily. Before creating the final questionnaire, a preliminary (piloting) survey with 25 respondents was conducted. Based on the feedback, a few terms and statements required some adjustments. One section of the final questionnaire was devoted to questions pertaining to demographic information, while

the second component had questions pertaining to all research variables. Data collection was supported at the site by a survey team from the Central Bureau of Statistics of Sorong Selatan Regency. Each member of the survey team was equipped with a mobile phone connected to the internet in order to assist respondents in filling out the questionnaire (hosted on Qualtrics, Provo, UT). As there was no relevant West Papuan body able to provide ethics authorisation, ethical approval for the study was obtained from the University of Newcastle, UK ethics committee, Project #: 19-SI-014, on the 28th of February 2019, prior to data collection.

5.2.1 Measurement

The list of items used in the survey is given in Appendix E. Responses to all items of the study variables were recorded on a five-point Likert-type scale (where 1 = strongly disagree, and 5 = strongly agree). A scale is considered valid and reliable when the value of the Construct Reliability (CR) is above 0.7 and the Variance Extracted (VE) is above 0.5 (Fornell and Larcker, 1981). By this standard, it was determined that the validity and reliability of all the scales employed in the study were good.

5.2.2 Statistical Analysis

A descriptive analysis was conducted using the IBM SPSS Statistic 25.0 software package (IBM Corp., Armonk, NY, USA). The Structural Equation Model (SEM) proposed was tested through AMOS V23.0 software, using the maximum-likelihood estimation method (Blunch, 2008). SEM was used because it allows to conduct a complex, multidimensional, and more precise analysis of empirical data considering different aspects of the examined reality and abstract concepts or theoretical constructs (Tarka, 2018). According to Anderson and Gerbing (1998), SEM is a two-step estimation technique that analyse the measurement model and structural model. The measurement model estimates the loadings and error variances of observation variables on the hypothesised constructs. Thus, Confirmatory Factor Analysis (CFA) was conducted for the constructs to see how well the observed variables are related to a set of latent variables. Afterward, the overall fit of the model was examined to determine the strength of the hypothesised causal relations among the latent constructs. Several indexes such as the comparative fit index (CFI), the Tucker-Lewis index (TLI), plus Chi-Square, root mean square error of approximation (RMSEA), standardised root mean square residual (SRMR) were applied to examine the SEM goodness-of-fit (GOF) (Kline, 1998).

5.3 Results

Table 5.2 summarises information of the sample. Data for the study were collected from a survey of 250 (63.6% male and 36.4% female) indigenous people of West Papua, Indonesia. The ages of respondents varied from 18 to 65 years, with most of the respondents were 45 to 54 years (39.6%). The education levels of the respondents range from Elementary School (33.2%), Junior High School (16.8%), Senior High School (39.2%), Undergraduate Program (4.8%), with 6% having not attending school. 50.8% (127 respondents) have a monthly income of IDR 1.8 - 3 million (£96.56 – £160.93), 46.4% (114 respondents) have an income of < IDR 1.8 million (£96.56), and only 2.8% (7 respondents) who have a monthly income of IDR 3 - 4.8 million (£160.93 - £257.48).

There was a total of 63 items included in the survey, relating to the ten factors of interest. The loading factors for all of the items are greater than 0.5 and this forming the construct. A value above 0.5 is recommended as acceptable (Kaiser, 1974), with the closer the value gets to 1, the more appropriate factor analysis is (Field, 2013). Appendix E shows factor loadings, Construct Reliability (CR) and Variance Extracted (VE).

Details of Respondents (n=250)	Frequency	%
<i>Gender</i>		
Male	159	63.6
Female	91	36.4
<i>Age</i>		
18-24	3	1.2
25-34	42	16.8
35-44	77	30.8
45-54	99	39.6
55-64	25	10.0
≥ 65	4	1.6
<i>Education</i>		
Elementary School	83	33.2
Junior High School	42	16.8
Senior High School	98	39.2
Undergraduate Program	12	4.8
Not attending school	15	6.0
<i>Relationship Status with Family Head</i>		
Family Head	76	30.4
Wife/Husband	161	64.4
Biological/stepchild	3	1.2
Son/daughter-in-law	10	4.0
<i>Number of children under 18 in the family</i>		
None	18	7.2
1 child	67	26.8
2 - 4 children	153	61.2
More than 4 children	12	4.8
<i>Marital Status</i>		
Single	16	6.4
Married	212	84.8
Widower/widow	20	8.0
Do not want to inform	2	0.8

Monthly Income		
< IDR 1.8 million (£96.56)	116	46.4
IDR 1.8 - 3 million (£96.56 – £160.93)	127	50.8
IDR 3 - 4.8 million (£160.93 - £257.48)	7	2.8
Employment status		
Working + entrepreneur	25	10.0
Working Part-Time	1	0.4
Entrepreneur	140	56.0
Not working/ looking for work	9	3.6
Retired	1	0.4
Taking care of household	68	27.2
Others	6	2.4
Means of travelling to Sago Forest		
Not going to the sago forest	7	2.8
Walking (the forest is in close proximity)	25	10.0
Riding a motorcycle	30	12.0
Taking a Speedboat	177	70.8
Other	11	4.4
Frequency to Sago Forest		
At least once a week	194	77.6
At least once a month	45	18.0
Very rarely	6	2.4
Never	5	2.0
Sago Forest Ownership		
Yes	237	94.8
No	13	5.2

Table 5. 1: Summary of demographic characteristics of respondents

The following is the calculation result of the structural model using AMOS V23.0 software. The results of SEM signified a good model fit (RMR = 0.047, RMSEA = 0.077, NFI = 0.932, GFI = 0.849, AGFI = 0.797, and TLI = 0.906). The path diagram of SEM is shown in Figure 5.2.

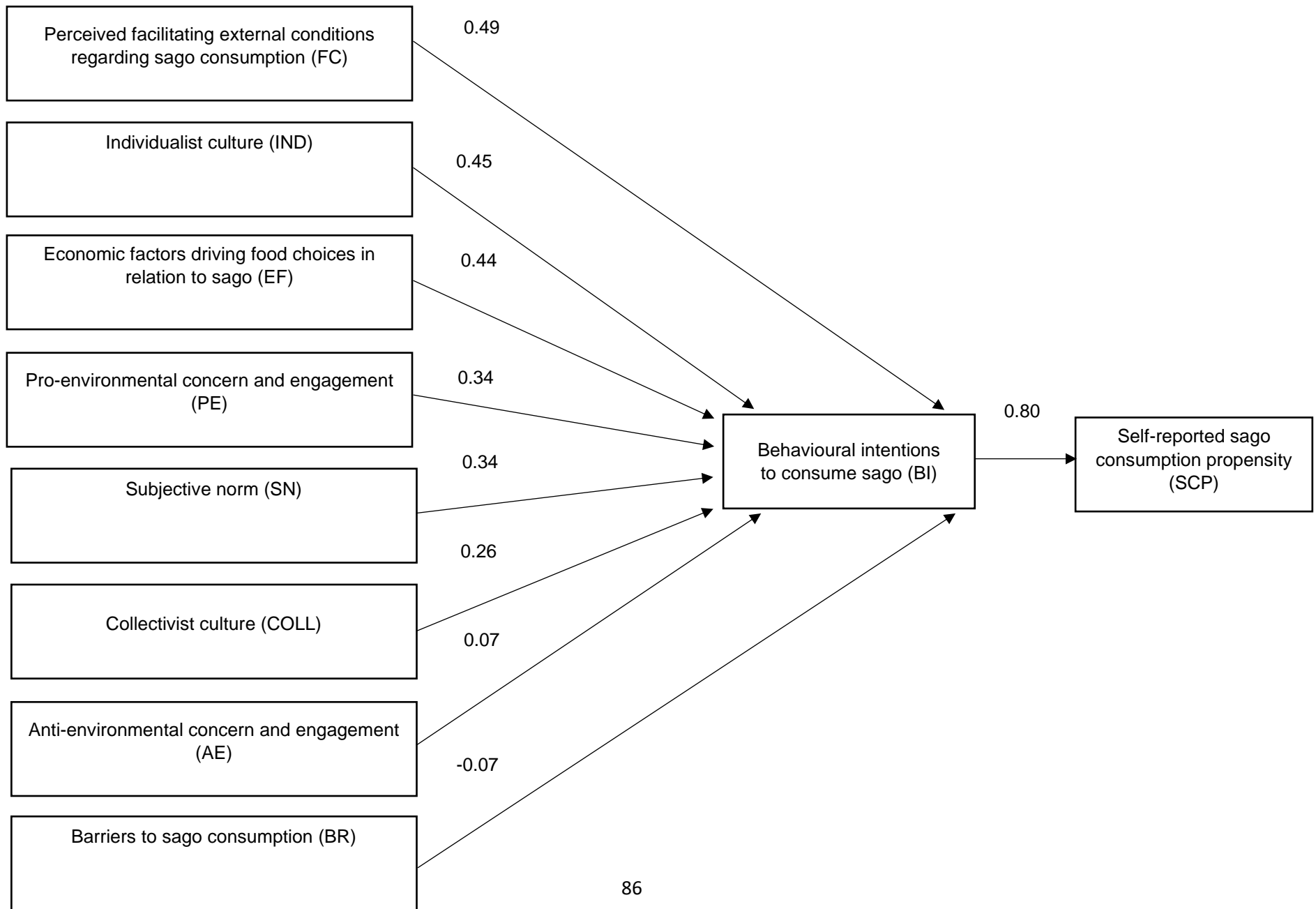


Figure 5. 2: Path Diagram of SEM

GOF	Acceptable Match Level	Model Index	Explanation
Chi-square	chi-square $\leq 2df$ (good fit), $2df < \text{chi-square} \leq 3df$ (marginal fit)	1762.4	Bad Fit
P-value	$P \geq 0.05$	0.000	Bad Fit
GFI	$GFI \geq 0.9$ (good fit), $0.8 \leq GFI \leq 0.9$ (marginal fit)	0.849	Marginal Fit
RMR	$RMR \leq 0.5$	0.047	Good Fit
RMSEA	$0.05 < RMSEA \leq 0.08$ (good fit), $0.08 < RMSEA \leq 1$ (marginal fit)	0.077	Good Fit
NFI	$NFI \geq 0.9$ (good fit), $0.8 \leq NFI \leq 0.9$ (marginal fit)	0.932	Good Fit
AGFI	$AGF \geq 0.9$ (good fit), $0.8 \leq AGFI \leq 0.9$ (marginal fit)	0.797	Bad Fit
RFI	$RFI \geq 0.9$ (good fit), $0.8 \leq RFI \leq 0.9$ (marginal fit)	0.907	Good Fit
CFI	$CFI \geq 0.9$ (good fit), $0.8 \leq CFI \leq 0.9$ (marginal fit)	0.912	Good Fit
TLI	$TLI \geq 0.9$ (good fit), $0.8 \leq TLI \leq 0.9$ (marginal fit)	0.906	Good Fit
IFI	$IFI \geq 0.9$ (good fit), $0.8 \leq IFI \leq 0.9$ (marginal fit)	0.903	Good Fit

Table 5. 2: Goodness of Fit Test

Following are the summary of the parameter estimation results from the SEM analysis.

Variables	Estimate	Critical Ratio	P-Value	Conclusion
Facilitating external conditions → Behavioural intentions	0.493	9.904	0.000	Significant
Individualist culture → Behavioural intentions	0.451	7.542	0.000	Significant
Economic factors → Behavioural intentions	0.441	7.910	0.000	Significant
Pro-environmental concern and engagement → Behavioural intentions	0.343	6.892	0.000	Significant
Subjective norm → Behavioural intentions	0.336	6.686	0.000	Significant
Collectivist culture → Behavioural intentions	0.259	6.019	0.000	Significant
Anti-environmental concern and engagement → Behavioural intentions	0.069	1.792	0.084	Non-Significant
Barriers → Behavioural intentions	-0.072	1.748	0.081	Non-Significant
Behavioural intentions → Self-reported sago consumption propensity	0.803	7.612	0.000	Significant

Table 5. 3: Hypotheses Testing

Overall, perceived facilitating external conditions made the greatest contribution to behaviour intentions to consume sago with a total direct effect of 49%,

followed by individualist culture (45%), economic factors (44%), pro-environmental concern and engagement (34%), subjective norm (34%), collectivist culture (26%), anti-environmental concern and engagement (0.07%), and barriers to sago consumption (- 0.07%). Perceived facilitating conditions such as statements: *“I would eat sago if it was made into tasty products”*, *“Sago is always available in emergencies”*, and *“There is a need to promote sago for young generations”*.

5.4 Discussion

The aims of this research were to identify the factors that influenced the consumption of sago among the indigenous people of West Papua, Indonesia. These factors were identified through a combination of literature review and the results of the stakeholder interviews. Previous research focused on the views of key stakeholders with interests in the research area and sago consumption (Sidiq *et al.*, 2022b). Hence, the current research seeks to build on empirical results from previous research by investigating the various factors from the indigenous people's perspective. Utilising SEM, the predictive influence of different dependent variables on sago consumption was analysed. The results show that some of the variables included in this research predicted sago consumption behaviour significantly in the following descending order: facilitating external conditions, individualist culture, economic factors, pro-environmental concern and engagement, subjective norm, and collectivist culture. Anti-environmental concern and engagement, and barriers to consumption, were non-significant predictors of behavioural intention.

Perceived facilitating external conditions regarding sago consumption were shown to have the highest predictive ability compared to the other variables evaluated. When people engage in food choices, they may seek easy and simple means to do so. The person will not choose the behaviour if the cost is too high, or the gain is too small for the effort expended. In the context of sago consumption by the indigenous peoples of West Papua, there are at least three main issues related to indigenous people's preferences for sago. *First*, sago is easy to obtain, especially during emergencies. This was proven during the pandemic, where people consumed more sago as a consequence of the limited supply of rice as happened in Maluku and Papua (Ansar *et al.*, 2021; Sidiq *et al.*, 2022b). However, awareness about consuming local food should not only arise during emergency times such as a pandemic. The reality is that even in conditions prior to the COVID-19 pandemic, Papua has experienced famine that resulted in fatalities (e.g., see BBC News, 2018). This is partly attributable to the high dependence on imported rice in diets, rather than relying on local

production. Furthermore, the ease of access for indigenous peoples to obtain “Raskin” (subsidised rice for poor households) is one of the main causes of the increasingly shifting patterns of people's consumption (Sidiq *et al.*, 2022b). *Second*, sago consumption will increase when sago can be processed into more attractive products in terms of sensory characteristics and convenience of preparation. Currently, the indigenous peoples of West Papua still eat sago in a simple way, as practiced from generation to generation. Sago Papeda⁸ with yellow sauce and fresh fish is a favourite food in many families (Nishimura, 2018; Ristanti *et al.*, 2019). Sago research is currently focusing on efforts to create artificial rice from sago (Sumardiono *et al.*, 2022), so that in the future sago can be consumed both traditionally and similarly to rice with a flavour that can be accepted by the wider community. *Third*, consumption of sago in indigenous peoples will increase even more when sago is massively promoted to the younger generation (see Chapter 6 for further elaboration regarding the role of the younger generation in sago as traditional food). Currently, sago is in fact frequently only present at yearly cultural events or festivals (Sidiq *et al.*, 2022b).

