



# Toward a Sustainable Food System in West Papua, Indonesia: Exploring the Links Between Dietary Transition, Food Security, and Forests

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Natural tropical forests cover 89% of the land area of West Papua Province, Indonesia. Forests have traditionally been an important part of local food systems for Indigenous Papuans. Despite the contribution of forests to food security, West Papua has been ranked as one of the most food-insecure provinces in Indonesia, with high rates of both under- and over-nutrition. This paper aims to discuss the dietary transition taking place in West Papua and uses local perspectives to explore the link between changes in diets, food security, and forests. We used mixed methods with a triangulation design to corroborate the quantitative data that we present from two rounds of the National Socioeconomic Survey (SUSENAS) on food consumption for West Papua from 2008 and 2017, with information from four focus group discussions with institutional and local stakeholders. The quantitative analysis showed that West Papua is experiencing a dietary transition, moving away from the consumption of traditional foods, such as sago, tubers, wild meat, and fresh legumes, toward diets with more rice, chicken, tofu, and tempeh. The consumption of processed and ultra-processed food (UPF) has increased while the consumption of fresh food has decreased. The qualitative analysis confirmed these findings. The institutional stakeholders expressed a desire for Papuans to return to eating traditional diets for better food security, whereas the local stakeholders worried about their children's high consumption of UPFs. We also found a disconnect between how food security is measured by the national Food Security Index (FSI) and the point of view of the institutional stakeholders. While the FSI indicators are more infrastructure-related measures, the institutional stakeholders link food security with the availability, accessibility, stability, and sustainability of the food sources in their surrounding environment, especially the forests. The institutional stakeholders support the commitment of the provincial government to maintain at least 70% of the forest cover

in West Papua, as stated in the Manokwari Declaration although they expressed the need for more clarity on how this will impact their food security. The Indonesian government and the international community should support this initiative and carry it out with substantial input from local Papuan stakeholders.

**Keywords:** West Papua Indonesia, dietary transitions, forest, sustainable food system, Indonesia, food security, nutrition transition, ultra-processed food

## INTRODUCTION

The world's diets are transitioning. Globally, diets are becoming dominated by higher intakes of animal-source foods, fats, and sugar and lower intakes of fiber (Popkin, 2006). This pattern is found in many parts of the world (Popkin et al., 2012). In low- and middle-income countries, dietary transitions have converged on what is often called a “modern diet” or “Western diet.” The terms used here do not narrowly refer to Western cuisines but instead refer to a higher intake of fat (particularly vegetable oils), added sugar, animal-source foods, refined carbohydrates, and less fresh vegetables, legumes, and coarse grains (Popkin, 2006). Dietary transition is linked with overweight, obesity, and various non-communicable diseases (Popkin et al., 2012; Popkin and Ng, 2021).

For Indigenous communities, which historically have a higher dependence on food sources from the surrounding natural environments, dietary transitions are associated with market penetration/integration and the commodification of their food systems. This includes moving away from traditional foods toward more processed foods higher in fat, added sugar, and salt (Kuhnlein, 2009). In a study of the dietary patterns of Indigenous people in forested areas of Bolivia, Cameroon, and Indonesia, Reyes-García et al. (2019) found that Indigenous people who lived far from market towns had more diverse diets than those living in villages closer to markets. They also found that the consumption of nutritionally important foods, such as fruits, vegetables, and animal-source foods, decreased with increasing market integration. In contrast, the consumption of foods such as fats and sweets increased (Reyes-García et al., 2019).

Studies on the contribution of forests to food security show that forests provide wild plant foods such as fruits, mushrooms, leaves, and tubers. In addition, forests provide habitats for edible insects, animals hunted for meat, and fish across the tropics, which are essential for food security (Rowland et al., 2017). They provide ecosystem services that indirectly affect food production, such as habitats for pollinators, water regulation, soil protection, nutrient recycling, and more (HLPE, 2017). Forests also provide the wood fuel used to prepare food and products that can

be sold for cash to purchase foods. However, there are few studies documenting the provisioning services of forests to food production or diets in West Papua.

Changing landscapes may be an important factor affecting dietary change (Broegaard et al., 2017; Ickowitz et al., 2021). This can be due to a loss of wild foods if cultivated landscapes replace wild ones or a loss of agrobiodiversity if more intensive monocultures replace polycultural landscapes (Ickowitz et al., 2019). Herforth and Ahmed (2015) also suggest that for people with a high dependence on surrounding food sources, such as those living in forested areas, changes in livelihood activities affect the time allocation for food production. This could mean that people no longer have the time to collect, hunt, or process traditional foods. Rasolofoson et al. (2018) assessed the impact of forests on children's diets in rural areas of 27 countries and found positive associations between forests and food security, dietary diversity, and even stunting. Galway et al. (2018) found that deforestation in West Africa decreased the dietary diversity of children living near forests and their consumption of healthy foods.

The recent addition of “agency” as an important dimension of food security was proposed by the High-Level Panel of Experts on Food Security and Nutrition (HLPE, 2020). Including agency highlights the need to take local perspectives and preferences into account in food and nutrition analyses and interventions to achieve food security and nutrition goals: “Agency refers to the capacity of individuals or groups to make their own decisions about what foods they eat, what foods they produce, how that food is produced, processed and distributed within food systems, and their ability to engage in processes that shape food system policies and governance” (HLPE, 2020). A focus on agency is highly relevant to Indigenous peoples' food systems because their food culture, knowledge, and practices have been and continue to be marginalized in food security policy forums (FAO, 2021). Agency can also be very useful for understanding issues of dietary transition and food security in Indigenous communities.

Addressing agency in food and nutrition is particularly relevant for the Indonesian province of West Papua.<sup>1</sup> West Papua has a large Indigenous population, and the province has high rates of poverty, malnutrition, and food insecurity. There are 40 Indigenous ethnic groups living across the province (Wambrauw, 2017; Statistics West Papua, 2021d), with a very different history, ecology, and traditional dietary culture than those found in other

**Abbreviations:** COICOP, Classification of Individual Consumption according to Purpose; F&B, Food and beverage; FGD, Focus group discussion; FSI, Food Security Index; FSVA, Food Security and Vulnerability Atlas; GI, Glycemic index; HDDS, Household Dietary Diversity Score; IDR, Indonesian rupiah; MIFEE, Merauke Integrated Food and Energy Estate; OAA, Other aquatic animal; POH, Processed-preserved-prepared-outside-home; RDA, Recommended dietary allowance; RTE, Ready-to-eat; SD, Standard deviation; SSB, Sugar-sweetened beverage; SUSENAS, Survei Sosial Ekonomi Nasional (National Socioeconomic Survey); UPF, Ultra-processed food.

<sup>1</sup>For the rest of the paper, when we refer to *West Papua*, we refer to the West Papua Province of Indonesia. This is sometimes confused with the term *West Papua* used internationally to represent the western part of the island of New Guinea, including both West Papua and Papua Provinces of Indonesia.

regions of Indonesia. West Papua is covered by natural tropical forests on 89% of the land area (**Figure 1**; Hansen et al., 2013). It is located on the furthest island from Java—the center of politics and economic development in Indonesia. For Papuans, forests are inextricably linked to food security and the identity of the Indigenous people (Pattiselanno et al., 2019). Papuans, especially those who live near forests, hunt and gather food in the forests (Pattiselanno, 2004; Pangau-Adam et al., 2012; Pattiselanno and Nasi, 2015).

Previous studies have indicated that land-use in Papua is linked to a dietary transition (Purwestri et al., 2019). Research on the diets of Indigenous households in Merauke, Papua Province, found that those who collected food and hunted in the forests ate more fruit, fish, and meat than fellow Papuans working in oil palm. Women working in oil palm also suffered from higher rates of anemia compared to women who lived a more traditional lifestyle (Purwestri et al., 2019). Anecdotal evidence suggests an increasing trend in the consumption of ultra-processed foods (UPFs) among Papuans. Although UPFs are typically sold in places with access to modern markets, they have also penetrated the rural communities of Papua (Hidayat, 2017; Rachmawati, 2020). Participants in focus group discussions (FGDs) in Merauke, Papua Province, reported that the consumption of wild foods, particularly wild meat and sago,<sup>2</sup> has declined with the decrease in forested landscapes. To harvest sago or hunt animals, such as deer and kangaroos, they reportedly now need to walk longer distances than they did 10 years ago (Purwestri et al., 2019).

This paper aims to provide evidence showing that a dietary transition is taking place in West Papua and uses local perspectives to explore the link between changes in diets, food security, and forests. To do so, we use household food consumption data from two rounds of the Indonesian National Socioeconomic Survey (Survei Sosial Ekonomi Nasional; SUSENAS) from 2008 and 2017 to show quantitative changes in food consumption over time. We then corroborate the evidence from the quantitative analysis of SUSENAS data with data from FGDs with local stakeholders. We also include a discussion of stakeholders' perspectives on what aspects of food systems matter to them, with a focus on health and nutritional issues, food security, and forests.