One of the interesting phenomena of this research is related to the collectivism and individualism variables. Individualistic cultures were the second highest predictors for the intentions to consume sago. The dichotomy between collectivism and individualism is the one that is most frequently utilised to explain cultural differences (Triandis and Suh, 2002). Previous research has indicated that, individualism tends to be more pronounced in Westernised countries (Hofstede *et al.*, 2010). However, the results of this research do not necessarily conclude that the indigenous peoples of West Papua are a collectivist society. The results show that in the context of sago consumption, individualist behavior is more dominant than collective behaviour. The extent to which people exhibit collectivist or individualist behaviour may vary across contexts and in time, however. Previous research shows that there is a

⁸ Papeda is a traditional Indonesian dish made with sago that is frequently referred to as the local porridge variety for the indigenous peoples of Papua and Maluku.

decrease in the role of the family in efforts to introduce traditional food, one of which is sago for the young generation of indigenous peoples of West Papua (Sidiq *et al.*, 2022a; See also Chapter 6). At the same time, with the increasingly massive development of information and technology, younger people are already more exposed to food choices other than sago, so that in the end it is individual choices that tend to affect their preferences between sago or other foods. In fact, this is a very good opportunity to further intensify promotion and education regarding sago as a traditional food for the people of West Papua, so that in turn, sago consumption will increase in line with the increasing public awareness of the benefits and important role of sago for people's lives.

Economic factors are the next most important predictors in relation to the intention to consume sago. Previous qualitative research has shown that sago has an economic value that benefits the families of people who grow it and/or after it has been processed and sold and has a good effect on the local economy (Sidiq *et al.*, 2022b). The results of this research are further strengthened by the data shown in table 5.1. It can be seen that 95% of participants had ownership of sago forests. This data shows that sago has economic potential that needs to be exploited. If the sago forest can be used for the greatest possible welfare of the community, then the level of the economy will be better, starting from the smallest family unit. Unfortunately, the data shows, that as many as 6 million tons of dried starch is wasted because it was not harvested every year (Djoefrie *et al.*, 2013). Furthermore, compared to rice, sago is more expensive. When the government introduce Raskin's policy (subsidised rice for poor households), the price disparity between sago and the Raskin's rice increased (Afridawati *et al.*, 2022). In addition, changes in income also cause changes in sago consumption patterns. Previous research has shown that if income increases, then the staple food consumed is increasingly rice (Sidiq *et al.*, 2022b).

Another major predictor is related to the environmental issues. The New Ecological Paradigm (NEP) scale used in this research shows that pro-

environmental concern and engagement is more significant predictor concerning the intention to consume sago. The indigenous people of West Papua are generally aware of the value of environmental sustainability and what may be done to guarantee that it is preserved. Because of this collective awareness, it appears that the indigenous peoples of West Papua view the conversion of sago forest to oil palm plantation as a mistake that needs to be remedied immediately (Indrawan *et al.*, 2019). Two palm oil firms with suspended licences are currently suing the regent of Sorong Selatan (Delegasi Papua, 2022). This company's licence has been revoked as a result of an evaluation of the licencing procedure carried out by the West Papua province and the local government, as well as indigenous peoples' expectations for welfare, security, and the long-term sustainability of the environment. This exemplifies how the sago forest conversion into oil palm plantations has turned into a new issue for the local indigenous population in Sorong Selatan.

Among the variables included in the survey, some barriers were found to have the less, and here non-significant predictive power in relation to self-reported sago consumption behaviour. Previous research has indicated that there are numerous difficulties and challenges in relation to sago production management that affect sago consumption (Sidiq *et al.*, 2022b), such as distance to and lack of infrastructure for farmers to go to sago forest and also sago processing which requires considerable time and energy. Currently, limited infrastructure is one of the biggest obstacles in sago management. However, these limitations should not hinder the process of raising awareness of the importance of sago culturally and economically. If not the indigenous people of West Papua who protect their sago forests, then who will? Although the role of both local and national government, as well as international bodies related to the issue of food security is expected to be a catalyst in efforts to raise awareness of the importance of sago for efforts to achieve food security, especially in West Papua.

Research Limitations

Due to the fact that this research was carried out during the COVID-19 pandemic, difficulties with data collection, particularly with regard to respondent availability, became a challenge. Men are more likely to be recognised the heads of families who are in charge of representing the household, and they are also easy to reach when gathering data. For this reason, men are over-represented in the sample. However, women may have greater responsibility for food preparation in households, and so the results may not be representative of the attitudes and perceptions of the overall community. The results cannot be applied to other population groups within Indonesia, and beyond, considering the fact that sago is produced and consumed not just by the indigenous people of West Papua, but also by the people in Maluku, Sumatra, and several other areas in Indonesia (Makkarenu, 2018). Future research may investigate sago consumption in other sago-producing regions in Indonesia such as Maluku and Sumatera to identify the factors influencing, intended sago consumption in relevant population groups. This would provide further evidence for policy measures which will ensure traditional foods become important pillars in the national food system. It is hoped that various policies can be produced by considering factors that can facilitate the community; not only to consume, produce, promote, but also ease of access to sago distribution to make it more affordable.

5.5 Conclusion

Indigenous people in West Papua are among Indonesia's biggest producers and consumers of sago. Sago consumption has, however, sharply declined over the years. The purpose of this research was to determine how important variables affect the consumption of sago among indigenous peoples in West Papua. According to SEM results, perceived facilitating external conditions had the greatest ability to predict sago consumption behaviour. Perceived facilitating external conditions were followed by individualist culture, economic factors, pro-environmental concern and engagement, subjective norm, collectivist culture,

anti-environmental concern and engagement, and barriers to sago consumption.

Chapter 6. Understanding the role of sago as traditional food among a group of young indigenous people of West Papua: A photovoice study

6.1 Introduction

This chapter builds upon the results of the previous chapters, as it specifically considers the attitudes of younger West Papuans regarding both sago consumption and its cultivation and preparation, and their perceptions of intergenerational knowledge processes which ensure information about cultivation and consumption, including cultural practices, is transmitted from existing producers and consumers to younger people.

There are 370 million indigenous people worldwide, with 45 percent aged between 15 and 30 years (Ortega & Franca, 2020). According to the United Nations Permanent Forum on Indigenous Issues (2010), indigenous peoples are defined as “inheritors” who inhabited a country or geographical region when people of different cultures or ethnic origins arrived. Indigenous peoples have unique cultures including in relation to environmental conservation and agronomic practices within these local contexts. Recent estimates indicate that, although indigenous peoples represent approximately 5 percent of the world's population, they account for 15 percent of the poorest people on the planet (UNDP, 2019), and face severe problems concerning food security (Sidiq *et al.*, 2022a). In addition, eighty percent of the world's biological diversity is entrusted to the care of indigenous people, including in relation to food production (FAO, 2021). As part of this, most indigenous peoples are connected to traditional food systems, which include agronomic practices involving many different plant species, at least 100 globally (Kuhnlein *et al.*, 2016). Traditional food systems are socially, culturally, and economically significant, including in relation to indigenous peoples' well-being and health (Bhat, 2012). These traditional foods are also significant because they fulfil cultural demands for maintaining regional communities' cultural heritage, traditional cuisine, and ways of life (Durst & Bayasgalanbat, 2014; Sidiq *et al.*, 2022b). At the same time, research has

indicated how important it is for intergenerational transmission of traditional knowledge and values to younger generations concerning traditional foods, culture, and identity if the role of these foods in relation to culture and ecosystem preservation is to be preserved (Demi, 2016; Islam *et al.*, 2016; Gendron *et al.*, 2017). The perceptions, attitudes, and concerns regarding intergenerational transmission of knowledge regarding sago production will be the focus of this chapter.

In West Papua, sago (*Metroxylon sagu* Rottb.) is a locally produced staple food integral to indigenous cultural traditions (Sidiq *et al.*, 2021). Sago is one of the underutilised food resources whose potential has not been fully realised (FAO, 2014). There are numerous social, economic, environmental, agronomic, and policy issues that many underutilised crops are currently facing. These crops are being used less frequently by farmers and consumers since they are not as competitive agronomically or economically as other crop species in the same agricultural environment. (Padulosi *et al.*, 2002; Padulosi *et al.*, 2013). They also compete with “western” diets which may be perceived to be more convenient or attractive. The sago palm has been recognised as an underutilised food resource with a high potential for contributing to local, regional, and global food security (Konuma, 2018). However, its continued production and consumption is dependent on its adoption by younger generations. In addition, it has been observed that traditional food crops are more adaptable to local agronomic contexts, emphasising their importance for providing food and nutrition security and resilience in relation to food system shocks, particularly during and after a natural disaster (Shava *et al.*, 2009; Mavhura *et al.*, 2013; Sambo, 2014). Previous research has indicated that the amount of greenhouse gas (GHG) emissions needed to create 1 ton of sago (17.9 kgCO₂eq) is significantly less than those required to produce corn starch (2700 kgCO₂eq), potato starch (2402 kgCO₂eq), and cassava starch (4310 kgCO₂eq) (Yusuf *et al.*, 2019). Moreover, sago palms have higher CO₂ absorption compared to other important commodity crops like corn and rice and can preserve soil water because the plants need high soil humidity (Bintoro *et*

al., 2018). Sago was reported to provide food security during Covid-19 pandemic when supply chain disruptions for other commodity crops were disrupted (Sidiq *et al.*, 2022b). However, there is evidence that, in the research region, people will choose rice as their preferred dietary option even when food security has improved (Sidiq *et al.*, 2022b). Even though Indonesia has the largest sago palm plantations worldwide, with around 1.1 million hectares (ha) of sago palm across the country (Konuma, 2018), sago consumption is very low (0.36 kg per capita per year) in comparison to other commodities, such as rice (97.1 kg per capita per year) and wheat (18.2 kg per capita per year) (Ministry of Agriculture, 2018).

Previous research which has considered sago as a food has focused on the sago plant's physical and chemical properties (Nisar & Hussain, 2022; Ahmad *et al.*, 2022; Ghalambor *et al.*, 2022), rather than on the issue of sago consumption in the community and the role within local culture, including by younger people. Recent research into sago consumption in West Papua has been limited to the perspectives of a limited number of stakeholders (Sidiq *et al.*, 2022b) or on quantitative analysis using regionally representative samples of research participants (Sidiq *et al.*, in preparation; chapter 5). There is no exploratory, qualitative research available that has considered the attitudes of younger people in West Papua to sago in dietary, cultural, and environmental contexts and concerning food security and the role of sago in traditional diets.

The objectives of this research were to: (a) explore how younger people in West Papua understand and value sago as traditional food, (b) explore their experiences in preparing and consuming sago, (c) investigate how information is transmitted to the younger generation of West Papua about sago in terms of diet and cultural identity, together with potential barriers to its consumption in this context.

6.2 Methods

Photovoice methodology was used to explore the perspectives of younger West Papuans in relation to sago, local cultural, and agronomic contexts. Photovoice methodology is a flexible arts-based methodology used by research participants to chronicle their thoughts and experiences in relation to issues of interest by taking pictures. Interviews are then used to explain the stories behind these pictures (Wright *et al.*, 2016). Photovoice methodology has been established as a culturally relevant, methodologically robust, and ethically sound research technique across a range of sociocultural contexts, including those involving indigenous peoples (Castleden & Garvin, 2008; Wright *et al.*, 2016). Additionally, photovoice methodology has been found to be a particularly effective method for including younger participants in research because they have the chance to develop and validate their skills, share their observations and understandings, and allow them to contribute positively to their communities and society (Strack *et al.*, 2004). Photovoice has three main goals, which are to enable people: (1) to record and reflect their community's strength and concerns, (2) to promote critical dialogue and knowledge about community issues through group discussions of photograph, (3) to reach policy makers regarding issues in society (Wang, 2022). Photovoice methodology has been applied to a wide range of research topics, including understanding of perceptions and experiences of health of young people in the US experiencing homelessness during the Covid-19 pandemic, (Damian *et al.*, 2022), how people with severe stroke experience community mobility in a power wheelchair in Berlin/Germany (Bottger *et al.*, 2022); the interactions among coastal communities and their environments adjacent to a marine protected area in Brazil (Dias & Armitage, 2021); food security issues from parents' in low income families in the US, (Lindow *et al.*, 2021); nursing and medical student's experience of access to healthy food in Qatar, (Al-Hamad *et al.*, 2022); and of relevance to the current research, how indigenous young people in Canada understand of traditional foods (Hanemaayer *et al.*, 2020).

The use of semi-structured interviews allowed for the collecting of extensive, in-depth data from the participants. Open-ended inquiries about the participants' preferences for food, both personally and within their families, as well as their opinions and experiences with sago, were explored. The narratives behind each photo taken by participants, and their reasons for taking and selecting it, were also gathered through a series of questions. Ethical approval was received from the University of Newcastle, UK ethics committee, Project #: 19-SI-014, on the 28th of February 2019, prior to data collection. The interview protocol was focused around these questions:

1. What story of sago did you want to share from your photos?
2. What are your experiences regarding sago? (e.g., planting, harvesting)
3. What is the role of family, community, and religious leaders in consuming sago?
4. What are the activities related to sago in the region?
5. What are the drivers and barriers to consuming sago?
6. What are your suggestions to increase sago's availability, access, and consumption?

Eight younger people aged 18-22 were recruited from the Sorong Selatan, West Papua community. They were recruited, and participated, in the research between June and October 2021 (Table 1). The researcher chose pseudonyms at random to remove the participants' identities, and those of any persons, organisations, and locations referenced in interviews and other text data gathered for research (Heaton, 2022). All eight volunteers (four male and four female) were between the ages of 18 and 22 at the time of their involvement in the data collection. To provide an overview of the research project, each participant and the lead researcher were members of the same WhatsApp group used specifically to meet the needs of this research. Since the beginning of this research, I, in my role as researcher, have consistently made clear my position as an active public servant who was granted a scholarship by the government. In this context, I have explicitly stated my impartiality within the context the research, highlighting that the outcomes were not subject to any

external influence. I have acknowledged, however, that my positionality as a government official may have influenced the research findings in various ways (Patnaik, 2013). Participants may have emphasized or omitted issues due to perceived alignment with government agendas (Harrington, 2003). My identity may therefore have led participants to present themselves differently than if I, as a researcher, was employed outside of a government role (Harrington, 2003). Therefore, in conducting this research, I attempted to be as transparent as possible with the participants, involving gatekeepers who actively reassured the participants that I had no intention of doing them any harm as part of the research. It was emphasised throughout the course of the research that individual participants would not be identified and that the research was purely for the academic interest of the researcher to provide recommendations for the government.

Participants were asked to take as many pictures of sago-related activities, including its production and consumption, as they thought were interesting or relevant. They were requested not to include any human beings in their photographs in order to safeguard privacy. For their interviews, participants selected 3-5 of their images to discuss. Zoom was used to digitally record the interviews. The duration of the interviews ranged from 50 to 78 minutes.

The interviews were transcribed verbatim by the lead researcher after the initial data collection was completed. The transcripts of the interviews were cleaned of participant names and other potentially identifying information, such as family names. The content of the interview transcripts and photographs was analysed using thematic analysis, a methodology for comparing and contrasting the viewpoints of various research participants and generating unexpected findings (Nowell *et al.*, 2017; Braun & Clarke, 2006; King, 2004). The data were managed and analysed using NVivo (QSR International Pty Ltd, 2020), a qualitative research analysis tool, which included transcripts of the interviews and photo images. The interview transcripts were coded, then grouped into themes that related to the research goals. The collected photographs were also

subjected to a thematic analysis. To allow for simultaneous analysis, photos and interview transcripts were organised within the same database.

Participant Pseudonym	Gender	Age	Educational Background
Selfia	Female	18	College student
Martina	Female	21	College student
Novela	Female	18	College student
Yomima	Female	21	College student
Yakonias	Male	22	College student
Abner	Male	19	College student
Agustinus	Male	19	College student
Jacob	Male	19	College student

Table 6.1: Study Participants

6.3 Results

Three primary themes emerged from the participants' interviews and photos. Some of the submitted photos will be used to illustrate each theme alongside quotes from the participants. These were (1) the knowledge of sago, (2) the role of sago in the family and community, and (3) sago consumption habits and food preferences.

6.3.1 Theme 1: The young indigenous people of West Papua have a basic knowledge of sago

At the beginning of the interviews, the researcher (FS) asked what the participants thought when they heard the word "sago". All the participants answered "Papeda", and one participant added "Papua" as an answer. Papeda is a traditional dish from Indonesia that is made with sago. It is often called the "local porridge" for the indigenous peoples of Papua, Maluku, and some areas in Sulawesi (Indonesia, 2019). Papeda and Papua were thought to have become inseparable parts of everyday life. Figure 6.1 shows a ready-to-eat papeda with vegetables and yellow gravy fish, which is a typical Papuan dish.

Papeda must be consumed if we return home to Papua. If you have not consumed it, we have not reached Papua (Jacob, 19).

Hearing sago is like hearing the word home, which is something unique to Papua (Abner, 19).



Figure 6.1: Yomima, 21

Some young people included in the research discussed the lengthy process which has to be taken before they can eat processed sago-based foods such as papeda and other foods. Figure 6.2 displays a sago tree that has been cut down.

For sago [food] to be prepared, the process can take weeks. First, the sago tree must be cut down. Then, the tree is cut into pieces (Selfia, 18).

... then we cut it for about 2-3 metres, peel the skin, and chop it into little pieces. Next, it is usually taken to be washed by moms. As a result, papeda as well as other sago preparations like pastries will be prepared later (Yakonias, 22).



Figure 6.2: Agustinus, 19

The young people included in this research not only understood sago to be their staple food, and how sago is prepared for consumption, but some also expressed an interest in learning to process sago that is ready for harvest. The pith that has been produced is ready to be processed to the next stage (Figure 6.3).

I had sufficient time to learn how to cut sago stems (Jacob, 19).

Men are mostly responsible for cutting down sago trees, whereas I can wash and squeeze the sago pulp because I have done so before (Yomima, 21).



Figure 6.3: Abner, 19

In general, all the participants understood that knowledge about sago contributed as part of their cultural identity. However, compared to the other

participants, one participant added some additional information. Martina presented images of the sago grubs (Figure 6.4 and 6.5) and other participants discussed the sago tree and the production of sago.

Therefore, if the sago tree that is ready for harvest is not processed right away, the sago grubs that live in it will cause the sago tree to rot (Martina, 21).



Figure 6.4 & Figure 6.5: Martina, 21

6.3.2 Theme 2: The role of sago in the family and community

The family plays an important role in encouraging sago eating from a young age. Sago consumption is a habit that starts at home and contributes to the Papuan people's general understanding of the need to protect sago as a staple food. All participants agreed that mothers have a significant role in introducing sago to children's diets from an early age.

It has been customary for the family to consume papeda on Sundays and holidays (Jacob, 19).

Since most families also eat sago, the family plays a significant role in its consumption (Abner, 19).

A mother's influence on sago consumption is significant (Martina, 21).

My mother prepared papeda so that it could all fit in one pan, allowing us to all sit down and eat as a family. We also eat it with yellow gravy fish (Yakonias, 22).

The family's role has influenced the young people of West Papua, who recognise the value of sago as a traditional food, to spread healthy information about consumption throughout their community through various digital platforms, such as via social media. The participants wanted to demonstrate to their community that they cared and contributed in this way. Additionally, the community can benefit from the sago processing facilities that the local government has established locally (Figure 6.6). Participants expressed that view that everyone involved, including local governments, must work together to promote and preserve the culture of eating sago. To further stimulate the interest of the Papuan people in sago, the view was expressed that various innovations related to sago must be promoted, including new foods produced from sago and to promotion and marketing innovations for more people to become aware of, and potentially consume sago products to more people.

We may start introducing sago through social media to both Papuans and those outside of Papua so that everyone is aware of its significance and practical uses. Or it might be by creating a specific kiosk or cafe for sago, especially given that sago is used in many different types of foods (Jacob, 19).

I desire prominent Papuans or influential individuals who can promote sago as a traditional Papuan food to increase its visibility to others (Abner, 19).

Sago, in my opinion, can be developed to be transformed into new dishes or variations outside papeda, like cendol or sago-based cakes. (Novela, 18).



Figure 6.6: Abner, 19

6.3.3 Theme 3: Sago consumption habit and food preferences

Sago consumption had developed into a habit for some of the research participants, one closely connected to their daily lives. In order to maintain this consumption habit, there needed to be intergenerational knowledge transmission and information dissemination. Participating in the preservation of sago-eating culture was believed to contribute to protecting the forests from which the sago is sourced.

We were raised on sago since we were young children, therefore it goes without saying that we will continue to eat it as it is our primary source of food, and we cannot rely on rice (Martina, 21).

Sago is a traditional food from Papua that must be introduced, shared, and preserved because it comes directly from the forest (Jacob, 19).

However, sago was not commonly considered as a staple food by some of the research participants. The most popular food choice is still rice.

Sago is not usually consumed every day; perhaps twice or three times in a month. I find that eating papeda does not fill me up; typically, after 15 minutes, I'm already hungry (Agustinus, 19).

Sago is not something I consume frequently; I only do so when I wish to; otherwise, I consume rice as usual (Novela, 18).

However, for some participants, when given the choice between sago and rice, sago was the preferred option.

I consume papeda each day. This does not apply to my younger siblings, as they favour rice on average. This also depends on the habits formed during childhood (Yakonias, 22).

Papeda is tastier than rice if I had to choose between the two foods to consume, especially when combined with yellow gravy fish (Selfia, 18).

The lack of facilities and supporting infrastructure was perceived by participants to be one of the challenges in managing sago processing. Participants indicated that sago processing by machines (Figure 6.7) is still relatively limited and only available in certain locations. There are still many people that process sago using manual methods.

People in my village do not support the use of machinery to prepare sago. They favour manual methods (Yakonias, 22).

In order to save the community from having to open new roads, the local government is currently assisting by constructing a connecting road to the sago forest and preparing production equipment (Jacob, 19).



Figure 6.7: Abner, 19

Sago processing requires extensive inputs in terms of time and effort from all the people involved, including farmers, processors, and on the part of those responsible for food preparation prior to consumption. One of the lengthy steps in the processing of sago is shown in Figure 6.8. After being split into pieces, the sago stems must go through a machine refining process, then be moved on to washing and drying.

Sago harvesting typically takes between a week and a month, depending on the size of the sago tree and the number of sago trees that will be chopped down (Martina, 21).

If a machine is used, it will take 1 day to harvest 1 sago tree. However, doing it manually could take days (Novela, 18).

Sago consumption at home depends on what my parents cook, whether it's roasted sago, papeda, or meals already prepared with sago flour in Teminabuan. Even so, I continue to consume more papeda every day (Novela, 18).



Figure 6.8: Selfia, 18

The participants perceived that they have a responsibility to preserve the tradition of eating sago, and that this responsibility extends to the entire West Papuan community, including the local government. According to the

participants, local government currently plays a relatively small contribution in safeguarding the sustainability of West Papua's sago-eating culture.

Local governments still have a limited role, particularly when it comes to spreading information about sago, including its advantages and where to buy it, so that young people in Papua and elsewhere in the country can do so with ease (Jacob, 19).

There are still very few local government promotions, such as cultural festivals. (Agustinus, 19).

There is still a limited role for community and religious leaders in urging people to eat sago; for instance, there is no specific announcement made in that regard (Martina, 21).

6.4 Discussion

This research is the first, to our knowledge, to use photovoice methodology to examine perspectives and experiences with sago as a traditional food among young indigenous people in the research area, and indeed within West Papua. When participants heard the word "sago," all responded in a similar way. The first word that occurs they mentioned was "Papeda," which refers to the main dish they typically consume made with sago, followed by the phrase "Papua," which denotes the region in where the participants live. This reflects the observation that Papeda, a characteristic traditional cuisine, has a unique history locally. The tribes in Papua are familiar with the mythology of sago, which tells the tale of human incarnation with numerous stories and names. This is evident from the Sentani people's beliefs, who hold that their first ancestor emerged from the earth with the help of his siblings, one of whom evolved into sago. In the provinces of Papua and Maluku, people don't just organise special celebrations in appreciation of the plentiful harvest; they also offer sago during first-child ceremonies, use it as a painkiller while getting tattoos, and celebrate a girl's puberty (Redaksi Indonesia, 2019; Kusumo, 2022). Thus, the people of Papua regard sago more than food. The participants in this research felt strongly connected to the cultural identity that was passed down from the previous generation, which includes knowledge and consumption

of traditional foods. In particular, the perspective of indigenous peoples has been used in a growing body of research to study culture as a crucial component in the understanding of food security (Kuhnlein *et al.*, 2009; Demi, 2016; Skinner *et al.*, 2016; Huambachano, 2018). Food security encompasses not just the agricultural methods used to generate sufficient food for everyone in the world (Huambachano, 2018), but also indigenous perspectives on the relationships and linkages between individuals and their natural environment (Ratima *et al.*, 2019).

The research participants expressed their familiarity with sago as a traditional dish. This is evidenced participants being knowledgeable about agronomic practices, including harvesting, from chopping down sago trees to preparing papeda that the whole family can eat. The mother introduces sago to the family from an early age, providing this basic knowledge within the family environment. As a result, the family plays an important role in establishing the foundation for the development of the habit of consuming sago. This supports research which has shown that women employ indigenous knowledge more frequently than men to ensure household food security (Ibnouf, 2012; Belahsen *et al.*, 2017; Kuhnlein, 2017; Lemke and Delormier, 2017; Mkumbo, 2017; Sirisai *et al.*, 2017; Aluko, 2018; Chapter 3).

Previous research has suggested that insufficient traditional knowledge about traditional foods represents an important obstacle to access and consumption (Luppens & Power, 2018; Neufeld *et al.*, 2017; Kuhnlein & Receveur, 1997; Elliot *et al.*, 2012). These results suggest that all participants in the research have sufficient knowledge of, and access to, sago, although this may be a consequence of self-selection in relation to participation - people who are interested in sago volunteered as contributors to the research. However, even in this small sample including this analysis, 2 participants indicated that they were not regular consumers of sago, as there were other alternatives available. This may, in part, be a consequence of the introduction of commercial food products, which have displaced the consumption and production of traditionally

harvested and prepared foods within household contexts foods (see also Padulosi *et al.*, 2002; Egeland and Harrison, 2013; Kuhnlein *et al.*, 2013).

One participant produced photographs of sago grubs (figure 4 and 5), which depicts sago trees from a more agronomic perspective. The sago grub is one of the pests that affects sago plants which will cause damage and decay if the stems were not cut down and processed immediately (Leatemala *et al.*, 2021), although sago grubs can also serve as a source of protein both for humans and livestock (Leatemala *et al.*, 2021; Kohler *et al.*, 2020). Martina passionately described her experience with sago grubs demonstrating how sago has many potential benefits.

Previous research has shown that the central and local governments have, and recognise, that they have, some responsibility for sago and its development (Sidiq *et al.*, 2022b). The participants in this research perceived that the local government is paying minimal attention to sago. There is a perception that there is an insufficient supporting infrastructure (roads and processing facilities), lack of active promotion by government regarding the health and environmental benefits of sago consumption, for example through exhibitions and festivals to promote sago and derivative foods. Research participants mentioned social media and sago-only cafes as a way to revive the local preference for producing and eating sago. For some participants, community activities involving sago were identified as their sole exposure to traditional foods (see also Skinner *et al.*, 2016). Furthermore, participants perceived that promotion of sago consumption is not only the responsibility of the government; the community and the private sector also have an important role in sago promotion. Hence, promoting sago consumption requires collaboration between the community, government, and private sector.

The adoption of the photovoice approach, which encourages young people to share their experiences through photographs and also participate through narratives, was a strength of this research. Through the application of this

methodology, participants actively engaged in issues that directly affected their lives. However, the absence of photo exhibitions to engage the broader community, one of the six stages of photovoice (Castleden and Garvin, 2008), is one of the limitations of this research. Ideally, the photovoice should be linked to a photo exhibition to promote community engagement, where participants can showcase their work and tell their story to the community and decision makers. Given that all research was conducted online, a consequence of the Covid-19 pandemic, a full exhibition was not possible, although some of the selected photographs were made available online (<https://akucintasagu.id/>). Furthermore, the small sample of participants included in the research cannot be assumed to be representative of all young people in West Papua, and so the results are not generalisable. In particular, it is possible that participants interested in sago self-selected themselves for this research, and so the results may be more positive or reflect greater interest than is typical within this age group.

Future research might therefore include more, and potentially more diverse, participants within the targetted age group, as well as including more people of different ages age groups, and educational backgrounds in relation to knowledge exchange and intergenerational information transmission. In addition, potential differences in behaviours in relation to agronomic practices and sago consumption, and the drivers of these behaviours might be further investigated using this methodology. This may be more informative in relation to policy and, if appropriate, sago promotion strategies and interventions.

6.5 Conclusion

Photovoice methodology was used to investigate the perspectives and experiences with sago as a traditional food, using a sample of younger, indigenous people within a localised area of Sorong Selatan regency, West Papua. Photos and narratives show the concerns and commitment of participants to contribute to the development of sago as part of their traditional food and cultural identity, although further research at greater scale is required

to generalise the results to West Papua and to understand the concerns of other age groups and those with other demographic and experiential characteristics.

Chapter 7. General Discussion

7.1 Introduction

This chapter draws together the findings from the systematic review on traditional diets for the indigenous peoples of LMICs (Chapter 2), the review on sago and the indigenous peoples of Papua (Chapter 3), the qualitative stakeholder interviews (Chapter 4), the quantitative survey with 250 indigenous peoples of West Papua (Chapter 5), and a photovoice study among a group of young indigenous people of West Papua (Chapter 6). Based on the findings, evidence to support policy will be discussed. This will provide information relevant to the future development of sago policy, not only in West Papua but also in Indonesia, as part of national policy directed towards increased sago consumption. In addition, the research limitations in the thesis are discussed, along with recommendations for future research activities to address these limitations and gaps in existing knowledge, as well as other promising areas for future research.

7.2 Summary and synthesis of results and implications of findings in relation to answering the original research questions

The thesis started with an overall objective, to study the indigenous peoples of West Papua and their traditional food resource; sago (*Metroxylon sagu* Rottb.) and to understand if there is a need to promote and preserve traditional food knowledge of sago based on local culture and agronomic practices, which has potential to improve local food security and reduce reliance on food imports. A series of related, relevant research questions was identified. The first was focused on understanding the role of traditional diets for food security for indigenous peoples in Low-and Middle-Income Countries (LMICs) (Chapter 2, published as Sidiq *et al.*, 2022a). The review suggested that traditional foods have a significant role in promoting and maintaining food security in local indigenous communities, as well as in the preservation of traditional cultures (Reyes-Garcia *et al.*, 2018; UNPFII, 2010; Shava *et al.*, 2009; Finnis, 2007; Longvah *et al.*, 2017; Singh *et al.*, 2013). Moreover, because such diets are based on locally produced foods that contribute to local ecological systems, they have a positive environmental impact on conserving the environment in which they are embedded (Erni, 2015; Gewa *et al.*, 2019; Paul *et al.*, 2018; Chyne *et al.*, 2017; Meldrum *et al.*, 2018). The systematic review suggested that there is a need to

promote, preserve, and ensure intergenerational knowledge traditions about agronomic and preparation practices in relation to traditional foods, as well as the cultural traditions with which they are associated. The review also indicated that women were constantly overlooked or undervalued in regard to achieving and sustaining food security and traditional diets (UNPFII, 2010; Kuhnlein *et al.*, 2013), despite the fact that women have knowledge pertinent to ensuring food security (Wane, 2003). While there exists a considerable literature considering the issue of traditional diets and indigenous communities who produce and consume them, most research has been conducted outside of the region of interest in this thesis, West Papua, Indonesia (e.g., in Kiribati; India; Kenya; Bolivia; and Zimbabwe). While it may be expected that research might focus on specific cases (Swanepoel *et al.*, 2020; Ravera *et al.*, 2019; Reyes-Garcia *et al.*, 2018), the systematic review indicated that there is limited research assessing sago as a traditional food, in relation to food security, local culture, and biodiversity, including for the indigenous peoples in West Papua, Indonesia. Considering that Indonesia is the largest sago palm growing areas worldwide (Konuma, 2018), research related to sago production (from an agronomic, environmental, and social-cultural context) is important, in order to understand its role in local culture, its potential to contribute to maintaining local food security and the balance of the ecosystem in local food systems, and the potential socio-economic, cultural, and practical barriers and facilitators of its production and consumption, (including climate change and local policy drivers of agronomic practices). Therefore, sago-related activity is a beneficial activity that promotes the indigenous peoples' way of life, both culturally and environmentally.