## METHOD

### Study Setting

The island of New Guinea is administratively divided into two countries: Indonesia in its western half and Papua New Guinea in its eastern half. Indonesia has divided its part of the island into two jurisdictions, specifically the provinces of Papua and West Papua. West Papua is located just below the equator. Its altitude ranges from sea level in the lowlands to more than 2,000 meters above sea level in the mountains (Statistics West Papua, 2021d). West Papua is among the poorest province in Indonesia, where 22% of the population lives under the poverty line

(Statistics Indonesia, 2021b). The province also has high rates of under- and overnutrition; almost one-third (27%) of children under 5 years old in West Papua are stunted in their growth, and 40% of adults are either overweight or obese (Ministry of Health, 2019a).

The majority of the population in West Papua adheres to Christianity (63%), and Muslims compose 37% of the population (Statistics West Papua, 2021d). Papuan traditional diets include sago, tubers, fresh fruits, wild meat, and fish. Their meals generally do not have many ingredients, and they use fewer spices than most cuisines from the other major islands of Indonesia (Tempo, 2018). West Papua achieved a substantial economic growth rate of 8% in 2020, supported mainly by the manufacturing, mining, and quarrying sectors. Despite this substantial growth rate, the poverty rate reached 22% in 2020 (Statistics West Papua, 2021d). The Human Development Index was 65% (Statistics West Papua, 2021d), below the national average of 72% (Statistics Indonesia, 2021b). Moreover, the province was classified as a food-insecure area in 2018 (Food Security Agency, 2018).

As part of New Guinea, the second-largest island and the largest tropical island in the world (Newbold et al., 2016), West Papua has a rich diversity of fauna and flora (Marshall and Beehler, 2011). Recognizing the importance of forests for biodiversity, climate change, and livelihoods, the provincial government of West Papua signed the Manokwari Declaration: Customary Area-Based Sustainable Development in Papua Lands on October 10, 2018 (Manokwari Declaration, 2018). The provincial government declared its commitment to conserving at least 70% of the land and integrating sustainability principles into its long-term development plans, including a commitment to promote and accelerate the formulation of gubernatorial regulations on food security.

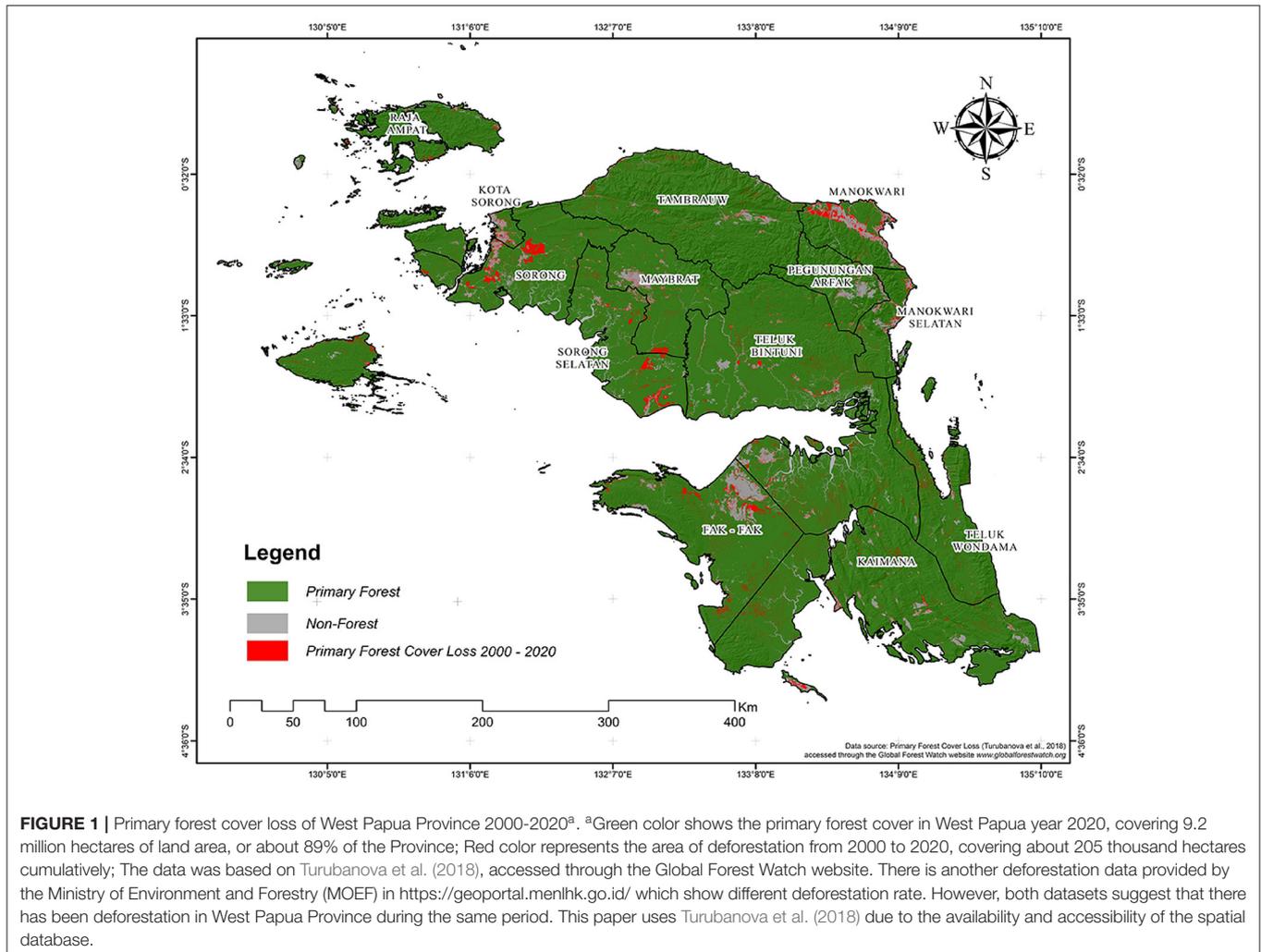
## Data and Analysis

We used mixed methods in this study with a triangulation design following the work of Plano Clark et al. (2008) to bring together different but complementary kinds of data. This enabled the authors to corroborate the evidence and expand the interpretations. The quantitative and qualitative data were collected in parallel and analyzed independently. The results from each analysis were then merged to validate and identify the discrepancies between the data sources (Plano Clark et al., 2008).

### Data Set for Quantitative Study

Using two rounds of weekly household food consumption data from the 2008 and 2017 SUSENAS, we explored the differences in the food consumption patterns in West Papua over those 2 years. These surveys provide data about the food consumed by the entire household as recalled by one respondent from the household. The data are representative of the population down to the regency level and include 2,196 households in 2008 and 3,981 households in 2017. However, comparative analysis at the regency level was not possible due to the expansion and changes in jurisdictions of the regencies between 2008 and 2017.

<sup>2</sup>Sago is a starch that is harvested from palms that grow mostly in the lowland forested areas of Papua.



**FIGURE 1 |** Primary forest cover loss of West Papua Province 2000-2020<sup>3</sup>. <sup>a</sup>Green color shows the primary forest cover in West Papua year 2020, covering 9.2 million hectares of land area, or about 89% of the Province; Red color represents the area of deforestation from 2000 to 2020, covering about 205 thousand hectares cumulatively; The data was based on Turubanova et al. (2018), accessed through the Global Forest Watch website. There is another deforestation data provided by the Ministry of Environment and Forestry (MOEF) in <https://geoportal.menlhk.go.id/> which show different deforestation rate. However, both datasets suggest that there has been deforestation in West Papua Province during the same period. This paper uses Turubanova et al. (2018) due to the availability and accessibility of the spatial database.

## Quantitative Analysis

We created the food groups from the SUSENAS food lists with four objectives in mind. First, to understand the general changes in food consumption, we created food groups based on Kennedy et al. (2013), modified to match the food list provided in the SUSENAS and West Papua context. We calculated the quantity consumed from each food group and the percent change of food consumed over the 2 years. Second, to assess if the ability of a household to access a variety of foods has changed over time, we grouped the food items listed in SUSENAS based on the guideline for measuring household and individual dietary diversity (Kennedy et al., 2013). We made as few modifications as possible to match the food list provided in SUSENAS and the food list in the household dietary diversity guideline. We used the recall data to generate dummy variables, indicating whether the household consumed each food group in the past seven days or not. Then we calculated the Household Dietary Diversity Score (HDDS) by summing the number of food groups consumed in the household. The HDDS is a validated tool to assess a household's economic ability to access a variety of foods using 24-h recall intake data (Kennedy et al., 2013). However, we refer to Mehraban and Ickowitz (2021) on the use of similar

7-day food consumption data at the national level in Indonesia for the HDDS.