Given the importance of traditional food for indigenous peoples, Chapter 3 (published as Sidiq *et al.*, 2021) addressed this gap, and specifically focused on reviewing existing knowledge regarding sago production and consumption by indigenous peoples in Papua, Indonesia. Insufficient publications (n = 37) were initially identified to justify conducting a systematic review, and so a traditional review was conducted. Despite sago palm's enormous potential to contribute to food security, little has been accomplished in cultivation, processing, and marketing in Malaysia and Indonesia, the two major world commercial sago producers (Jong, 2018). In the context of sago consumption in Papua, the local and national government, academia, and private sectors need to work together to promote awareness about the importance of sago consumption as a staple food. One of the challenges faced is the low level of

consumption of sago compared to other commodities such as rice and wheat. At the same time, a downward trend in national production needs to be counteracted by national and local policy initiatives implemented by government.

An important issue relates to the food system's resilience to system shocks, for example in relation to local food insecurity crises and how these are managed (Godfray *et al.*, 2010). A case in point is provided by the consideration of local food security issues in Papua, during the global pandemic. The indigenous peoples of Papua faced problems in relation to their food supply. Their response was to make compensatory increases in sago production and consumption (Sidiq *et al.*, 2021). At the same time, the pandemic highlighted that humanity cannot only depend on relatively small numbers of crops, those involving long or complex food supply chain, or which are dependent on imported commodities and foods for food security (Food and Agriculture Organization, 1995). Research has shown that about 30 crops provide 95% of human food energy needs, four of which (rice, wheat, maize, and potato) are responsible for more than 60% of our energy consumption globally (Konuma, 2018). Due to the reliance on this relatively small number of crops for global food security, it will be essential to maintain a high genetic diversity to cope with growing environmental stress and to give farmers and researchers opportunities to breed for crops that can be grown in unfavourable conditions, like drylands, wetlands, swamps, and saline soils, and that are tolerant of extreme weather conditions. Hence, sago is one of the underutilised food crops, which is adapted to local agronomic conditions, and can be an alternative solution to contribute to food security as an additional source of staple foods which can be grown in underutilised wetlands and swamps where other food crops cannot be grown economically and produce high yields of starch (Konuma, 2018). The review suggested that sago helped local farmers' financial well-being by increasing their revenue, fostering the region's circular economy through the reuse of sago wastes, which lessens the pollution caused by sago processing industries, and by offering a cost-effective option for waste management systems (Awg-Adeni *et al.*, 2010; Abu Hasan *et al.*, 2021).

Given that there is evidence that increased sago production has potentially beneficial effects on food security, local ecosystems and reservation of cultural traditions, it is important to identify the barriers to, facilitators of, and opportunities for sago

cultivation and production. Research was conducted which aimed to understand local stakeholder perceptions of these barriers, facilitators, and opportunities (Chapter 4, published as Sidiq *et al.*, 2022b). Semi-structured interviews were conducted to assess stakeholder perspectives on these key issues. Relevant stakeholders were identified to include politicians, local and national civil servants, academia, sago farmers, and local food activists. The results suggested that these stakeholders perceived that sago represented a traditional food that is essential to, and inseparable from, every aspect of Papuan culture, human and environmental health and local people's stewardship of their environment. The stakeholders interviewed indicated that they thought ensuring the continuation of, and indeed increasing, sago consumption would increase food security within West Papua, and that future policies relevant to food security should be established to promote sago production and consumption. Despite the fact that sago has long been considered the staple food of the Papuan people and has a special place in their culture as a requirement for certain tribal traditional ceremonies (Kadir *et al.*, 2022), there is evidence from stakeholders that sago consumption within the general diet of Papuans is declining. However, since sago is a locally cultivated food that has been adapted to the agronomic and climatic conditions of the region, it has the potential to drastically lessen the Papuan population's reliance on imported food supplies, as indeed was the case in the case of the COVID-19 pandemic, which has interrupted the food supply chain. However, it is important to note that the perceptions and attitudes of stakeholders may not corroborate with the views of the general population, or groups of people in the general population, who hold different perceptions and attitudes. For this reason, a quantitative survey was conducted to understand if stakeholder views aligned with those held by local people who did not hold specific stakeholder "identities" in relation to food security policy or other aspects of sago production. This was investigated in Chapter 5, which utilised survey methodology to identify the psychological, social-economic, and cultural drivers of sago consumption within the local population. A survey instrument was developed from the results of a systematic review (chapter 2), the existing literature (chapter 3), and qualitative interviews with key stakeholders (chapter 4). The survey was designed to identify the factors which acted as barriers to, or facilitated, the inclusion of sago in the diets of West Papuans. Two hundred and fifty indigenous people from Sorong Selatan Regency, West Papua Province were recruited into the study. The results are consistent with previous research (Sidiq *et al.*, 2022b, see chapter 4), which shown that sago has economic

value that benefits the families of those who cultivate it and/or after it has been processed and sold, as well as has a positive impact on the local economy. However, other factors were also shown to be important determinants of sago consumption, including external facilitating conditions, concern about, and engagement with, the environment, and the “subjective norm”, the extent to which relevant peer groups “approved” sago consumption practices. Interestingly, alignment with collectivist culture did not predict sago consumption, which is dependent on community agronomic and processing practices to some extent but was better predicted by alignment with an individualist cultural perspective, potentially because sago consumption daily is no longer considered a “normative” practice within the surveyed communities. Given that production and consumption may no longer be perceived as currently relevant, a concern arises as to whether sago production and consumption will continue to be practiced in the future, and for this reason it is important to understand the perspectives of younger West Papuans in relation to both production and consumption.

It is important to understand the needs of younger people tasked with continuing the agricultural production and food preparation, as well as consumption practices associated with sago, if the benefits to their cultural identity, food security and the local environment are to be continued in the future. Photovoice methodology was used in a case study to investigate how a small group of younger people in West Papua perceived and used sago as a traditional food. The results suggested that these younger people living in the region have basic knowledge of sago as traditional food and are aware of its significance to the family and community. Participants also noted obstacles to eating sago, such as a lack of processing facilities and infrastructure that would allow for easy access to sago markets and forests. They also stated their desire to help conserve and preserve sago as a vital element of West Papuan indigenous peoples' culture. It was determined that these younger individuals express both concerns and a desire to uphold the sago tradition in order to support the growth of sago as a component of their traditional diet and sense of cultural identity, although it was noted that the population may have “self-selected” themselves as individuals with a particular interest in sago production, processing, and consumption.

The empirical work presented in this thesis indicated that there is viability in promoting sago as a traditional food, and potential for its continued production and consumption to promote food security, including in relation to its future consumers. At the same time, the role of both local and national government in promoting its production and consumption requires further clarification. Policy development should also take due account of stakeholder and consumer perspectives, priorities, and preferences, (Sorrentino *et al.*, 2018; Bevi *et al.*, 2019), including those citizens who are both primary producers and consumers of sago. Taken together, the results of this thesis suggest that the community and the private sector have potential to play a significant role in promoting the consumption of sago, which is not just a policy issue, and hence not just the government's responsibility. Therefore, encouraging sago consumption necessitates cooperation between the public, business, and non-profit sectors.

Overall, this thesis provides a starting point for understanding sago as a traditional food resource for the West Papuan indigenous peoples, as well as the need to promote and preserve sago-based traditional food knowledge. It is important to balance the interests of all stakeholders and interested people involved in better sago management in the future while also meeting the demands of the indigenous people's community regarding sago.

7.3 Significance of thesis findings

If they were to adopt sago as a source of sustenance and income, indigenous communities in West Papua have potential access to a number of viable options. These options can vary based on their geographical location, cultural context, accessible resources, and market opportunities. Realistic options include traditional consumption (Chapter 2 and 3, published as Sidiq *et al.*, 2021; Sidiq *et al.*, 2022a), small-scale sago production (Haryanto, 2015; Humaerah *et al.*, 2020), value-added sago products (Sumardiono *et al.*, 2022), and sago tourism villages (Fitriani *et al.*, 2022). To make sago adoption viable, support could come through training programs in cultivation techniques, product development, and business/marketing skills. Private sector partnerships could facilitate technology transfers and collaboration on product R&D, quality standards and distribution channels. NGO support in community organization, financing and early market access could help operations become self-sustaining. Government services assisting with training, inputs and market linkages

could catalyse wider commercialization of sago for food security and economic growth.

Expanding sago production and consumption beyond indigenous communities has the potential to bring benefits to both indigenous and non-indigenous populations. However, it is important to do this through a process of co-creation that respects the rights, knowledge, and cultural heritage of the indigenous communities involved, or who are stakeholders in the issue at hand, while promoting sustainable practices (Hasibuan et al., 2018). Some considerations for expanding sago production and consumption include:

- Cultivation and awareness: non-indigenous communities can be introduced to sago cultivation and encouraged to grow sago palms in suitable tropical regions. This expansion could be supported through agricultural training, access to seeds or seedlings, and awareness campaigns about the nutritional and economic benefits of sago (Yaakub et al., 2023).
- Market expansion: by introducing sago products to a wider market, such as urban areas or regions outside the traditional sago-producing regions, demand can be increased (Makkarennu et al., 2018). Market support could help smallholder sago farmers and Indigenous peoples leverage the commercial potential of sago, but only if done through a rigorous stakeholder engagement process respecting community priorities, knowledge, and consent.
- Tourism and cultural exchange; Sago-producing indigenous communities can benefit from sustainable tourism initiatives that showcase their culture and traditional practices, including sago production. Tourists interested in authentic experiences and local products can help boost the local economy (Fitriani et al., 2022).

While traditional sago extraction methods may have limited impacts on deforestation, the expansion of oil palm plantations has been a major driver of deforestation, causing habitat loss, biodiversity decline, and carbon emissions (Numata et al., 2022). The competition for land between oil palm plantations and traditional sago cultivation can disrupt local communities and their cultural practices, potentially leading to social and economic challenges. Sustainable land-use practices and conservation efforts are needed to address these interrelated issues and mitigating their negative impacts on the environment and local communities.

Promoting the cultivation and consumption of traditional foods like sago can help maintain food sovereignty by preserving local knowledge and promoting biodiversity (FAO, 2019b). Over time, the definition of food sovereignty has been expanding, from its initial focus on national self-sufficiency in food production to local self-sufficiency (Agarwal, 2014). In the context of sago and indigenous peoples, food sovereignty emphasizes the right of communities to determine their own food systems and plays a crucial role in the relationships between sago and the well-being of local populations. Efforts to promote sustainable land use, protect indigenous rights, and support traditional food systems can contribute to a more equitable and food-secure future. By incorporating the best practices outlined in the community and stakeholder engagement in Food, Energy, and Water System (EngageINFEWS) conceptual framework (Kliskey et al., 2021), such as establishing respect and trust, facilitating collaborative knowledge co-creation and policy shaping among stakeholders, and providing for ongoing refinement through evaluation, greater stakeholder input has the potential to help develop policy solutions around land use, indigenous rights and traditional food systems that are more equitable, culturally appropriate and locally endorsed for environmental sustainability.

7.4 Methodological approach

The empirical data collection associated with this thesis research was carried out during the COVID-19 pandemic, in 2021. Due to a number of current restrictions, the data collecting, and analysis process used a methodology adjusted to contemporary “lock-down” requirements and restrictions on travel. Use of ICT technology, including virtual conferencing and interviewing methods such as Zoom, enabled data collection to occur. However, it is not known whether more “in-person” ethnographic methods would have delivered different results and conclusions, nor whether the pandemic itself influenced participant perceptions.

In terms of the different research stages, a systematic review was the initial step to systematically looking for relevant subjects from primary studies relevant to the goals of this research. This identified a gap in relation to sago and West Papua, which was confirmed in the second review.

The comparison between stakeholders and citizens perceptions indicated and confirmed that continued sago production and consumption was a good thing and

identified barriers and facilitators in relation to continued inclusion in local diets. The application of an in-depth case study methodology with younger people confirmed the results for younger people living in the region, and as well identified potential for future development on sago production and processing. It is notable that quantitative, qualitative, and ethnographic methods pointed to the same conclusions - that continued production and consumption of sago is regarded as have positive impacts in future food security, but government policy, infrastructural development, and industry collaboration is needed if a strategy for future development is to be successful.

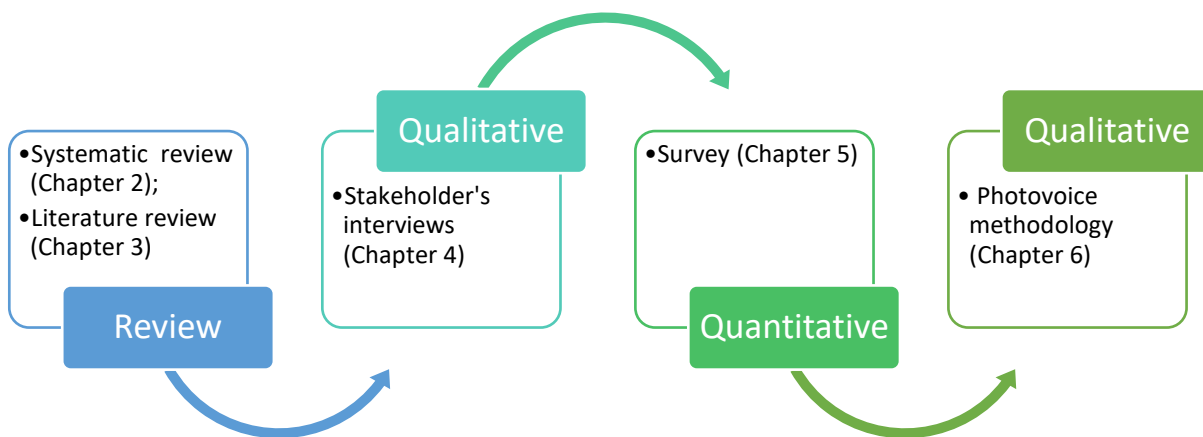


Figure 7.1: Methodological approach

7.5 Policy implications

The findings of this thesis provide evidence upon which policy implications associated with the promotion of sago production consumption among indigenous peoples of West Papua can be developed and can be described as follows.

7.5.1 Raising awareness of sago as traditional food

Taken together, the literature reviews and empirical chapters provide evidence to suggest that the tradition of producing and consuming sago may deliver multiple benefits both to local communities (in terms of food security, livelihoods, and continuation of cultural traditions), and to local environments and ecological systems. It is a tradition which merits, preservation and protection. Some existing policies militated against this (e.g., Raskin's subsidised rice for poor households policy). Other policy initiatives might usefully focus on rebuilding awareness to all indigenous community of West Papua as a staple food in the family, as well as in cultural or

religious festival activities, might focus as a prominent inclusion on diet and public health communication interventions. One strategy to revive people's interest for sago is to provide basic knowledge about production, processing, and its advantages to food security and the local environment. Some specific benefits were also identified. For example, sago grubs—which are generally regarded as pests— may also have importance as a source of protein for people and animals. Future research and associated communication strategies might usefully promote sago to the public, starting with family units, in order to promote the inclusion of sago in the diet. Some targeted health communication might also be useful. For example, recent research has shown that sago is not only beneficial for healthy people, but also one of the food sources of carbohydrates suitable for consumption by diabetics (Syariful Thamid, 2022).

7.5.2 Improve production and processing infrastructure

Limited infrastructure and supporting facilities are one of the major challenges in sago management. The indigenous people of Papua continue to be concerned about issues such as inadequate machinery and tools for harvesting sago, as well as limited road access to the sago forest. Consequently, one option is to construct local processing facilities in each district to bring people closer, to provide convenience to the community to access the sago forest, and the harvesting process. Alternatively, improved transport infrastructure might facilitate sago production, but this would still not overcome barriers associated with issues associated with harvesting in local forests.

7.5.3 Inclusion of sago in public procurement and initiatives

Although sago has been recognised as one of the local foods for the indigenous people of Papua, sago has yet to gain its economic value. Sago is still less competitive economically to produce than rice, which is the main agricultural commodity in Indonesia. Government efforts to make sago a strategic commodity, by providing incentives and funding allocations to support its development, are needed. Furthermore, the inclusion of sago in public procurement will make sago a commodity which is associated with more uninterrupted supply chains and price stability.

7.5.4 Penta Helix collaboration and co-production of policies

As discussed, the management of sago production, processing and market access is not only the responsibility of the national or local governments. To operationalise modern and sustainable sago management, the institutions, and individuals who constitute the "Penta Helix" pillars—public authorities, industry, academia, non-governmental organisations (NGOs), and citizens—have equal roles and responsibilities on the co-production of policy. Penta Helix is an extension of the triple helix strategy that entails collaborating with diverse members of the public or non-profit organisations to bring the innovation to life (Sturesson *et al.*, 2009). This research represents an initial step towards building more intensive communication and knowledge exchange between key stakeholders, including the public. It can be challenging to give all types of actors the encouragement and inspiration they need to become involved in sago management; however, by taking the first step—identifying current stakeholders with Penta Helix—has paved the way by providing the necessary structure to build an engaging and well-organised sago management implementation process. Previous research has shown that many different stakeholders are involved and interested in sago management (Sidiq *et al.*, 2022b). Therefore, excellent collaboration between existing stakeholders is needed to ensure effective management of the supply chain. From primary production through consumption.

7.5.5 Empowerment of women and younger people in relation to promoting and preserving sago-eating culture

This research has shown how women and younger people potentially a very important role in preserving the culture of producing, preparing, and eating sago. Sago is first introduced to the family by the mother, who imparts this fundamental knowledge to family members. It is within family structures that the groundwork (for example, knowledge about preparation practices) is transmitted from one generation to the next. This is consistent with research which has shown that women are more likely than men to use indigenous knowledge to safeguard the security of the household's food supply (Wane, 2003). At the same time, the younger people who participated in this research expressed the concerns regarding contribute to the development of sago as part of their traditional food and cultural identity, although they were also committed to this goal. Policies which focus on, for example, school

education as well as working with women's groups regarding the promotion of sago as a staple food, as well as one representative of local culture, may be important.

7.5.6 Effective regulatory framework

Currently, policies related to sago are embedded in the specific regulations regarding food implemented by the national government (Laws of the Republic Indonesia No. 18 of 2012 concerning food). Even though sago has been recognised as one of the local foods in Indonesia, in practice, sago and other local foods have not received sufficient policy attention, either from the national or local government. The national government is currently still focusing on rice as the main agricultural commodity in relation to food security. Foods other than rice are still perceived as "inferior" in terms of nutrition, by the public. There is a proverb that states that if someone has not had rice, they have not eaten. This proverb applies to Indonesians in general.

To date, the Raskin policy (where subsidised rice is provided for poor households) represents one of the government's main policies to support low-income people. However, every region in Indonesia has produced, and had access to, local carbohydrate-based foods which have been their staple food before this was substituted by rice under this policy. Incentivising sago consumption might occur through introducing policies which subsidise (processed) sago as a food or provide financial policy levers elsewhere in the sago supply chain, such as in relation to processing sago facilities. The government can also change existing interventions, for example in relation to Raskin, by substituting rice, or by providing subsidies reducing retail prices with local foods which have equivalent, or better nutritional properties.

7.6 Strength of the research presented in this thesis

The strengths of the research presented in this thesis lies in its innovative methodological approach targeting an applied problem in the area of local diets and food security. Different methodological approaches were applied in the empirical phases of the research, where the research questions were identified through application of systematic review methodology to enabling improved understanding of the factors influencing consumption of sago in West Papua by indigenous people. The application of qualitative methodology captured the perspectives of relevant stakeholders in responding to food security issues, particularly those related to sago.

This allowed comparison with the perceptions and attitudes of local people regarding sago consumption, which were assessed using quantitative methodology to facilitate assessment a greater scale.

Confirmation of the results were provided by the photovoice methodology involving the participation group of young people in West Papua regarding the importance sago as a traditional food, which also had potential to contribute to local ecosystems and the development of the local economy. Evidence for policy development was identified in the results, allowing identification of recommendations regarding sago cultivation, processing, and consumption. This research has indicated the importance of continued exploration and innovation in the field, and the methodological approaches developed can be applied in research elsewhere in Indonesia and beyond, to understand factors influencing the consumption and production of local diets. Thus, overall, this research adds to the existing literature regarding the importance of local diets in ensuring food security, particularly for indigenous people who are dependent on staple food (such as sago) that will allow them to continue, maintain and preserve their culture and traditions. It also highlights the relevance of the application of a mixed method approach to investigate complex issues, such as those examined in this thesis.

7.7 Research limitations and future research directions

This thesis has provided evidence of that sago has local importance in West Papua, not only as a traditional food and in terms of its contribution to local culture, but also as a commodity with potential to improve food security for the indigenous peoples of West Papua. However, some research limitations and gaps in knowledge have been identified.

First, the empirical research in the thesis focused on discussing sago that is consumed daily (e.g., in the form of Papeda). Other food processing innovations may be a topic of future research, for example in relation to innovative new products which increase the convenience of sago consumption, or even provide added functional properties such as fortification with vitamins and minerals, or other nutrients (Rasulu *et al.*, 2021). Sago also has potential in realising benefits in relation to the circular bioeconomy (Awg-Adeni *et al.*, 2010), which may contribute to improved environmental functioning and sustainability. Future research could assess

the potential for exploitation of sago as a food crop that is not only used for consumption - also waste and by-products can be used to produce new products and commodities, such as fermentable sugar, enzymes, composts for mushrooms, animal feeds, and adsorbent. The advantage of such an approach, if successful, would be the creation of new employment and economic opportunities which can benefit the local community (Kumar Awasthi *et al.*, 2022).

Second, the research is limited in terms of geography and scale to one regency in West Papua, Indonesia. The results need to be compared against data from other sago-producing areas in West Papua and other islands such as Sumatra and Maluku. This is important, considering that Indonesia is an archipelagic country with various cultural traditions that are different from one another, as well as potentially varying infrastructures, supply chains and agronomic conditions and farming practices. It is necessary to consider all existing factors before formulating the best national policies in relation to the management of sago in Indonesia. In addition, other countries may also benefit from similar research programmes. Due to the conversion of sago-growing wetlands and swamps for other purposes, such as the expansion of industrial crops like oil palm and rubber trees, the number of sago palms has significantly decreased in places like Papua New Guinea, Malaysia, Thailand, the Philippines, and others where sago plays an important role as a source of income generation for poor rural communities (Konuma, 2018).

Third, although the research presented here has involved younger people (in particular the photovoice diaries presented in chapter 6), it has not focused on understanding *how* the transmission of cultural values is passed down from generation to generation. Future research might usefully anticipate globalisation factors that can directly influence the mindset of the indigenous younger people in accepting, or at least recognising, the importance of their local culture values (Chenhall & Senior, 2009). Furthermore, intergenerational knowledge exchange may mean including members of previous generations in such research. To encourage broader community engagement, the photovoice should be connected to a photo exhibition where participants can present their work and share their stories with the public and decision-makers, and this should be integrated into future research activities. Here, an *in situ* exhibition was not feasible as a result of the COVID-19 pandemic, but some of the chosen photographs were posted online to promote

broader community engagement (<https://akucintasagu.id/>), although this might exclude those community members with limited access to the internet. Furthermore, future research must consider what targeted marketing interventions are appropriate in promoting sago as a traditional food for the indigenous people of West Papua. As suggested by the younger people of West Papua included in this research, the use of social media and sago-based cafes may represent impactful approaches to promote the sago-eating culture among the indigenous community but may not necessarily be inclusive. Using targeted marketing strategies, which take into account the information needs and information channels accessible by different consumer groups, may facilitate sago consumption.

Finally, the research presented in this thesis was limited by the COVID-19 pandemic. It was initially intended that the research with indigenous peoples by communicating and interacting directly to experience daily life through an ethnographic approach and direct observation. As a direct consequences of the pandemic, the role of the gatekeeper became more important in the data collection process. Furthermore, it was originally intended that coproduction of the research objectives, methods and policy translation activities would occur through direct interaction with the researcher, explicitly embedding the research process in the Responsible Research and Innovation (RRI) framework. None the less, the research adopted the Global Code of Conduct for Research in Resource-Poor Settings from the four TRUST values: *fairness, respect, care, and honesty* (Trust Project, 2018). These four values were the foundation of activities throughout this research process.

7.8 Conclusion

This research aimed to understand barriers to, and facilitators of, the preservation and promotion of sago (*Metroxylon sago* Rottb.) as traditional food resource among the indigenous peoples of West Papua. Drawing together the findings from qualitative and quantitative research, the synthesis of results has shown the importance of maintaining and preserving sago consumption culture for the Papuan people, and the local environment for which they have stewardship. A variety of factors influence the production, processing and consumption of sago such as sago supply chain, motivators and barriers to production and consumption, and multi stakeholder collaboration. Evidence for policy was provided, and various policy recommendations were identified, ranging from those which involved citizen engagement, policy

changes focusing on educational, economic, and infrastructural change, and local empowerment of youth and women's groups.

Although this research has been confirmed to a limited geographical area, implications for developing more effective policy frameworks to benefit the sago management policy in Indonesia can be identified. However, further research-based evidence may be required to refine and attune policies and interventions to local cultural contexts and conditions.

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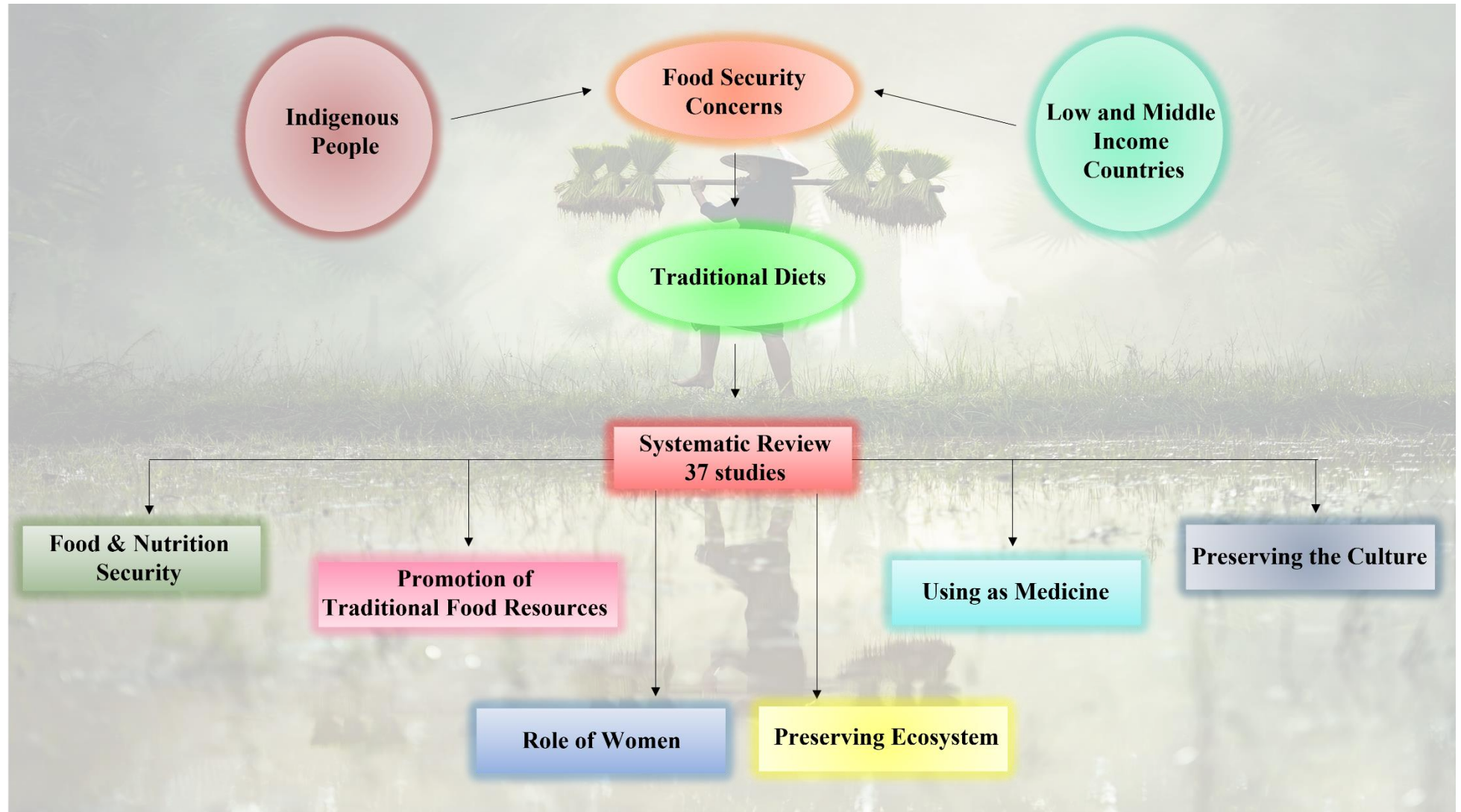
Appendix A. Search Terms for Five Databases

Search #	Query	Number of Articles
<i>Scopus</i>		
<i>(26/05/2020)</i>		
# 1	"traditional food*" OR "indigenous food*" OR "traditional diet*" AND "Indigenous People*" OR "primitive" OR "orang asli" OR "native" OR "aboriginal" AND "food security" OR "food resilien*" OR "food safety" OR "food availability" OR "food sufficiency"	89
# 2	"traditional food*" OR "indigenous food*" OR "traditional diet*" AND "Indigenous People*" OR "primitive" OR "orang asli" OR "native" OR "aboriginal" AND "food security" OR "food resilien*" OR "food safety" OR "food availability" OR "food sufficiency"	5
<i>(29/05/2020)</i>		
# 3	"traditional food*" OR "indigenous food*" OR "traditional diet*" AND (indigenous OR native OR primitive OR "orang asli" OR aboriginal) AND people* AND (security OR insecurity OR resilien* OR safety OR availability OR sufficiency) AND food*	118*
<i>ProQuest</i>		
<i>(26/05/2020)</i>		
# 1	("traditional food" OR "traditional foods") OR ("indigenous food" OR "indigenous foods") OR ("traditional diet" OR "traditional diets") AND ("indigenous people" OR "indigenous peoples") OR "primitive" OR "orang asli" OR "native" OR "aboriginal" AND "food security" OR "food resilience" OR "food safety" OR "food availability" OR "food sufficiency"	253,734
# 2	("traditional food" OR "traditional foods") OR ("indigenous food" OR "indigenous foods") OR ("traditional diet" OR "traditional diets") AND ("indigenous people" OR "indigenous peoples") OR "primitive" OR "orang asli" OR "native" OR "aboriginal" AND "food security" OR "food resilience" OR "food safety" OR "food availability" OR "food sufficiency"	4,448
<i>(28/05/2020)</i>		
# 3	"traditional food*" OR "indigenous food*" OR "traditional diet*" AND (indigenous OR native OR primitive OR "orang asli" OR aboriginal) AND people* AND (security OR insecurity OR resilien* OR safety OR availability OR sufficiency) AND food*	1,029*
<i>Web of Science</i>		
<i>(28/05/2020)</i>		
	("traditional food" OR "traditional foods") OR ("indigenous food" OR "indigenous foods") OR ("traditional diet" OR "traditional diets") AND ("indigenous people" OR	514,211

# 1	"indigenous peoples") OR "primitive" OR "orang asli" OR "native" OR "aboriginal" AND "food security" OR "food resilience" OR "food safety" OR "food availability" OR "food sufficiency"	
(29/05/2020) # 2	"traditional food*" OR "indigenous food*" OR "traditional diet*" AND (indigenous OR native OR primitive OR "orang asli" OR aboriginal) AND people* AND (security OR insecurity OR resilien* OR safety OR availability OR sufficiency) AND food*	186*
Google Scholar (28/05/2020) # 1	("traditional food" OR "traditional foods") OR ("indigenous food" OR "indigenous foods") OR ("traditional diet" OR "traditional diets") AND ("indigenous people" OR "indigenous peoples") OR "primitive" OR "orang asli" OR "native" OR "aboriginal" AND "food security" OR "food resilience" OR "food safety" OR "food availability" OR "food sufficiency"	17,500
(29/05/2020) # 2	"traditional food*" OR "indigenous food*" OR "traditional diet*" AND (indigenous OR native OR primitive OR "orang asli" OR aboriginal) AND people* AND (security OR insecurity OR resilien* OR safety OR availability OR sufficiency) AND food*	17,000
#3	"traditional diet*" AND "indigenous people*" AND "food security"	511*
EBSCOhost (CAB Abstracts) (29/05/2020) # 1	"traditional food*" OR "indigenous food*" OR "traditional diet*" AND (indigenous OR native OR primitive OR "orang asli" OR aboriginal) AND people* AND (security OR insecurity OR resilien* OR safety OR availability OR sufficiency) AND food*	187*

* Recommendation Search

Appendix B. Graphical Abstract



**Appendix C. Consolidated criteria for reporting qualitative studies (COREQ):
32-item checklist**

Manuscript: Factors Influencing Consumption of Traditional Diets: Stakeholder Views regarding Sago Consumption among the Indigenous Peoples of West Papua.