Third, to understand whether the dietary transition has moved toward increased consumption of UPFs and less fresh and minimally processed foods, we categorized the foods listed in SUSENAS based on the NOVA food processing classification (Poti et al., 2017). The NOVA classification categorizes food into four groups: fresh and minimally processed foods (Group 1); oil, sugar, and salt (Group 2); processed foods (Group 3); and UPFs (Group 4). Here, we divide Group 2 into edible fats (2a) and sugar and salt (2b) to anticipate the different trends in consumption as indicated by another study Nurhasan et al.<sup>3</sup> UPFs and beverages were defined as multi-ingredient industrial formulations. This includes sugar-sweetened beverages (SSBs), packaged bread, cookies, savory snacks, candy, ice cream, breakfast cereal, and pre-prepared frozen meals (Poti et al., 2017).

<sup>3</sup>Nurhasan, M., Fahim, M., Aprillyana, N., and Ickowitz, A. (forthcoming). *Changing Food Consumption Patterns in Indonesia's Most and Least Deforested Areas*. Bogor: Center for International Forestry Research (CIFOR), Statistics Indonesia (BPS).

*Fourth*, to understand whether a dietary transition has moved toward the increased consumption of foods prepared by vendors but not necessarily processed foods, we analyzed the consumption of ready-to-eat (RTE) foods (Bhutta et al., 2013). The RTE food category was based on the Classification of Individual Consumption according to Purpose (COICOP) Division 11 (United Nations, 2018). This food classification includes all of the foods served or prepared by the food vendors and the food from RTE vendors, restaurants, cafés, and street food vendors, including factory-produced foods (e.g., vegetable sautés, fried snacks, chicken skewers, carbonated drinks served with ice in a café, etc.). RTE foods can include processed foods and UPFs. In the Indonesian context, small-scale food vendors provide fresh and minimally processed foods and sell them at affordable prices to consumers of various economic classes. Increasing the consumption of RTE foods in Indonesia highlights the importance of improved food safety and quality when it is prepared by micro- and small-scale, informal food vendors (Vermeulen et al., 2019).

We calculated the energy intake from the consumption of each food group in NOVA and COICOP 11. We presented the average daily per capita consumption for both years at the provincial level. The differences in the energy consumed per food group between the years were assessed based on a two-sample independent *t*-test with the significance declared at  $p < 0.05$ . The food listed for each food group is presented in **Supplementary Tables 1–3**. There were differences in the SUSENAS food lists from 2008 to 2017. Some food items were excluded from our food list if not represented in both years. For ease of comparison, we generated an approximate consumption per capita per day by dividing the total household consumption by the number of household members and the number of days in a week. Due to data limitations, it was not possible to consider the age and sex of all household members.

In addition to the analysis of the food consumption data, we also used SUSENAS data to confirm findings from our qualitative data on price changes for different staple foods. We did this by calculating the mean price of staple foods from the 2008 and 2017 SUSENAS. We then measured the change of each staple food over time against the price of instant noodles in 2017. We chose instant noodles as our comparator because this food is a market-based commodity consumed all over Indonesia, and its price is readily available from the SUSENAS data set. In the results section, we also include a calculation on the percentage of staple foods consumed from own production compared to purchase. The differences in consumption and prices per food item or food group between the years were assessed based on a two-sample independent *t*-test with the significance declared at  $p < 0.05$ .

### Qualitative Study: FGDs

We used the data from the two sets of FGDs involving different stakeholders: two FGDs with institutional stakeholders and two FGDs with local stakeholders (mothers and caretakers of young children in villages).

#### *Institutional Stakeholders*

We carried out two FGDs with stakeholders from various institutions in West Papua whose mandates were related to

food security and land use (later referred to as *institutional stakeholders*). The invited institutions were those working in food security and nutrition-related areas, such as agriculture, health, women's groups, and university faculty. The list of invited institutions was discussed with a local non-governmental organization partner, the EcoNusa Foundation, and a local government partner, the West Papua Center for Research and Development (Badan Penelitian dan Pengembangan Daerah; Balitbangda). The invited institutions officially sent the stakeholders who attended the FGD. However, the opinions shared by the participants might represent their personal views and not necessarily the views of their institutions.

The FGDs were held twice—on February 7 and March 13, 2019—in Manokwari, the capital of West Papua. The FGDs were part of a series of larger food and land-use workshops organized by Balitbangda. The first institutional stakeholder FGD was attended by six people (four men and two women) from six institutions and lasted around 2 h. The second institutional stakeholder FGD was attended by 16 people (six men and ten women) from 13 institutions and lasted around 3 h. The group discussions were audiotaped with verbal consent. The participants received 150,000 Indonesian rupiah (IDR; ~10 USD) for transportation fees, except for those who came from Pegunungan Arfak, who received 500,000 IDR (~35 USD) to cover the high travel cost from their home to the meeting venue.

#### *Local Stakeholders (Mothers and Caretakers of Children)*

The second set of FGDs targeted the mothers and caretakers of children from two villages with different landscapes (later referred to as *local stakeholders*). Mothers were purposively selected because the researchers wanted to gather information about household diets and child feeding. The FGDs were held on February 9–10, 2019, in the village of Bamaha in Pegunungan Arfak Regency and the village of Arowi in Manokwari Regency. The regencies were selected to represent a coastal community with a mixed-race population and better market access and a highland community populated mostly by Indigenous people who were relatively remote with poor access to markets. The villages were selected where the researchers had a link with the civil organization (Bentara in Pegunungan Arfak and the health care at Manokwari) in the area.

The heads of the organizations verbally invited the mothers and caretakers of the preschoolers and elementary schoolchildren in the village. The FGD in Arowi took place in the house of the village chief, was attended by eight participants, and lasted around 2 h. The FGD in Bamaha was conducted in the Bentara library with eight participants and lasted around an hour and a half. The FGDs were audiotaped with oral consent. Each session began with introductions by the facilitators and the participants, followed by critical questions and discussions. It ended with the thanking of the participants. Every participant received 50,000 IDR (~3.5 USD) to compensate for their time.

### Qualitative Data Analysis

The objective of the qualitative data analysis was to corroborate evidence of dietary transitions from the quantitative analysis and document the perspective on what aspects of food systems matter

to the stakeholders, with a focus on health and nutrition, food security, and forests. We used the scissor-and-sort technique for the analysis drawn from the work of Stewart et al. (2007). We determined which segments of the transcript we considered essential and developed a categorization system for the topics discussed by the group. Following this, we selected the representative statements regarding the same topics from the transcript and interpreted the findings based on the statements in each category. To avoid personal bias, the analysis was conducted separately by coauthors MN and AMM on the same transcripts. Both of the coauthors then compared and drafted the findings together.

## RESULTS

### Quantitative Analysis

#### General Trends in Food Consumption

The amount of foods consumed per food group for 2008 and 2017 is presented in **Table 1**. The trend in food consumption is presented as the percentage change of the quantity per food group consumed in West Papua in **Figure 2**. Consumption of the following food groups increased: rice- and wheat-based staples, avian meats (dominated by broiler chicken), dairy foods and beverages, vitamin A-rich vegetables, vitamin A-rich fruits, processed legumes, processed ingredients, caloric snack crackers, and SSBs. Conversely, consumption of the following food groups decreased: “other” staples, including traditional staple foods; fresh meat and “other” fresh meat, which includes wild meats (but not exclusively); processed-preserved-prepared-outside-home (POH) meat; eggs; dark-green leafy vegetables; “other” fruits; fresh legumes and nuts; and beverage materials. **Table 1** also shows that the HDDS in 2008 and 2017 increased from 8.5 to 9.0.

#### Trends Toward Consumption of UPFs and RTE Foods

**Figure 3** presents the calorie consumption per food group based on NOVA and the COICOP 11 classification in 2008 and 2017. The consumption of processed foods (Group 3), UPFs, and RTE foods increased, and the consumption of fresh and minimally processed foods (Group 1) and sugar and salt (Group 2b) decreased. The calorie contribution from UPFs in 2008 was 130 kilocalories per capita per day (kcal/capita/day), which is 6% of the recommended dietary allowance (RDA) of 2,100 kcal (Minister of Health Regulation Number 28, 2019). In 2017, the calorie contribution from UPFs increased to 156 kcal/capita/day, contributing to 7% of the RDA. The calorie contribution from RTE foods in 2008 was 117 kcal/capita/day, which was 6% of RDA. In 2017, the calorie contribution from RTE foods increased to 210 kcal/capita/day, which was 10% of the RDA.

#### Changes in Staple Food Prices and Consumption From Own Production

**Table 2** shows that the price of sago doubled compared to the price of rice from 2008 to 2017. **Figure 4** shows that the percentage of rice consumed from own production increased, but consumption of traditional Papuan

**TABLE 1** | Consumption per food group and household dietary diversity in 2008 and 2017 in West Papua Province, Indonesia.