Developed from:

Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

No. Item	Reported on #
Domain 1: Research team and reflexivity	
<i>Personal Characteristics</i>	
1. Interviewer/facilitator	<p>Fathir Fajar Sidiq is a PhD student at School of Natural and Environmental Sciences, Newcastle University. He is interested in using mixed methods to investigate food policy in Indonesia, particularly sago as traditional food for the indigenous peoples of Papua.</p> <p>David Coles whose background is in chemistry and ethics, is a Senior Research Fellow at the Centre for Professional Ethics, UCLan, a Research Associate at the University of Newcastle’s School of Agriculture, Food and Rural Development and Director of Enhance International Ltd. His interests include ethical and risk communication issues, particularly in relation to food production and security, biomedical ethics, multidisciplinary, converging and emerging technology research, innovation and the relationship between science, technology and policy.</p> <p>Carmen Hubbard is a senior lecturer in Center for Rural Economy at School of Natural and Environmental Sciences, Newcastle University. She is a quantitative researcher with the area of expertise in agricultural economics focusing on the economics and political economy of Common Agricultural Policy (CAP), agriculture and rural development, farm animal welfare, applied welfare economics, and comparative country analysis.</p> <p>Beth Clark is a research associate at School of Natural and Environmental Sciences, Newcastle University. Her research interests include exploring the use of mixed and evidence-based methods in</p>
2. Credentials	
3. Occupation	
4. Gender	
5. Experience and training	

	exploring public perceptions towards animal welfare and meat consumption, specifically qualitative and quantitative systematic reviews, and mixed qualitative research methods. Lynn J. Frewer is a professor of food and society at School of Natural and Environmental Sciences, Newcastle University. She has interests in all areas of food and society, including those areas which require transdisciplinary collaboration between the social and natural sciences.
<i>Relationship with participants</i>	
6. Relationship established	Page 3
7. Participant knowledge of the interviewer	Page 3
8. Interviewer characteristics	See above
Domain 2: study design	
<i>Theoretical framework</i>	
9. Methodological orientation and Theory	Page 3
<i>Participant selection</i>	
10. Sampling	Page 3
11. Method of approach	Page 3
12. Sample size	Page 3
13. Non-participation	N/A
<i>Setting</i>	
14. Setting of data collection	Page 4
15. Presence of non-participants	Page 4
16. Description of sample	Page 4
<i>Data collection</i>	
17. Interview guide	Page 4
18. Repeat interviews	N/A
19. Audio/visual recording	Page 4
20. Field notes	Page 4
21. Duration	Page 4
22. Data saturation	Page 4, 10
23. Transcripts returned	N/A
Domain 3: analysis and findings	
<i>Data analysis</i>	
24. Number of data coders	Page 5
25. Description of the coding tree	N/A
26. Derivation of themes	Page 5
27. Software	Page 5
28. Participant checking	N/A
<i>Reporting</i>	
29. Quotations presented	Page 6 – Page 9
30. Data and findings consistent	Page 9 – Page 10

31. Clarity of major themes	Page 9 – Page 10
32. Clarity of minor themes	Page 10

Appendix D. Semi-Structured Interview Materials (Chapter 4)

CONSENT FORM

Title of Study: Is Sago the Answer to Food Security in West Papua, Indonesia?

Thank you for your interest in taking part in this research. Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research study. You will be given a copy of this Consent Form.

Please Initial box to confirm consent		
1	I confirm that I have read / being read the information sheet dated [] for the above study, I have had the opportunity to consider the information, ask questions and I have had any questions answered satisfactorily	
2	I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without any penalty or loss of benefits.	
3	I consent to the processing of my personal information [food consumption, dietary diversity pattern] for the purposes of this research study, as described in the information sheet dated []	
4	I consent to my pseudonymized research data being stored and used by others for future research.	
5	I understand that my research data may be published as a report.	
6	I understand that my research data may be looked at by individuals from the Government of Indonesia and Newcastle University, where it is relevant to my taking part in this research.	
7	I consent to being audio and/or video recorded and understand that the recordings will be stored on password-protected software and used for research purposes only.	
8	I agree to take part in this research project	
	Participant	

	<p>Name of participant Signature Date</p>
	<p>Researcher</p> <p>Name of researcher Signature Date</p>

INFORMATION SHEET

Title of Study: Is Sago the Answer to Food Security in West Papua, Indonesia?

Invitation and Brief Summary

You are being invited to take part in a research study. Before you decide whether you wish to take part it is important that you understand why the research is being done and what it will involve. Please read this information carefully and discuss it with others if you wish. Take time to decide whether you wish to take part. If you do decide to take part, you will be asked to sign a consent form. However, you are free to withdraw at any time, without giving any reason and without any penalty or loss of benefits.

What is the purpose of the research?

This research will focus on food security in Papua and the extent to which sago as local and traditional food plays an important role in food diversification. In addition to that, this research will critically assess the implementation of Indonesia's food policy, especially in West Papua, where the government has formulated a plan for dealing with problems of food security.

What does take part involve?

The overall time for this research is 3 months, that will include preparation time, permission from the local government of South Sorong Regency and Head of Districts. Household survey will collect data from 250 participants, equally distributed between male and female participants. There will be five enumerators who will help researcher to collect data of the households in five districts (Matemani, Kais, Kokoda, Teminabuan, Seremuk) Researcher will conduct key informant interviews (n=22) and field observation to experience the daily activities in Teminabuan Districts, in the sago forest, or any other activities.

What information will be collected and who will have access to the information collected?

We will use your name and contact details to contact you about the research study. Individuals at Newcastle University may look at your research data to check the accuracy of the research study. If you agree to take part in the research study, your data will become part of a dataset which can be accessed by other users running other research studies at Newcastle University and in other organizations. Your information will only be used by organizations and researchers to conduct research.

Information provided by you will be pseudonymized and made available to researchers. The information will only be used for the purpose research and cannot be used to contact you. It will not be used to make decisions about future services available to you.

Why have I been invited to take part?

Purposive sampling will be used to select five districts (*Kokoda, Kais, Teminabuan, Matemani, dan Seremuk*) in South Sorong regency, West Papua province. These five districts were purposefully chosen for some of the reasons: the significant size of sago plantation, the traditional and cultural wealth of local people regarding sago, and the existence of sago factory in the regency.

What are the benefits?

This study will benefit at least three things. First, increase the awareness of the community of the potential for sago being one of the fundamental solutions for food security and to improve the livelihood of the community. This could mean that the people of Papua may become less dependent on rice as staple food. Second, an increase in the awareness of the community may encourage government allocation of more funding resources to increase productivity and to create economic value from sago and design effective policies regarding sago and food security. Lastly, community engagement based on trust, respect, and transparency will have a positive education value for young generations so that they can understand the importance of sago for Papuan food security in the future.

Who is the sponsor and data controller for this research?

Newcastle University (United Kingdom) and LPDP (Indonesia) is the sponsor for this study. Newcastle University will be using information from you in order to undertake this study and will act as the data controller for this study. This means that Newcastle University is responsible for looking after your information and using it properly. The lawful basis for carrying out this study under the General Data Protection Regulation (GDPR) is a "Task in the Public Interest", (Article 6,1e) as research is cited as part of the University's duties.

Your rights to access, change or move your information are limited, as Newcastle University need to manage your information in specific ways for the research to be reliable and accurate. If you withdraw from the study, Newcastle University will keep the information about you that has already been obtained. To safeguard your rights, the minimum personally identifiable information will be used.

Has this study received ethical approval?

This study has received ethical approval from the Faculty of Science, Agriculture and Engineering Ethical Review Committee.

Who should I contact for further information relating to the research?

Professor Lynn Frewer

Professor of Food and Society

Email: lynn.frewer@ncl.ac.uk

Telephone: +44 (0) 191 208 8272

Room 3.17

3rd Floor

Agriculture Building, Newcastle University, Newcastle Upon Tyne, NE1 7RU

Fathir Fajar Sidiq

Newcastle University, Agriculture Building 5th Floor

f.f.sidiq2@newcastle.ac.uk

(+44) 07576261322

Semi-Structured Interview Protocol

Time of interview :
Date :
Place :
Interviewer :
Interviewee :
Position of Interviewee :

Questions (*specific stakeholders will have certain questions. These questions will only use as a general guidance*):

1. What has been your role in the household?
2. What has happened since people got introduced to eat rice?
3. What has happened to the culture of sago consumption as staple food?
4. Why is sago important for the people of Papua?
5. What are the challenges and obstacles faced by the people of Papua to consume sago?
6. What do you think is the best way to preserve the culture?
7. Who is responsible to bring back the culture to the society?
8. What kind of activities to bring back the traditional culture of sago consumption?
9. What is the potential of sago in the context of economic value?
10. What is the role of academia in promoting sago?
11. What is the best policy for promoting sago? What do you think with the current local and national policy regarding sago?
12. During the COVID-19 pandemic, were you aware of any cases/incidents where households or community members faced food shortages? If yes, what kind of strategy is done to overcome this? Has any external assistance (eg government, donor agencies, volunteers, etc.) been received by the affected communities? What form does this assistance take?
13. Are you aware of a significant increase in sago consumption during the COVID-19 pandemic?

(Thank the individual for participating in this interview. Assure him or her of confidentiality of responses and potential future interviews)

Appendix E. Survey Materials

Online Questionnaire

A. Demographic	What is your gender? <ul style="list-style-type: none"><input type="radio"/> Male<input type="radio"/> Female<input type="radio"/> Prefer not to say
	What is your age range? <ul style="list-style-type: none"><input type="radio"/> 18 – 24 years<input type="radio"/> 25 – 34 years<input type="radio"/> 35 – 44 years<input type="radio"/> 45 – 54 years<input type="radio"/> 55 – 64 years<input type="radio"/> > 65 years
	What is the highest degree or level of education you have completed? <ul style="list-style-type: none"><input type="radio"/> Not attending school<input type="radio"/> Elementary school<input type="radio"/> Junior High School<input type="radio"/> Senior High School<input type="radio"/> Bachelor's Degree<input type="radio"/> Master's Degree<input type="radio"/> Doctoral Degree<input type="radio"/> Other (please specify)
	How many children under 18 are living in the household? <ul style="list-style-type: none"><input type="radio"/> None<input type="radio"/> 1<input type="radio"/> 2 – 4<input type="radio"/> More than 4
	Marital status? <ul style="list-style-type: none"><input type="radio"/> Single

	<ul style="list-style-type: none"> <input type="radio"/> Married <input type="radio"/> Divorced <input type="radio"/> Widowed <input type="radio"/> Prefer not to say
	<p>What is your monthly household income before taxes? Include all income received from social security, retirement, investments, etc.</p> <ul style="list-style-type: none"> <input type="radio"/> < Rp. 1.8 million <input type="radio"/> Rp. 1.8 – 3 million <input type="radio"/> Rp. 3 – 4.8 million <input type="radio"/> Rp. 4.8 – 7.2 million <input type="radio"/> > Rp. 7.2 million
	<p>What is your employment status?</p> <ul style="list-style-type: none"> <input type="radio"/> Employed <input type="radio"/> Employed part-time <input type="radio"/> Self-employed <input type="radio"/> Not currently employed, looking for work <input type="radio"/> Retired <input type="radio"/> Household manager <input type="radio"/> Disabled (not working because of permanent or temporary disability) <input type="radio"/> Other (please specify)
	<p>What is the common means of travel that you use to reach sago forest?</p> <ul style="list-style-type: none"> <input type="radio"/> I don't go to sago forest <input type="radio"/> By walking (the forest is within walking distance) <input type="radio"/> Need to go by motorcycle <input type="radio"/> Need to go by speedboat <input type="radio"/> Other (please specify)
	<p>How often do you go to the sago forest?</p> <ul style="list-style-type: none"> <input type="radio"/> At least once per week <input type="radio"/> At least once per month <input type="radio"/> Very rarely

	<ul style="list-style-type: none"> ○ Never
	<p>Does your family have cultural ownership rights to sago forest?</p> <ul style="list-style-type: none"> ○ Yes ○ No ○ I don't know
	<p>Does your household produce your own food for your family?</p> <ul style="list-style-type: none"> ○ Yes. If yes, please specify what food do you produced: (.....) ○ No
B. Self-reported sago consumption propensity	<p>On a scale from 1 (strongly disagree) to 5 (strongly agree) to what extent do you agree or disagree with the following statements</p> <ol style="list-style-type: none"> 1. I enjoy eating sago 2. I prepare sago to eat 3. I consume sago everyday
C. Behavioural Intentions to consume sago	<p>On a scale from 1 (strongly disagree) to 5 (strongly agree) to what extent do you agree or disagree with the following statements</p> <ol style="list-style-type: none"> 1. I intend to consume sago within one month 2. Sago is important for my diet 3. Consuming sago is beneficial 4. Consuming sago is enjoyable 5. Consuming sago means preserving traditional culture
D. Economic factors driving food choices in relation to sago	<p>On a scale from 1 (strongly disagree) to 5 (strongly agree) to what extent do you agree or disagree with the following statements</p> <ol style="list-style-type: none"> 1. Sago which has been prepared is expensive to buy 2. Sago is more expensive than rice 3. I will not eat sago if my salary increases 4. The government should subsidize sago 5. I cannot support my family if I only depend on sago forests 6. I am happy with the income I earn
E. Subjective norm	<p>On a scale from 1 (strongly disagree) to 5 (strongly agree) to what extent do you agree or disagree with the</p>