Consumption in quantity unit per capita per day <sup>a</sup> at the Province level	2008 (n = 2,196)	2017 (n = 3,981)	SS 2008 and 2017 <sup>b</sup>
Average household member	4	4	
<b>Household dietary diversity</b>	8.5 ± 1.6	9 ± 1.7	
Mean ± standard deviation			
Median	8	9	
<b>Staple foods</b>	204 ± 122	229 ± 97	***/+
Rice-based staple (g)			
Wheat-Based staple (g)	18 ± 28	21 ± 25	***/+
Other staples (g)	189 ± 239	103 ± 137	***/-
<b>Animal-Source foods</b>	112 ± 98	111 ± 94	ns/-
Fresh and preserved fish and other aquatic animals (g)			
Fresh red meat (g)	10 ± 27	7 ± 19	***/-
Fresh avian meat (g)	5 ± 18	10 ± 25	***/+
Other fresh meat (g)	6 ± 27	3 ± 13	***/-
Preserved POH meat (g)	4 ± 23	2 ± 8	***/-
Eggs (g)	14 ± 37	12 ± 16	**/-
Dairy food and beverages (g)	4 ± 14	4 ± 15	*/+
<b>Vegetables, legumes, and fruits</b>	100 ± 101	67 ± 60	***/-
Dark-Green leafy vegetables (g)			
Other vitamin A-rich vegetables (g)	1 ± 6	2 ± 9	***/+
Other vegetables (g)	58 ± 75	58 ± 75	ns/-
Vitamin A-rich fruits (g)	7 ± 28	13 ± 36	***/+
Other fruits (g)	88 ± 113	59 ± 79	***/-
Legumes and nuts (g)	5 ± 20	2 ± 9	***/-
Processed legumes (g)	18 ± 40	22 ± 37	***/+
<b>Side dishes and beverages</b>	275 ± 379	153 ± 143	***/-
Beverage materials (ml)			
Spices (g)	21 ± 18	20 ± 16	ns/-
Processed ingredients (g)	4 ± 6	5 ± 5	***/+
Snacks and crackers (g)	21 ± 30	37 ± 42	***/+
Sugar-Sweetened beverages (ml)	38 ± 85	54 ± 89	***/+
Alcoholic beverages (ml)	2 ± 31	2 ± 23	ns/+

ns, not significant statistically; POH, processed-preserved-prepared-outside-home; SS, statistical significance.

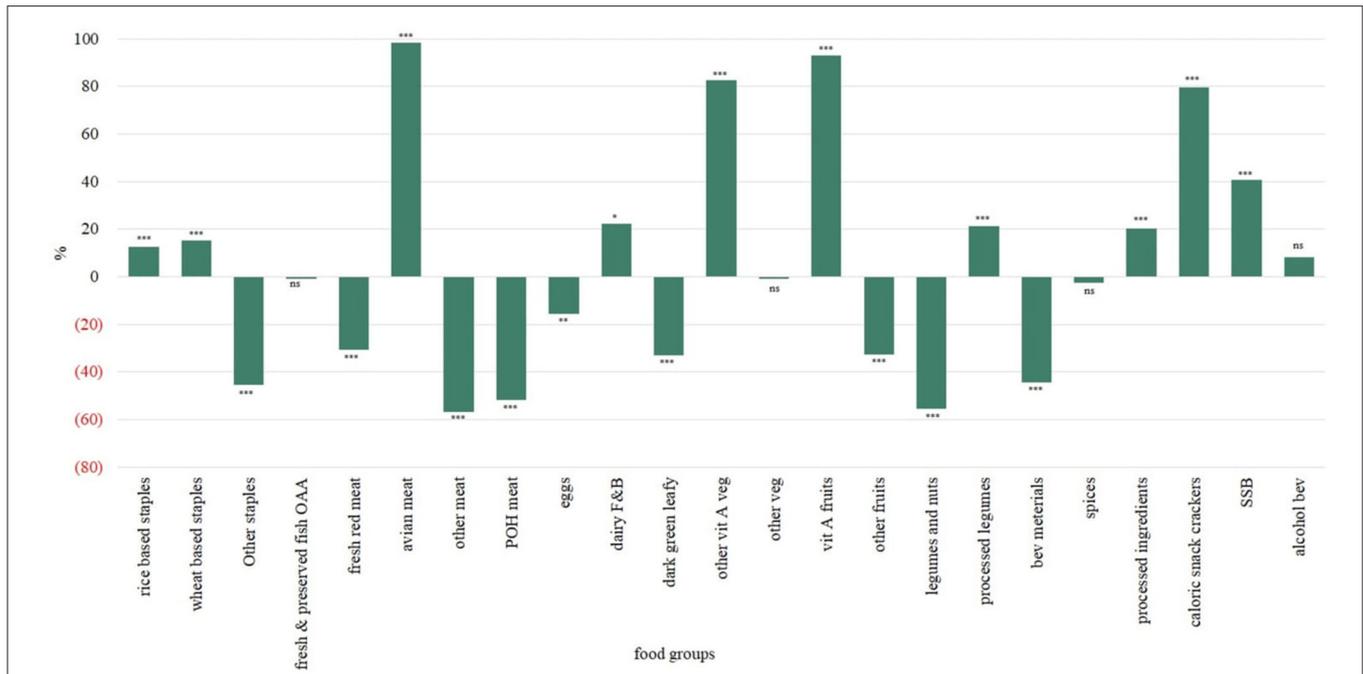
<sup>a</sup>Unless stated otherwise.

<sup>b</sup>\*\*\*shows a statistically significant difference at < 0.001; \*\*shows a statistically significant difference at 0.001–0.01; \*shows a statistically significant difference at < 0.05. Additionally, +indicates that the mean of 2017 is greater than the mean of 2008, while -indicates the mean of 2017 is smaller than the mean of 2008.

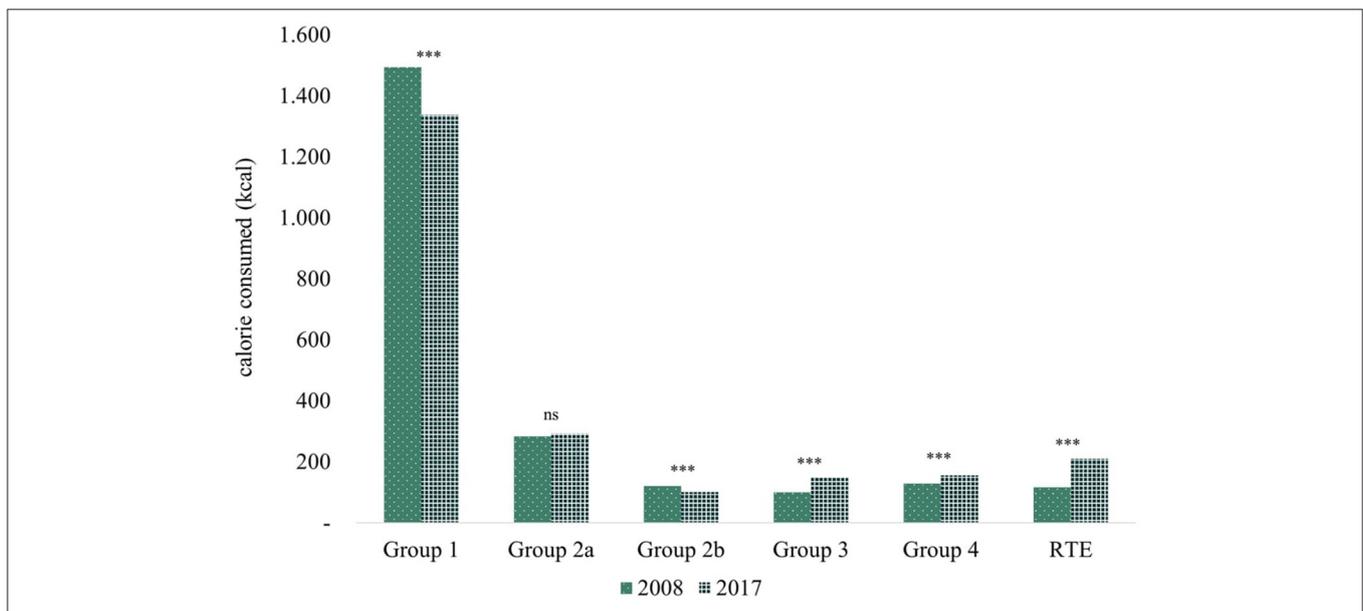
staples (such as sago and tubers) from own production decreased.

### Qualitative Analysis

The analysis of the FGD transcripts of the institutional and local stakeholders revealed four dominant issues: a dietary transition from sago to rice, the higher consumption of UPFs and SSBs, the stakeholders' view that West Papua is not food insecure, and the link between diets and forests.



**FIGURE 2** | Food consumption trends in West Papua Province, 2008–2017<sup>a</sup>. <sup>a</sup>Measured as percent change of the food groups consumed in the West Papua province in 2008 and 2017; OAA, other aquatic animals; POH, processed-preserved-prepared-outside-home; F&B, food and beverages; SSB, sugar-sweetened beverages; bev, beverages; ns, not significant; \*\*\*shows a statistical significance at <0.001, \*\*at 0.001–0.01, and \*at < 0.05.



**FIGURE 3** | Calorie intake from consumption of food—grouped based on nova food processing classifications in 2008 and 2017<sup>a</sup>. <sup>a</sup>Group 1: Unprocessed or minimally processed foods; Group 2a: Oils and fats; Group 2b: Salt and sugar; Group 3: Processed foods; Group 4: Ultra-processed foods; RTE, Ready-to-eat foods; ns, not significant; \*\*\*shows statistical significance at < 0.001.

### A Dietary Transition From Sago to Rice

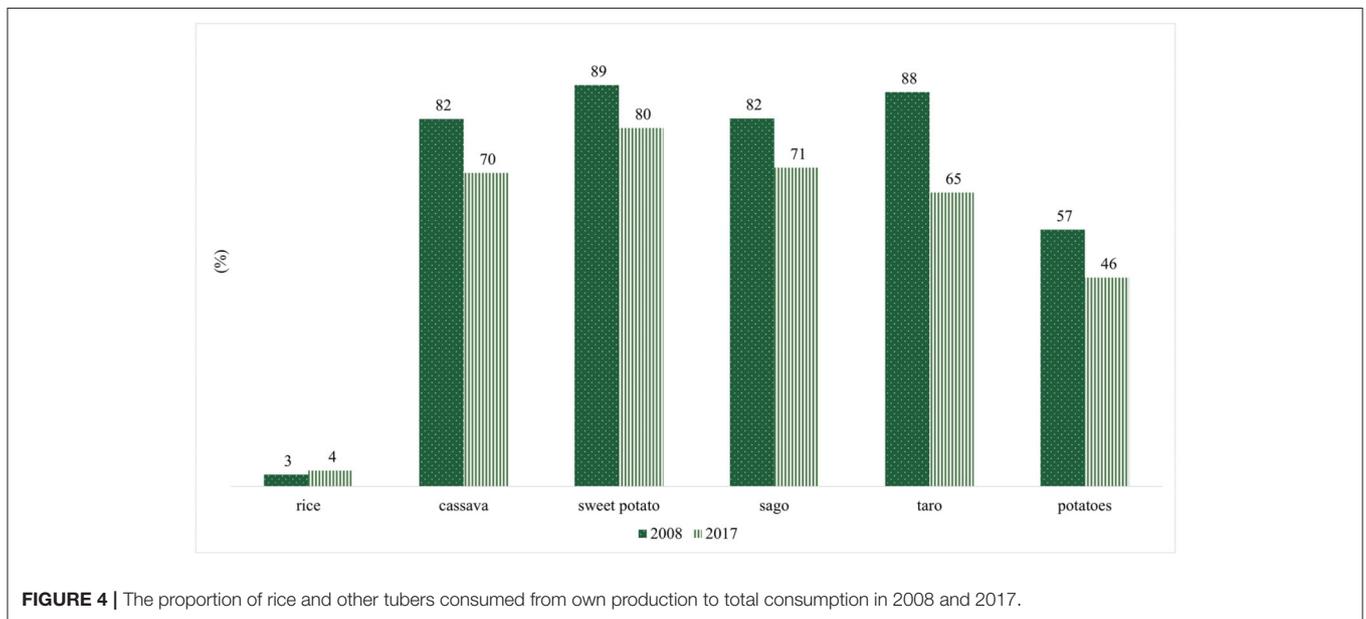
Generally, the institutional and local stakeholders both agreed that rice is now West Papua’s primary staple food. Only the elderly members of the Indigenous communities where we

conducted the FGDs are still consuming sago daily. In the local stakeholder groups, the participants stated that they eat rice daily. Most mothers in Bamaha seemed to consume local staple foods more often (three times a week) than the mothers in Arowi (once

**TABLE 2 |** Change in price of staple foods between 2008 and 2017 relative to the price of instant noodles in 2017.

Commodities	2008		2017		Change in price, 2008–2017 (IDR)	Change in price relative to price of instant noodles, 2017
	Mean price (IDR) ± SD	n	Mean price (IDR) ± SD	n		
Rice	7.229 ± 4.539	1.907	10.062 ± 2.720	3.709	2.833	1.1
Wheat	9.010 ± 4.873	279	9.959 ± 2.489	883	948	0.4
Cassava	7.156 ± 5.959	283	9.346 ± 4.747	602	2.190	0.9
Sweet potato	4.343 ± 2.398	93	9.702 ± 4.657	298	5.359	2.1
Sago	7.068 ± 4.957	165	12.833 ± 6.017	368	5.765	2.2
Taro	5.800 ± 3.739	158	11.513 ± 6.249	371	5.713	2.2
Potato	9.703 ± 4.451	74	24.208 ± 8,235	143	14.505	5.6
Instant noodles	1,806 ± 946	1.331	2,569 ± 616	2.569	763	0.3

IDR, Indonesian rupiah; n, number of households; SD, standard deviation.



**FIGURE 4 |** The proportion of rice and other tubers consumed from own production to total consumption in 2008 and 2017.

or twice a week). One stakeholder in Bamaha said with humor, “If we do not eat rice [every day], we will die.” The local stakeholders in both sites suggested that children prefer rice to traditional staple foods. A stakeholder in Arowi said, “Only the elderly like to eat tubers.” Furthermore, a stakeholder in Bamaha said, “During a family meal, children only want to eat rice. Us the elders, we can still eat without rice. We eat tubers which has supported us since we were children.”

The institutional stakeholders explained that eating rice is also a matter of prestige because rice is considered the premium staple food compared to the local staple foods. The institutional stakeholders in this study also expressed that prestige plays a role in increasing rice consumption. One stakeholder shared, “I used to do research in the rural area [of Papua]. I found that rice was not just a regular staple food. It was a prestigious staple food.” The institutional stakeholders suggested it in a negative light.

Rice is also preferred over sago because of its relatively lower cost. In the FGD with the institutional stakeholders, the participants mentioned that the daily consumption of sago is more expensive than rice if it is purchased. As one stakeholder stated, “When we buy sago in the market, just this much [hand gesture showing small amount], is 20 thousand and the content is not dense...” The same stakeholder then continued, “If we buy rice, you know how much it costs? Raskin [a government program that subsidizes rice for the poor] costs 7 thousand, right? The same amount of money is more than enough to buy two kilograms [of rice].” Government programs such as Raskin, which provide free or subsidized rice for the poor, were discussed as one of the causes of a dietary transition by the institutional stakeholders. One participant argued that rice could replace the local staple foods of the West Papuans because of subsidies. The stakeholders recommended that traditional staple foods should be subsidized

to boost production and consumption: *“Rice used to be expensive, but because of the subsidy program, it started to be cheaper.”*

One institutional stakeholder blamed rice for making the West Papuans lose their skills to process their local foods. *“Our dietary pattern has shifted to rice-based. To return to that [sago- or tuber-based diet] is rather difficult. I think it must be done gradually. It is not as easy as turning your palm around. It has to be started from kindergarten students; they have to be motivated [to consume traditional foods].”* The fact that rice is now widely available was said to have contributed to creating the West Papuan dependence on rice. One participant stated, *“The availability of rice makes the Indigenous people consume rice. They are not gardening, hunting, and gathering anymore.”* The harvesting and processing of sago were also mentioned several times as both a problem and a solution in the staple food transition. The institutional stakeholders said that processing sago for staple food consumption is still traditional. This is more complicated than cooking rice with a rice cooker. Therefore, rice is often chosen over sago for its practicality. One institutional stakeholder expressed the physical hardship of the traditional sago production activities. Subsequently, this limits sago production and consumption. The stakeholder suggested that it should be made easier to make it more attractive.

Rice is also viewed as a more suitable staple to serve with more side dishes. The local stakeholders in Arowi and Bamaha villages preferred to eat sago as a staple with fish and “yellow and sour soup.” This recipe was also viewed as a more complicated dish to serve than rice. Some of the institutional stakeholders also argued that the growing industry in tuber-based snack production for *oleh-oleh* (food souvenirs) has also changed the perception of West Papuans. Tubers, traditionally consumed as a staple food, have gradually become known and consumed as snacks.