	<p>following statements</p> <ol style="list-style-type: none"> 1. It is expected of me that I consume sago 2. Most people who are important to me think that I should I consume sago 3. My friends do not eat sago 4. My friends eat sago
F. Facilitating external conditions regarding sago consumption	<p>On a scale from 1 (strongly disagree) to 5 (strongly agree) to what extent do you agree or disagree with the following statements</p> <ol style="list-style-type: none"> 1. I enjoy eating traditional foods 2. I enjoy preparing traditional foods 3. I like eating traditional foods within my community 4. Traditional foods like sago are good for my environment 5. I would eat sago if it was made into tasty products 6. Sago is always available in emergencies 7. There is a need to promote sago for young generations 8. Sago is prepared for me at home
G. Pro-environmental concern and engagement	<p>On a scale from 1 (strongly disagree) to 5 (strongly agree) to what extent do you agree or disagree with the following statements</p> <ol style="list-style-type: none"> 1. We are approaching the limit of the number of people the Earth can support 2. When humans interfere with nature it often produces disastrous consequences 3. Humans are seriously abusing the environment 4. Plants and animals have as much right as humans to exist 5. Despite our special abilities, humans are still subject to the laws of nature 6. The Earth is like a spaceship with very limited room and resources 7. The balance of nature is very delicate and easily upset 8. If things continue on their present course, we will soon experience a major ecological catastrophe
H. Anti-environmental concern and engagement	<p>On a scale from 1 (strongly disagree) to 5 (strongly agree) to what extent do you agree or disagree with the following statements</p> <ol style="list-style-type: none"> 1. Humans have the right to modify the natural environment to suit their needs 2. Human ingenuity will ensure that we do not make the Earth unliveable 3. The Earth has plenty of natural resources if we just learn how to develop them

	<ol style="list-style-type: none"> 4. The balance of nature is strong enough to cope with the impacts of modern industrial nations 5. The so-called "Ecological Crisis" facing humankind has been greatly exaggerated 6. Humans were meant to rule over the rest of nature 7. Humans will eventually learn enough about how nature works to be able to control it
I. Collectivist culture	<p>On a scale from 1 (strongly disagree) to 5 (strongly agree) to what extent do you agree or disagree with the following statements</p> <ol style="list-style-type: none"> 1. Parents and children must stay together as much as possible 2. It is my duty to take care of my family, even when I have to sacrifice what I want 3. Family members should stick together, no matter what sacrifices are required 4. It is important to me that I respect the decisions made by my group 5. If a co-worker gets a prize, I would feel proud 6. The well-being of my co-workers is important to me 7. To me, pleasure is spending time with others 8. I feel good when I co-operate with others
J. Individualist culture	<p>On a scale from 1 (strongly disagree) to 5 (strongly agree) to what extent do you agree or disagree with the following statements</p> <ol style="list-style-type: none"> 1. It is important that I do my job better than others 2. Winning is everything 3. Competition is the law of nature 4. When another person does better than I do, I get tense and aroused 5. I'd rather depend on myself than others 6. I rely on myself most of the time, I rarely rely on others 7. I often do my own thing 8. My personal identity, independent of others, is very important to me
K. Barriers to sago consumption	<p>On a scale from 1 (strongly disagree) to 5 (strongly agree) to what extent do you agree or disagree with the following statements</p> <ol style="list-style-type: none"> 1. Sago is difficult to prepare 2. I do not like the taste of sago 3. I enjoy foods from "Western" restaurants 4. Sago is very difficult to harvest

	<ul style="list-style-type: none">5. Sago is time consuming to prepare6. Sago forest is being exploited by sago companies
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Factor Loadings, CR (Construct Reliability), VE (Variance Extracted)

Variables	Factor Loadings										CR	VE	
	1	2	3	4	5	6	7	8	9	10			
(1) Self-reported sago consumption propensity												0.844	0.647
1. I enjoy eating sago	0.799												
2. I prepare sago to eat	0.917												
3. I Consume sago everyday	0.680												
(2) Behavioural intentions to consume sago												0.864	0.572
1. I intend to consume sago within one month		0.605											
2. Sago is important for my diet		0.514											
3. Consuming sago is beneficial		0.880											
4. Consuming sago is enjoyable		0.943											
5. Consuming sago means preserving traditional culture		0.751											
(3) Economic factors driving food choices in relation to sago												0.909	0.631
1. Sago which has been prepared is expensive to buy			0.881										
2. Sago is more expensive than rice			0.767										
3. I will not eat sago if my salary increases			0.620										
4. The government should subsidies sago			0.840										
5. I cannot support my family if I only depend on sago forests			0.933										
6. I am happy with the income I earn			0.677										
(4) Subjective norm												0.863	0.614
1. It is expected of me that I consume sago				0.892									
2. Most people who are important to me think that I should I consume sago				0.807									
3. My friends do not eat sago				0.723									
4. My friends eat sago				0.698									

(5) Facilitating external conditions regarding sago consumption											0.921	0.598
1. I enjoy eating traditional foods					0.746							
2. I enjoy preparing traditional foods					0.760							
3. I like eating traditional foods within my community					0.721							
4. Traditional foods like sago are good for my environment					0.663							
5. I would eat sago if it was made into tasty products					0.834							
6. Sago is always available in emergencies					0.547							
7. There is a need to promote sago for young generations					0.920							
8. Sago is prepared for me at home					0.920							
(6) Pro-environmental concern and engagement											0.952	0.716
1. We are approaching the limit of the number of people the Earth can support						0.679						
2. When humans interfere with nature it often produces disastrous consequences						0.903						
3. Humans are seriously abusing the environment						0.894						
4. Plants and animals have as much right as humans to exist						0.950						
5. Despite our special abilities, humans are still subject to the laws of nature						0.870						
6. The Earth is like a spaceship with very limited room and resources						0.681						
7. The balance of nature is very delicate and easily upset						0.896						
8. If things continue on their present course, we will soon experience a major ecological catastrophe						0.852						
(7) Anti-environmental concern and engagement											0.929	0.660
1. Humans have the right to modify the natural environment to suit their needs							0.896					
2. Human ingenuity will ensure that we do not make the Earth unliveable							0.941					
3. The Earth has plenty of natural resources if we just learn how to develop them							0.585					

4. The balance of nature is strong enough to cope with the impacts of modern industrial nations							0.870				
5. The so-called "Ecological Crisis" facing humankind has been greatly exaggerated							0.965				
6. Humans were meant to rule over the rest of nature							0.552				
7. Humans will eventually learn enough about how nature works to be able to control it							0.771				
(8) Collectivist culture										0.927	0.623
1. Parents and children must stay together as much as possible							0.579				
2. It is my duty to take care of my family, even when I have to sacrifice what I want							0.920				
3. Family members should stick together, no matter what sacrifices are required							0.885				
4. It is important to me that I respect the decisions made by my group							0.941				
5. If a co-worker gets a prize, I would feel proud							0.705				
6. The well-being of my co-workers is important to me							0.712				
7. To me, pleasure is spending time with others							0.567				
8. I feel good when I co-operate with others							0.897				
(9) Individualist culture										0.938	0.660
1. It is important that I do my job better than others								0.665			
2. Winning is everything								0.820			
3. Competition is the law of nature								0.962			
4. When another person does better than I do, I get tense and aroused								0.928			
5. I'd rather depend on myself than others								0.885			
6. I rely on myself most of the time, I rarely rely on others								0.876			
7. I often do my own thing								0.677			
8. My personal identity, independent of others, is very important to me								0.605			
(10) Barriers to sago consumption										0.905	0.614
1. Sago is difficult to prepare										0.801	

2.	I do not like the taste of sago											0.7 32
3.	I enjoy foods from "Western" restaurants											0.6 96
4.	Sago is very difficult to harvest											0.7 36
5.	Sago is time consuming to prepare											0.8 61
6.	Sago Forest is being exploited by sago companies											0.8 60

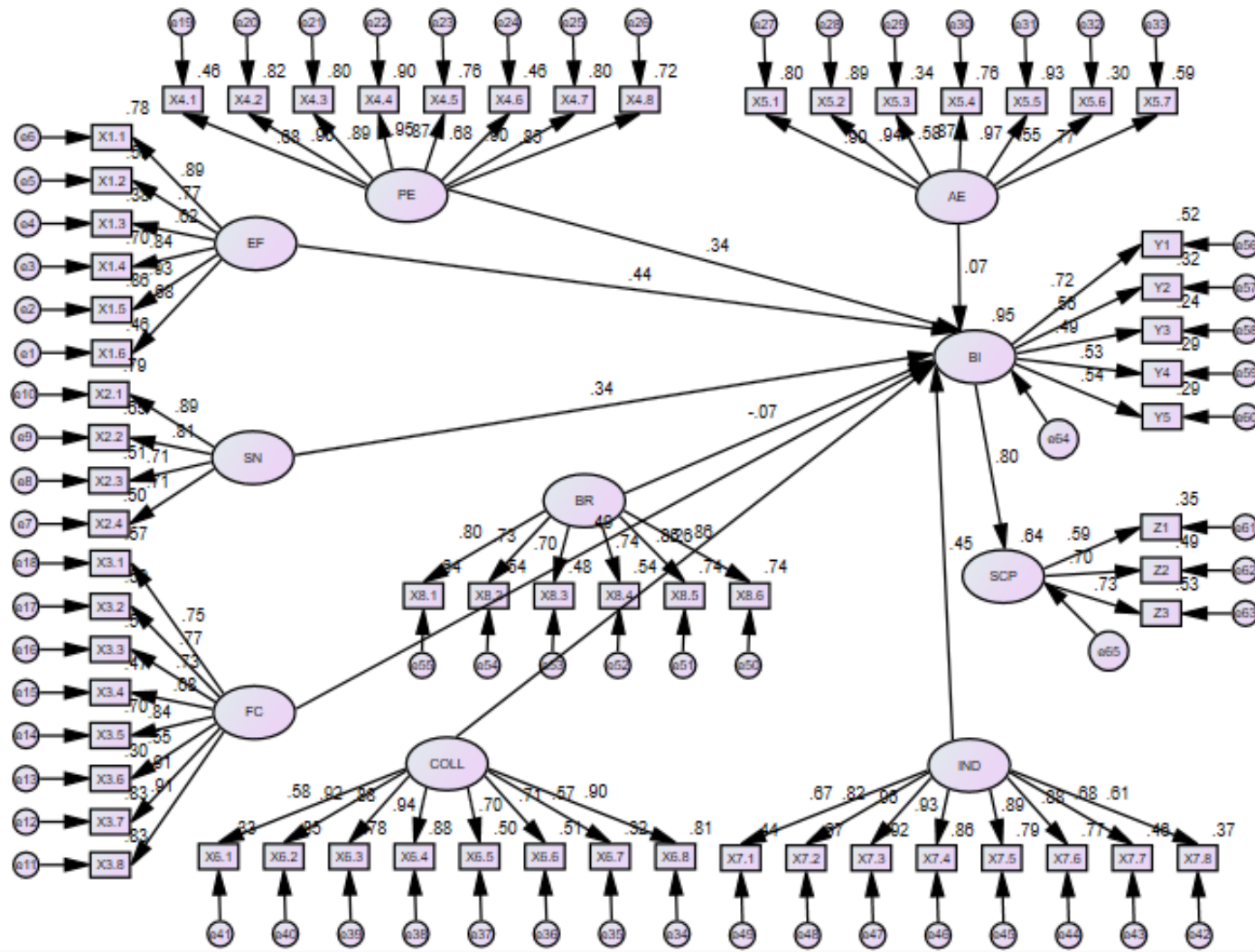
Measurement Model

Standardized Regression Weights: (Group number 1 - Default model)

	Estimate
X1.6 <--- EF	.677
X1.5 <--- EF	.933
X1.4 <--- EF	.840
X1.3 <--- EF	.620
X1.2 <--- EF	.767
X1.1 <--- EF	.881
X2.4 <--- SN	.698
X2.3 <--- SN	.723
X2.2 <--- SN	.807
X2.1 <--- SN	.892
X3.8 <--- FC	.920
X3.7 <--- FC	.920
X3.6 <--- FC	.547
X3.5 <--- FC	.834
X3.4 <--- FC	.663
X3.3 <--- FC	.721
X3.2 <--- FC	.760
X3.1 <--- FC	.746
X4.1 <--- PE	.679
X4.2 <--- PE	.903
X4.3 <--- PE	.894
X4.4 <--- PE	.950
X4.5 <--- PE	.870
X4.6 <--- PE	.681
X4.7 <--- PE	.896
X4.8 <--- PE	.852
X5.1 <--- AE	.896
X5.2 <--- AE	.941
X5.3 <--- AE	.585
X5.4 <--- AE	.870
X5.5 <--- AE	.965
X5.6 <--- AE	.552
X5.7 <--- AE	.771
X6.8 <--- COLL	.897
X6.7 <--- COLL	.567
X6.6 <--- COLL	.712
X6.5 <--- COLL	.705
X6.4 <--- COLL	.941
X6.3 <--- COLL	.885
X6.2 <--- COLL	.920
X6.1 <--- COLL	.579

	Estimate
X7.8 <--- IND	.605
X7.7 <--- IND	.677
X7.6 <--- IND	.876
X7.5 <--- IND	.885
X7.4 <--- IND	.928
X7.3 <--- IND	.962
X7.2 <--- IND	.820
X7.1 <--- IND	.665
X8.6 <--- BR	.860
X8.5 <--- BR	.861
X8.4 <--- BR	.736
X8.3 <--- BR	.696
X8.2 <--- BR	.732
X8.1 <--- BR	.801
Y1 <--- BI	.605
Y2 <--- BI	.514
Y3 <--- BI	.880
Y4 <--- BI	.943
Y5 <--- BI	.751
Z1 <--- SCP	.799
Z2 <--- SCP	.917
Z3 <--- SCP	.680

Path Diagram



- SCP= Self-reported sago consumption propensity
- BI = Behavioural intentions to consume sago
- EF = Economic factors driving food choices in relation to sago
- SN = Subjective norm
- FC = Facilitating external conditions regarding sago consumption
- PE = Pro-environmental concern and engagement
- AE = Anti-environmental concern and engagement
- COLL = Collectivist culture
- IND = Individualist culture
- BR = Barriers to sago consumption

Estimates (Group number 1 - Default model)

Scalar Estimates (Group number 1 - Default model)

Maximum Likelihood Estimates

Regression Weights: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
BI <--- AE	.050	.029	1.729	.084	
BI <--- PE	.389	.057	6.892	***	
BI <--- EF	.938	.119	7.910	***	
BI <--- SN	.569	.085	6.686	***	
BI <--- BR	-.067	.038	-1.748	.081	
BI <--- IND	1.160	.154	7.542	***	
BI <--- FC	.700	.071	9.904	***	
BI <--- COLL	.414	.069	6.019	***	
SCP <--- BI	.359	.047	7.612	***	
X1.6 <--- EF	1.000				
X1.5 <--- EF	2.716	.206	13.168	***	
X1.4 <--- EF	2.537	.209	12.110	***	
X1.3 <--- EF	1.050	.114	9.175	***	
X1.2 <--- EF	1.727	.154	11.209	***	
X1.1 <--- EF	2.128	.168	12.681	***	
X2.4 <--- SN	1.000				
X2.3 <--- SN	.751	.072	10.432	***	
X2.2 <--- SN	2.110	.180	11.752	***	
X2.1 <--- SN	2.121	.169	12.545	***	
X3.8 <--- FC	1.000				
X3.7 <--- FC	.996	.043	23.153	***	
X3.6 <--- FC	1.428	.147	9.696	***	
X3.5 <--- FC	1.938	.102	18.988	***	
X3.4 <--- FC	.584	.044	13.124	***	
X3.3 <--- FC	.625	.042	14.783	***	
X3.2 <--- FC	.717	.045	16.039	***	
X3.1 <--- FC	.876	.056	15.518	***	
X4.1 <--- PE	1.000				
X4.2 <--- PE	.764	.058	13.138	***	
X4.3 <--- PE	.939	.072	13.037	***	
X4.4 <--- PE	.869	.063	13.703	***	
X4.5 <--- PE	.756	.059	12.737	***	
X4.6 <--- PE	.789	.078	10.163	***	
X4.7 <--- PE	.861	.066	13.059	***	
X4.8 <--- PE	.730	.058	12.474	***	
X5.1 <--- AE	1.000				
X5.2 <--- AE	.941	.037	25.207	***	
X5.3 <--- AE	.280	.027	10.536	***	