### Consumption of UPFs and SSBs

Some institutional stakeholders and all local stakeholders raised concerns regarding the marketing of UPFs and SSBs. For example, the local stakeholders in Arowi and Bamaha villages complained about their children’s “pester power” when nagging for the UPF snacks sold by food traders. In Bamaha village, where access was only possible from Manokwari by either four-wheel vehicles or special trucks, the mobile snack traders come and go about four times a day by motorcycle. When asked what they usually buy from the mobile snack trader, the local stakeholders in Bamaha answered, *“Candies, biscuits, Supermi [a brand of instant noodles], Super Mama [a brand of UPF snacks marketed to children], grilled corn [extruded snacks].”*

The local stakeholders in Bamaha village reported spending up to 50,000 IDR (~3.5 USD) every day on snacks for their children. *“I bought Supermi, sometimes five thousand, biscuits, ten thousand, chiki, five thousand. That popcorn was ten [thousand]. Today I spent fifty [thousand]. Tomorrow again another 50 thousand.”* Another local stakeholder said that she spent 20,000 IDR (~ 1.4 USD) in a day. While explaining this, the stakeholders seemed upset. *“When the mobile snack vendor comes, children cry [begging for the parents to buy snacks]. When the mobile snack vendor doesn’t come, children will eat just local foods. They don’t cry.”* The stakeholders also reported that they have directly

complained to the mobile UPF snack traders for coming to their area four or five times a day from the early morning onward. However, the complaint did not result in the mobile snack vendor coming less often.

The local stakeholders in Arowi explained that their children usually asked them to buy UPF snacks and SSBs, such as instant juice powder, biscuits, and juice in a glass from micro- and small-scale food kiosks. The stakeholders also included RTE foods, such as meatballs (*bakso*) and tapioca balls (*cilok*), as the snacks commonly purchased and consumed by their children. The stakeholders also reported that the children in Arowi used to cry when asking their parents for UPF snacks: *“When I was a child, I didn’t usually buy snacks because my parents gave me maybe 50 or 500 rupiahs for one whole day. But now, there are so many snack kiosks, children would cry asking for money [to buy snacks].”* The stakeholders reported spending about 10,000–30,000 IDR per day on their children’s snacks.

### “The Malnutrition Is Actually Due to the Dietary Transitions”

The institutional stakeholders admitted that there are problems regarding health and undernutrition in West Papua. However, they did not believe that the problems were caused by insufficient food availability. The participants doubted that the problems had anything to do with their local food supply because they argued that the landscape of Papua could support the production of food for the local people. *“In Papua, there are no malnourished or starving people because they don’t have enough food. What happens is a health problem,”* said one stakeholder, blaming health issues as the cause of malnutrition instead of lack of food. There was concern expressed by the institutional stakeholders that a dietary transition in their communities had reduced the ability of local people to process their own staple foods and that this could lead to starvation, as suggested by one stakeholder: *“That [malnutrition] is actually due to the dietary transitions. People used to eat local food. And now, when the Raskin is running out, they cannot make or process [local foods].”*

The institutional stakeholders were confident that West Papua could be self-sufficient in its food supply because it has a large land base that could be used to grow local foods. This message was delivered consistently by different participants. Statements saying that there is no problem with local food sufficiency were often heard, such as, *“... we have everything. The production of tubers, the production of local foods, is [enough] to fulfill the need of the local people. Thus, in my opinion, the problem of food security is not due to land issues.”* Most of the stated assumptions about self-sufficiency included arguments about how large Papua is and its richness in terms of food diversity. However, there was some doubt when it came to the sufficiency of the food for non-Indigenous Papuans in urban areas: *“... I think the availability of the local foods is sufficient to fulfill the needs of the [local] people who live in the villages. The problem is for the non-indigenous Papuan, including myself, is it sufficient or not?”*

One stakeholder expressed his confidence that malnutrition in West Papua is independent of food sufficiency and availability. *“I once went to a coastal village in Kebar. There were fewer teenagers than the under-five-year-old children. Also, there were a*

lot of undernourished pregnant mothers, and none of the children were chubby. However, if we look at the availability of the food resource there, they were good, sufficient. They had plenty of deers [wild animal-source food], and the water source was good.” The stakeholder further explained that the local agency in the area did not know why the villagers were malnourished and that such issues had never been discussed with related agencies. There is a need for members of the health and agricultural agencies to sit together to discuss the problem from various perspectives.

### The Link Between Dietary Transition and Forests

The institutional stakeholders expressed their concerns about the land-use management in West Papua and how it affected food security. There was an intense discussion about the *cetak sawah* program (literally translated as a paddy field printing program). This is a policy enacted by the central government to boost rice production and has resulted in the conversion of forests in Papua into rice fields. A stakeholder stated the concern that the implementation of this program encourages local people to convert their land to paddy fields and to consume rice: “The *cetak sawah* program encourages the local communities to clear their land [for paddy fields]. This means supporting the indigenous people to consume rice.” The stakeholder indicated that Papua is the target area for paddy fields because Java has no more agricultural land. “Because in Java there is no more [agricultural] land. [They have to look for land outside Java.] Where is outside Java? It’s here [Papua]! And it is reducing local food production.”

The institutional stakeholders expressed concerns regarding the suitability of the converted land for growing rice. One participant said, “Don’t convert our land which is suitable for local food into rice fields.” The stakeholders explained that the forest areas cleared for the *cetak sawah* program were widely abandoned in the past. “The agriculture agency cleared the land, but they didn’t continue to plant it. Better not to burden West Papua. The number of cleared lands [for agriculture] is increasing, but not productive.” The representative from the Office of Agriculture admitted that there were obstacles that delayed planting on the cleared land. However, he argued that the cleared land can be planted with anything in practice and that it does not have to be rice. They also complained that the premium lands (forested areas or cleared lands suitable and fertile for agriculture) are allocated for oil palm and transmigration programs. They feared that the remaining available lands were not the most suitable for agriculture, such as slopey areas. As one participant stated, “Flatlands become the government’s target for oil palm plantation, pushing away the land-used for planting local food.”

The institutional stakeholders had a strong sense of solidarity for the Indigenous people and local small-scale farmers, as elaborated on by one participant: “Actually, people, in general, are still depending on the forest, for now. So, it is impossible to implement activities that would change our nature on a large scale. For example, large-scale planting of cassava and sweet potatoes is the same as planting oil palm. They can damage the forest, too. The indigenous people still depend on their forests. Therefore, we should regulate land use, to stop the exploitation of forests on a large scale.” The stakeholders seem to believe that exploiting the

local lands, including the Papuan forest, for agriculture should be implemented in collaboration with the traditional chiefs.

There was confusion surrounding land allocation for conservation, large-scale plantations, and local food production. Participants repeatedly expressed their concerns that there would not be enough land for food production to feed West Papuans after the allocation for conservation and large-scale plantations. “There are intact forests which will be handed over to the private sector, but the private sector will only get 30%, and the 70% will not be cleared.” One stakeholder referred to the Manokwari Declaration, a provincial commitment to conserve at least 70% of their forests. The same stakeholders speculated about how the percentage of the conservation area was determined: “However, it is not the numbers that we are concerned about. Instead, it is more about how it will be executed spatially. No one can answer that until today.” The stakeholders discussed the status of the declaration, which has not yet been embodied in the West Papua Province regulations at the time of this study.

## DISCUSSION

The results from the quantitative data show that diets in West Papua are transitioning toward less consumption of fresh and minimally processed foods, traditional staple foods, wild meat, dark-green leafy vegetables, fresh legumes, nuts, and “other” fruits. Diets are also transitioning toward more consumption of processed foods, avian meat, vitamin A-rich fruits, UPFs, and RTE foods. Some of the results from the quantitative analysis were echoed by the findings from the FGDs involving institutional and local stakeholders, particularly that diets were transitioning away from traditional foods and toward more rice and UPF consumption. Whereas, the institutional stakeholders were more concerned about the transition in staple foods and the link to land use, the local stakeholders seemed to accept that their diets are now rice based. The local stakeholders seemed to be more concerned about their children’s high consumption of UPFs and SSBs and the social and economic difficulties that this has created.

### A Dietary Transition in West Papua Toward Javanese-Influenced Diets

In earlier research on the dietary transition in Indonesia, a shift in dietary preferences toward Western food was reported among people who moved to Jakarta, the capital city (Colozza and Avendano, 2019). Lipoeto et al. (2004) found an increase in expenditure on meat, eggs, milk, and prepared food, following a similar pattern of dietary transition in other developing countries. Another study suggested that Southeast Asians are retaining their traditional diets. However, more animal foods, sugar, and vegetable oils are added to their traditional recipes due to increased purchasing power (Lipoeto et al., 2013). Pawera et al. (2020) suggested that although traditional foods are still preferred over Western foods in rural Indonesia, concerns are raised over the increased availability of fried snacks and UPFs. Oddo et al. (2019) found that consumption of UPF is common in Indonesia, and physical activity has decreased over a decade.

The dietary transition that we see in West Papua has some contextual differences from the “typical” dietary transition. First, we see a change in the composition of staple foods toward rice and wheat, away from tubers. From the institutional stakeholder point of view, this was an important concern. Second, instead of an increase in animal-source foods in general, we see a decrease in fresh meat consumption, no significant change in fish consumption, and an increase in avian meat consumption, which is dominated by broiler chicken, presumably imported frozen from Java (Isnanto, 2016). There was also an increase in the consumption of processed legumes, which are traditionally rooted in Javanese food culture (Shurtleff and Aoyagi, 2007). These changes reflect the rather special character of the Papuan diet, which has traditionally been based on harvesting sago and tubers and hunting, gathering, and fishing.

In the West Papua context, diets appear to be transitioning toward being more “Javanese.” Javanese diets are dominated by rice with smaller portions of meat and fish and processed soy products such as tofu and tempeh. The following conversation, which occurred among the local stakeholders in Arowi, describes the situation: “*Now we eat chicken, in the past, we ate fish.*” Another stakeholder answered that they did not eat tofu in the past, and now they do. A dietary transition in which coarse staple foods are replaced by the consumption of “prime staple foods,” such as wheat and polished rice, has also been reported as part of the modernization of diets in China, particularly in rural low-income settings (Popkin, 1999; Chang et al., 2018). In Indonesia, the adoption of rice has been noted for more than 20 years on a remote island in Siberut (Persoon, 1992) and more recently on the islands of Moluccas (Damanik and Tahitu, 2011) and Riau (Syartiwidya et al., 2019).

From a nutritional perspective alone, the modernization of diets has likely brought some benefits for West Papuans. The increased consumption of broiler chicken, tofu, and tempeh has likely increased the protein intake. The consumption of “other” fruits has also increased, plausibly due to the trade between West Papua and other provinces in the region. The data also show that consumption of processed food has increased substantially, indicating the modernization of the region’s diet. The increased consumption of processed foods does not have the same negative health implications as the consumption of UPF. Preserving fish and processing soybeans could help improve the level of food security (Fusco et al., 2017) by increasing the intake of protein from tofu and tempeh. Protein consumption was well-below the recommendation (57.0 grams/capita/day) in several regencies in West Papua, such as Pegunungan Arfak (38.5 g) and Sorong Selatan (43.4 g) (Statistics West Papua, 2018b).

Further, analysis of the HDDS shows that dietary diversity increased from 8.5 to 9.0, indicating improvement in household access to diverse foods. However, the institutional stakeholders expressed dissatisfaction with the current dietary pattern. They described the move away from traditional foods as losing the power of their food systems. This finding suggests that the diets of a population can be improved in quality but toward consumption of foods that are less preferred by the local communities for reasons such as culture and values. If agency is to be considered as one of the food security dimensions, measuring diet quality

from a nutritional perspective alone is not enough. For example, the Minimum Dietary Diversity for Women (MDDW) indicator considers the consumption of sago, tubers, and rice to be the same (under the starchy staples food group). The HDDS differentiates between rice consumption (recorded under the cereal group) and sago and tubers (under the white roots and tubers group), but it scores them equally. An effort to develop metrics to assess food agency in West Papua, such as in the Food Consumption Agency Metrics for Burkina Faso context, is needed (Tkaczyk, 2021).

## UPF: A Significant Social and Economic Burden

In other respects, the dietary transition in West Papua also reflects the more “typical” pattern of the increased consumption of UPFs. Our finding on the increased consumption of UPF is consistent with other studies focused on the high consumption of UPF in Indonesia (Green et al., 2019; Oddo et al., 2019). The increased consumption of UPFs raises concerns over potential health impacts. UPFs (e.g., baked goods, savory snacks, and packaged extruded salted snacks) tend to have poor nutritional profiles (Poti et al., 2017). They may replace fresh and traditional minimally processed foods. UPF snacks and SSBs deliver high energy in the form of simple carbohydrates and are also high in preservatives and sodium (Moubarac et al., 2017). Our findings indicate that the consumption of UPFs (Group 4 NOVA classification) has increased significantly in West Papua. The consumption of SSBs, caloric snacks, and crackers has also increased. And the increase was detested by the stakeholders.

The displacement of minimally processed foods and freshly prepared dishes and meals by UPFs is associated with unhealthy nutrient profiles. The consumption of UPFs is linked with various health problems, including the increased risk of all-cause mortality, overall cardiovascular diseases, coronary heart diseases, cerebrovascular diseases, hypertension, metabolic syndrome, the state of being overweight or obese, depression, irritable bowel syndrome, overall cancers, postmenopausal breast cancer, gestational obesity, adolescent asthma and wheezing, and frailty (Chen et al., 2020). In West Papua, 40% of adults are overweight or obese. This is higher than the national average of 35%. From 2007 to 2018, the prevalence of diagnosed hypertension, stroke, and heart disease increased, noticeably for diabetes mellitus, the rate increased by more than three folds (Ministry of Health, 2008, 2019a). Due to changes in jurisdictions and limited data availability during the observed years, we cannot compare the data at the regency level. However, from the available diabetes mellitus data, six out of eight regencies with complete data had increased prevalence in 2007 and 2018: Kaimana, Manokwari, Raja Ampat, Sorong, Sorong City, and Teluk Bintuni (Ministry of Health, 2009, 2019b).

Although this study provides no evidence of the relationship between dietary transitions and health problems, the increased consumption of UPFs and the increased prevalence of non-communicable diseases during the same period suggests a plausible connection that should be further studied. Increased prevalence of overweight, hypertension, diabetes, and cholesterol

was found among former hunters in Borneo after easier access to food markets. Improved access to markets has presumably stimulated an increase in the consumption of unhealthy snacks that are high in fat and free sugars but low in complex carbohydrates (Dounias et al., 2007).

UPFs can also have negative social and economic impacts (Monteiro et al., 2018). In West Papua, the local stakeholders complained about the circulation of ultra-processed snacks and beverages in their villages and how their children use pester power to make them buy such foods. They reported spending up to 3.5 USD per day on UPF snacks. Compared to the average per capita expenditure, the spending on UPF snacks is significant in Manokwari Regency (where Arowi is located), and it is also paramount in Pegunungan Arfak Regency (where Bamaha is located) (Statistics West Papua, 2018a). The high expenditure on nutritionally poor food can be a substantial economic burden for households.

Furthermore, a concern was raised by the institutional stakeholders regarding the increasing proportion of food produced outside of Papua that is part of the overall food intake. They expressed concerns about their weakening power over their own food systems amid the rice-based food assistance, imported products, and the marketing of UPF snacks. Interestingly, supermarkets, hypermarkets, and convenience stores are known as the increasingly dominant channels for the distributing UPFs (Baker and Friel, 2016). In West Papua, where there are few supermarkets (one in Manokwari, six in Sorong City in 2021) and a growing number of minimarkets (Nursalikah, 2015), the local and institutional stakeholders explained that micro- and small-scale food stalls and mobile food vendors were the primary channels for UPF distribution at the time of the study.

Several brands discussed during the FGDs with the local stakeholders are part of the national and transnational food and beverage corporations. The brands mentioned can refer to a specific brand or to other brands connected to similar products. It is common to name a product after the most popular brand in the Indonesian context. Baker and Friel (2016) suggested that as the growth of markets in high-income countries has stagnated, UPF producers are targeting low-income and middle-income countries. In Asian countries, the market power of corporations shapes both the global and local food systems by altering the availability, price, nutritional quality, desirability, and ultimately the increased consumption of UPFs (Baker et al., 2020). This also could be the case in West Papua.

## Local Perspectives on the Rise of Rice Consumption in West Papua

The dietary transition toward rice and away from sago and tubers was mentioned repeatedly and consistently by the institutional stakeholders as something that they perceived negatively. Whereas, the institutional stakeholders had strong feelings that West Papuans should revert to traditional staple foods and expressed dissatisfaction with the central government policies that support rice as a staple food in West Papua, the local stakeholders seemed to accept this transition. Both the local and institutional stakeholders recognized several factors that support

the transition from rice to sago: (i) the importance of nutrient content (health aspect), (ii) the perception of rice as a “prestige” food, (iii) cooking practicality, (iv) the wide market availability, and (v) the relatively low price (accessibility).

Based on the institutional FGD, we identified the following concerns from stakeholders regarding the rise of rice consumption: (i) rice consumption could have a negative health impact on Papuans who are biologically adapted to consume sago and other tubers instead of rice, (ii) Papua land is unsuitable for growing rice which would create a dependence on the external production of staple foods, making West Papuans vulnerable to shocks in the rice supply, and (iii) that the knowledge of the how to produce and process local staple foods is disappearing.