	Estimate	S.E.	C.R.	P	Label
X5.4 <--- AE	.711	.035	20.562	***	
X5.5 <--- AE	1.013	.037	27.104	***	
X5.6 <--- AE	.360	.037	9.763	***	
X5.7 <--- AE	.731	.045	16.098	***	
X6.8 <--- COLL	1.000				
X6.7 <--- COLL	1.438	.143	10.084	***	
X6.6 <--- COLL	1.186	.085	13.989	***	
X6.5 <--- COLL	1.112	.081	13.762	***	
X6.4 <--- COLL	1.239	.050	24.891	***	
X6.3 <--- COLL	1.042	.049	21.213	***	
X6.2 <--- COLL	1.180	.050	23.629	***	
X6.1 <--- COLL	1.463	.141	10.344	***	
X7.8 <--- IND	1.000				
X7.7 <--- IND	1.391	.152	9.160	***	
X7.6 <--- IND	3.775	.345	10.956	***	
X7.5 <--- IND	3.924	.356	11.030	***	
X7.4 <--- IND	3.182	.280	11.344	***	
X7.3 <--- IND	3.458	.298	11.589	***	
X7.2 <--- IND	2.460	.235	10.474	***	
X7.1 <--- IND	1.065	.118	9.022	***	
X8.6 <--- BR	1.000				
X8.5 <--- BR	1.001	.058	17.239	***	
X8.4 <--- BR	.692	.051	13.497	***	
X8.3 <--- BR	.691	.055	12.470	***	
X8.2 <--- BR	.491	.037	13.401	***	
X8.1 <--- BR	.550	.036	15.337	***	
Y1 <--- BI	1.000				
Y2 <--- BI	.475	.055	8.643	***	
Y3 <--- BI	.290	.038	7.566	***	
Y4 <--- BI	.297	.036	8.180	***	
Y5 <--- BI	.324	.039	8.196	***	
Z1 <--- SCP	1.000				
Z2 <--- SCP	.987	.125	7.866	***	
Z3 <--- SCP	2.336	.292	8.009	***	

Standardized Regression Weights: (Group number 1 - Default model)

	Estimate
BI <--- AE	.069
BI <--- PE	.343
BI <--- EF	.441
BI <--- SN	.336
BI <--- BR	-.072
BI <--- IND	.451
BI <--- FC	.493
BI <--- COLL	.259

	Estimate
SCP <--- BI	.803
X1.6 <--- EF	.681
X1.5 <--- EF	.928
X1.4 <--- EF	.839
X1.3 <--- EF	.619
X1.2 <--- EF	.770
X1.1 <--- EF	.885
X2.4 <--- SN	.710
X2.3 <--- SN	.711
X2.2 <--- SN	.808
X2.1 <--- SN	.891
X3.8 <--- FC	.912
X3.7 <--- FC	.909
X3.6 <--- FC	.552
X3.5 <--- FC	.836
X3.4 <--- FC	.682
X3.3 <--- FC	.734
X3.2 <--- FC	.768
X3.1 <--- FC	.754
X4.1 <--- PE	.680
X4.2 <--- PE	.903
X4.3 <--- PE	.895
X4.4 <--- PE	.948
X4.5 <--- PE	.872
X4.6 <--- PE	.680
X4.7 <--- PE	.897
X4.8 <--- PE	.851
X5.1 <--- AE	.896
X5.2 <--- AE	.941
X5.3 <--- AE	.585
X5.4 <--- AE	.870
X5.5 <--- AE	.965
X5.6 <--- AE	.552
X5.7 <--- AE	.771
X6.8 <--- COLL	.898
X6.7 <--- COLL	.568
X6.6 <--- COLL	.712
X6.5 <--- COLL	.705
X6.4 <--- COLL	.940
X6.3 <--- COLL	.883
X6.2 <--- COLL	.922
X6.1 <--- COLL	.579
X7.8 <--- IND	.608
X7.7 <--- IND	.680
X7.6 <--- IND	.877
X7.5 <--- IND	.887

	Estimate
X7.4 <--- IND	.927
X7.3 <--- IND	.961
X7.2 <--- IND	.820
X7.1 <--- IND	.666
X8.6 <--- BR	.861
X8.5 <--- BR	.861
X8.4 <--- BR	.735
X8.3 <--- BR	.696
X8.2 <--- BR	.732
X8.1 <--- BR	.800
Y1 <--- BI	.724
Y2 <--- BI	.564
Y3 <--- BI	.495
Y4 <--- BI	.534
Y5 <--- BI	.535
Z1 <--- SCP	.590
Z2 <--- SCP	.700
Z3 <--- SCP	.725

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
EF	.080	.013	5.984	***	
SN	.126	.021	6.150	***	
FC	.179	.019	9.285	***	
PE	.280	.046	6.044	***	
AE	.706	.078	9.081	***	
COLL	.141	.016	9.088	***	
IND	.054	.010	5.246	***	
BR	.425	.051	8.293	***	
e64	.019	.014	1.386	.166	
e65	.026	.007	3.604	***	
e1	.092	.009	10.534	***	
e2	.095	.014	6.549	***	
e3	.215	.023	9.389	***	
e4	.141	.013	10.710	***	
e5	.164	.016	10.098	***	
e6	.100	.012	8.407	***	
e7	.124	.013	9.671	***	
e8	.070	.007	9.659	***	
e9	.299	.036	8.226	***	
e10	.147	.027	5.513	***	
e11	.036	.005	7.978	***	
e12	.037	.005	8.111	***	
e13	.833	.077	10.884	***	
e14	.289	.030	9.682	***	

	Estimate	S.E.	C.R.	P	Label
e15	.070	.007	10.610	***	
e16	.060	.006	10.423	***	
e17	.064	.006	10.249	***	
e18	.104	.010	10.325	***	
e19	.326	.030	10.829	***	
e20	.037	.004	9.439	***	
e21	.061	.006	9.594	***	
e22	.024	.003	7.691	***	
e23	.051	.005	9.934	***	
e24	.203	.019	10.829	***	
e25	.051	.005	9.562	***	
e26	.057	.006	10.141	***	
e27	.172	.018	9.618	***	
e28	.080	.010	8.070	***	
e29	.107	.010	10.970	***	
e30	.114	.011	9.999	***	
e31	.053	.009	5.981	***	
e32	.208	.019	11.000	***	
e33	.257	.024	10.623	***	
e34	.034	.004	9.167	***	
e35	.615	.056	10.937	***	
e36	.194	.018	10.678	***	
e37	.177	.017	10.698	***	
e38	.029	.004	7.541	***	
e39	.043	.005	9.470	***	
e40	.035	.004	8.436	***	
e41	.602	.055	10.924	***	
e42	.093	.008	10.939	***	
e43	.123	.011	10.837	***	
e44	.232	.024	9.882	***	
e45	.228	.023	9.750	***	
e46	.090	.010	8.755	***	
e47	.054	.008	6.501	***	
e48	.161	.015	10.385	***	
e49	.077	.007	10.860	***	
e50	.149	.018	8.102	***	
e51	.149	.018	8.095	***	
e52	.173	.017	9.919	***	
e53	.216	.021	10.173	***	
e54	.089	.009	9.945	***	
e55	.072	.008	9.272	***	
e56	.328	.033	9.836	***	
e57	.174	.016	10.675	***	
e58	.093	.009	10.834	***	
e59	.080	.007	10.752	***	
e60	.094	.009	10.749	***	

	Estimate	S.E.	C.R.	P	Label
e61	.136	.014	9.645	***	
e62	.073	.009	8.347	***	
e63	.356	.045	7.888	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
BI	.948
SCP	.644
Z3	.526
Z2	.491
Z1	.348
Y5	.287
Y4	.286
Y3	.245
Y2	.318
Y1	.524
X8.1	.640
X8.2	.536
X8.3	.484
X8.4	.541
X8.5	.741
X8.6	.741
X7.1	.444
X7.2	.672
X7.3	.924
X7.4	.859
X7.5	.786
X7.6	.770
X7.7	.462
X7.8	.370
X6.1	.335
X6.2	.850
X6.3	.780
X6.4	.883
X6.5	.497
X6.6	.507
X6.7	.322
X6.8	.807
X5.7	.595
X5.6	.305
X5.5	.932
X5.4	.757
X5.3	.342
X5.2	.886
X5.1	.804

	Estimate
X4.8	.725
X4.7	.804
X4.6	.462
X4.5	.760
X4.4	.899
X4.3	.801
X4.2	.815
X4.1	.462
X3.1	.569
X3.2	.590
X3.3	.538
X3.4	.466
X3.5	.699
X3.6	.304
X3.7	.825
X3.8	.832
X2.1	.794
X2.2	.653
X2.3	.506
X2.4	.504
X1.1	.783
X1.2	.592
X1.3	.384
X1.4	.704
X1.5	.861
X1.6	.464

Appendix F. Semi-Structured Interview Protocol (Chapter 6)

1. What is the story of sago that you want to share from your photos?
2. What are your experiences regarding sago? (e.g., planting, harvesting, etc.)
3. What is the role of family in consuming sago?
4. What is the role of community and religious leaders in consuming sago?
5. What are the activities related to sago in the region?
6. What are the drivers and barriers in consuming sago?
7. What are your suggestions to increase the availability, access, and consumption of sago?

Appendix G. Certificate of Ethical Approval

Faculty of
**Science, Agriculture
& Engineering**



CERTIFICATE OF ETHICAL APPROVAL

Project #: 19-SI-014

Project Title: Food Security in Papua, Indonesia: A Study of Responsible Research & Innovation Approach

This certificate confirms that the application made by **Fathir Sidiq (PGR project in SNES)** was ~~APPROVED~~ **APPROVED SUBJECT TO CONDITIONS** on 28/02/2019.

Conditions of approval (If applicable):

- i. You must submit a travel risk assessment form
- ii. Ensure you have all necessary local permissions in place
- iii.

*It is the responsibility of the applicant to ensure that any conditions of approval are fully met before proceeding with the research. Applicants are also required to notify the Faculty Ethics Committee (sage.ethics@ncl.ac.uk) if they wish to make any changes to the design/methods/participants of the study **before** commencing with any changes.*

Signed:

A handwritten signature in blue ink, appearing to read "Fathir Sidiq".

CERTIFICATE OF ETHICAL APPROVAL

Project #: 19-SID-014 AMENDMENT

Project Title: Food Security in Papua, Indonesia: A Study of Responsible Research & Innovation Approach

This certificate confirms that the amendment application made by **Fathir Sidiq (PGR student in SNES)** was **APPROVED SUBJECT TO CONDITIONS** on 27/01/2020

Conditions of approval (If applicable):

- i. Ensure you obtain the appropriate approvals/licenses from the relevant Gatekeepers/Government bodies
- ii. You should only offer compensation for time/travel/accommodation and must be transparent with all participants regarding compensation rules
- iii. Be sensitive to the needs of the local culture/community and provide all documentation in an appropriately accessible format

*It is the responsibility of the applicant to ensure that any conditions of approval are fully met before proceeding with the research. Applicants are also required to notify the Faculty Ethics Committee (sage.ethics@ncl.ac.uk) if they wish to make any changes to the design/methods/participants of the study **before** commencing with any changes.*

*If you receive any complaints or encounter any issues during the implementation of your research study, please contact the Ethics Committee via SAGE.Ethics@newcastle.ac.uk. Please **do not** respond directly to the complaint.*

Signed:



Date: 27 Jan 2020

COVID-19 APPROVAL FOR REMOTE RESEARCH

Project #: 19-SID-014

Project Title: Food Security in Papua, Indonesia: A Study of Responsible Research & Innovation Approach

This certificate confirms that the application made by **Fathir Sidiq (PGR student in SNES)** supervised by **Lynn Frewer**, has been approved for remote working during the Covid-19 quarantine restriction period provided that the below conditions are adhered to.

Conditions of approval:


- i. You must obtain (ideally written) consent from all participants who take part in your research.
- ii. You must ensure that you only use University servers to store data, and must ensure adequate data/document security and privacy, especially when transferring files/documents.
- iii. You must only use approved and secure forms of online hosting for surveys, calls, etc.
- iv. You must consider any accessibility requirements of participants and how remote working may affect these.
- v. You must consider how remote working may be more upsetting for participants when conducting sensitive research and should put appropriate support in place.
- vi. You must provide participants with clear contact details in case of complaints/follow-up queries.

*It is the responsibility of the applicant to ensure that any conditions of approval are fully met before proceeding with the research. Applicants are also required to notify the Faculty Ethics Committee (sage.ethics@ncl.ac.uk) if they wish to make any changes to the design/methods/participants of the study **before** commencing with any changes. If you receive any complaints or encounter any issues during the implementation of your research study, please contact the Ethics Committee via SAGE.Ethics@newcastle.ac.uk. Please **do not** respond directly to the complaint.*

Signed: Prof. Patrick Degenaar (Signature unavailable during Covid-19 restrictions)

Date: 01.04.2020

Appendix H. Recommendation Letter from Sorong Selatan Reg

**PEMERINTAH KABUPATEN SORONG SELATAN**
BADAN KESATUAN BANGSA DAN POLITIK
Alamat : Kompleks Kantor Bupati Sorong Selatan, Besna – Teminabuan

REKOMENDASI
NOMOR : 070/021/KESBANGPOL-SS/II/2020

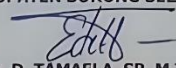
Kepala Badan Kesatuan Bangsa dan Politik Kabupaten Sorong Selatan memperhatikan peraturan Menteri Dalam Negeri Nomor : 64 Tahun 2011 tentang Pedoman Penerbitan Rekomendasi Penelitian ; maka dengan ini kami memberikan Izin Kepada :

Nama Peneliti	: Fathir Fajar Sidiq
NIM	: 170706889
Jabatan	: Mahasiswa Program Doktor Pertanian Dan Pembangunan Pedesaan Dibidang Ketahanan Pangan, Newcastle University.
Alamat	: Newcastle University, Agriculture Building, newcastle upon Tyne, Ne1 7ru United Kingdom
Lokasi Penelitian	: Kabupaten Sorong Selatan Papua Barat
Lama Penelitian	: Maret s/d Mei 2020
No. Telepon	: +447576261322
Judul Proposal	: “ MENGEMBANGKAN KERANGKA KERJA PENELITIAN DAN INOVASI YANG BERTANGGUNG JAWAB UNTUK MEMPROMOSIKAN SAGU SEBAGAI KETAHANAN PANGAN LOKAL ”.

Izin ini di berikan dengan Ketentuan sebagai berikut :

1. Izin ini hanya bagi kegiatan mencari data atau bahan penelitian
2. Menaati ketentuan yang berlaku
3. Setelah tiba di lokasi dan sebelum melaksanakan penelitian terlebih dahulu harus melaporkan diri ke instansi setempat dengan menunjukan surat ini.
4. Harus memperhatikan keamanan dan ketertiban umum selama kegiatan berlangsung
5. Surat rekomendasi ini hanya berlaku untuk kegiatan penelitian tersebut diatas.
6. Setelah selesai penelitian harap melaporkan diri kepada Bupati Sorong Selatan CQ. Badan Kesatuan Bangsa dan Politik Kabupaten Sorong Selatan.

Demikian Rekomendasi ini diberikan untuk dapat di pergunakan sebagaimana mestinya dan atas perhatian dan kerja samanya disampaikan terima kasih.

Teminabuan, 19 Februari 2020
KEPALA BADAN KESATUAN BANGSA DAN POLITIK
KABUPATEN SORONG SELATAN

EDITH. D. TAMAELA, SP, M.Tr.APN
PEMBINA TINGKAT I. IV/b
NIP : 19751007 200312 1 007

Tembusan Kepada Yth.

1. Bupati Sorong Selatan (Sebagai laporan);
2. Newcastle University ;
3. Professor of Food and society;
4. Kepala Dinas Pertanian;
5. Kepala KPHL Kabupaten Sorong Selatan;
6. Kepala Distrik Kais;
7. Kepala Distrik Kokoda;
8. Kepala Distrik Teminabuan;
9. Kepala Distrik Matemani;
10. Kepala Distrik Saif;
11. Yang bersangkutan untuk diketahui;
12. A r s i p.