## The Health Characteristics of Staple Foods

The stakeholders generally viewed sago as healthier than rice. Although rice provides about the same amount of energy as sago, it contains more protein: 8.4 g per 100.0 g of rice compared to 0.4 g per 100.0 g of sago flour (Nilaiigizi.com., 2021). Furthermore, rice is a good source of vitamins B1 and B3, which are barely present in sago. However, sago has a lower glycemic index (GI) than rice and therefore has a better impact on blood glucose levels (Wahjuningsih et al., 2016; Syartiwidya et al., 2019). One FGD participant mentioned that many Papuans whose bodies were used to consuming sago suffered diabetes caused by the transition to rice, a staple food with a higher GI. Because sago and tubers are higher in fiber than rice (Nilaiigizi.com., 2021), they tend to delay gastric emptying and thus prolong satiety. Additionally, emerging evidence also suggests that the probiotics derived from sago could have a role in reducing diabetes (Ahmadi et al., 2019).

According to the Ministry of Health, the prevalence of diabetes among West Papuans aged 15 years old or older increased from 0.6% in 2007 to 1.9% in 2018 (Ministry of Health, 2008, 2019a). A study using animal models showed a decreased lipid profile and an improvement in the insulin resistance of rats fed with sago analog rice due to the role of resistant starch (Wahjuningsih et al., 2018). Thus, the relative health and nutritional benefits of rice and sago are mixed. The dietary transition from sago and tubers to rice may increase protein and certain micronutrients from rice, but it may also trigger negative health impacts.

## The Availability, Accessibility, and Stability of Staple Foods

A study in Papua Province showed that the dietary changes of the people who lived in Merauke can be explained by changes in the availability of traditional and wild foods, access to markets, how the women use their time, and preferences (Purwestri et al., 2019). The results from the qualitative analysis are in line with these hypotheses and findings. The institutional stakeholders pointed out that sago flour is more expensive than subsidized rice. The institutional stakeholders explained that rice is more available and affordable in West Papua, partly due to subsidies. When rice became familiar to local people, the demand for rice increased, and the demand for other staple foods decreased.

Nationally, rice-based food assistance programs appear to have lessened rice's economic burden.

However, according to the stakeholders in this study, the financial mechanism that improves rice consumption in West Papua has had a negative impact by reducing the consumption of traditional staple foods. Quantitative analysis of the change in the price of rice and traditional staple foods shows that from 2008 to 2017, whereas the price of rice was more stable, the price of traditional staple foods increased more substantially. Further, the proportion of staple foods consumed from own production increased for rice but decreased for traditional staple foods. Although the findings do not provide evidence of a causal relationship, they confirm the information conveyed by institutional stakeholders.

### The Prestige, Preference, and Practicality of Rice Preparation

The FGD with the local stakeholders from both villages (mountainous and coastal) confirmed their dependence on rice and their low sago consumption. The institutional stakeholders raised concerns that the transition from sago to rice contributed to a change in the palate of West Papuans, with sago becoming less familiar compared to rice. In contrast, the local stakeholders in Arowi did not show any concerns over the transition to rice. Instead, they suggested that only “the old people” eat sago every day, in a tone that seemed to look down on this behavior. In Bamaha, there was more of a sense of pride when the local stakeholders stated that as elders, they still consume tubers: “*We eat tubers which have supported us since we were children.*” The desire to revert to a traditional diet was not equally expressed by all of the stakeholders in our study.

Some stakeholders preferred rice over sago and tubers because they could easily purchase rice before cooking rather than harvesting and processing sago and tubers from the forests or buying them at a higher price. Particularly for sago, local Papuans generally harvested from the sago palm trunk which grows mostly in forested and swampy areas. The palm needs to be cleaned, cut down, and split in half. The sago palm fiber is then crushed with a hoe or an ax-like device. The more modern process uses a mechanical shredder to crush the cutout sago palm fiber. Water is then added to the shredded sago palm fiber, and then it is squeezed and filtered for the starch before it finally settles or is sedimented in a bucket made of sago palm leaves (Dewi and Bintoro, 2016). The process is laborious and time-consuming (Persoon, 1992), while practices and technological innovations for facilitating the preparation of sago are still limited (Akzar et al., 2020).

Some of the stakeholders preferred sago for its suitability to accompany local dishes. However, rice was said to be more practical as it can be served with more varied dishes. With increasing but still relatively low amounts of energy from UPFs and RTE foods, home-cooked meals still play a prominent role in the diets of West Papuans. It is also important to note that the local stakeholders who expressed their preference for rice were women, who are also the ones responsible for preparing food for their families. Statements made by the male institutional stakeholders—such as “*The scenario to shift back to the traditional*

*food consumption pattern, depends on the mothers*”—hints at the gendered nature of the discourse. The representation of male and female participants at the institutional FGDs was relatively equal. However, we rightly noted that women handled food preparation in Papuan culture (Kasniyah, 2006). The statement implies that to some members of society, this complex challenge is the responsibility of women rather than a multifaceted challenge that needs to be addressed systematically.

### Sustainability

The HLPE (2020) report defines sustainability in food security as the long-term ability of food systems to provide food security and nutrition that does not compromise food security and nutrition for future generations. Concerns over sustainability expressed by institutional stakeholders were centered on the issue of land suitability. Stakeholders stated that Papuan land is not suitable for growing rice. From the perspective of the institutional stakeholders, traditional foods grown and produced locally are more sustainable than foods imported from other regions or UPFs. Thus, in their views, dependence on rice means that Papuans cannot be food secure because their land is not suitable for growing rice. Rice production in West Papua is low, with a low productivity rate. Production decreased from 17,899 tons in 2019 to 14,572 tons in 2020 (Statistics West Papua, 2021b). The average consumption of rice-based staple foods in 2017 in West Papua was 204 grams/capita/day (Table 1), and 1.13 million people live in West Papua (Statistics West Papua, 2021a). Thus, local production is far from adequate to fulfill local needs.

From an environmental sustainability perspective, sago is more climate resilient than rice (Bantacut, 2014). Rice contributes to 30 and 11% of global agricultural greenhouse gas emissions of methane and nitrous oxide, respectively. Sago mainly grows naturally in swampy forest areas and can also be cultivated without pesticides and chemical fertilizers. Sago can be reharvested from the same clump after 2–3 years (Novarianto et al., 2020). From this viewpoint, the dietary transition that moves away from sago toward rice will worsen the impact of climate change; hence, it is not environmentally sustainable (Gupta et al., 2021). Studies on the sustainability aspect of Indonesian diets have suggested a cut in rice and sugar consumption. Therefore, the opinion of the institutional stakeholders in this study is aligned with the sustainable food systems agenda (Vermeulen et al., 2019; de Pee et al., 2021). Further, it is also aligned with the recommendation from the central government to reduce per capita rice consumption and to diversify staple foods beyond rice and wheat as stated in Presidential Regulation Number 22 (2009), Minister of Health Regulation Number 41 (2014), and Minister of Agriculture Decree Number 64.1/KPTS/RC.110/J/12/2017 (2017).

### Are West Papuans Food Insecure?

When measuring and understanding food security in West Papua, there seems to be a disconnect between the food security indicators used by the central government and the perspective of the institutional stakeholders. The Food Security Index (FSI) used by the Indonesian government consists of nine indicators, including (1) the ratio of per capita of normative consumption to

net availability<sup>4</sup>, (2) the percentage of the population living below the poverty line, (3) the percentage of households where the proportion of expenditure on food is more than 65% of the total expenditure, (4) the percentage of households without electricity, (5) the average school years for women older than 15 years old, (6) the percentage of households without access to clean water, (7) the ratio of health care providers to the population, (8) the percentage of stunted children, and (9) life expectancy at birth.

The indicators originate from the Food Security and Vulnerability Atlas (FSVA) indicators, initiated by the World Food Program. When adopted by the Food Security Agency under the Ministry of Agriculture in 2018, the name became *Indeks Ketahanan Pangan* (IKP), or the Food Security Index (Food Security Agency, 2018). Since the FSVA published its first atlas in Indonesia, West Papua has always been among the provinces with the lowest score.

However, from the perspective of the institutional stakeholders, there is no food insecurity in West Papua. They claimed that malnutrition is not caused by unavailability and inaccessibility of food, such as dietary transition and diseases. From their explanation, it seems that the institutional stakeholders define food insecurity as the absence of availability and accessibility to food sources. This is a common perspective. The FSI seems to be more analogous to a human development index because it measures more than just food-related issues. In West Papua, from the stakeholders' perspective, the abundance of natural resources, especially the often-mentioned forests, can provide all of the food needed by local Papuans. The differences between the FSI measures and the views of the stakeholders in our study suggest disagreement in defining and valuing food security between the government and some West Papuans.

The analysis of the HDDS indicates an improvement in household access to diverse foods. Further, the stunting rate of children under the age of 5 years in West Papua decreased from 39% in 2007 to 28% in 2018 (the national average is 31%) (Ministry of Health, 2008, 2019a). The improvements in access to sanitation and education are plausible factors for reducing the stunting rate nationally (Arif et al., 2020). In West Papua, the access to improved sanitation has increased from 26% in 2007 to 74% in 2018 (Statistics Indonesia, 2021a). The mean years of schooling have also increased from 6.8 years in 2010 to 7.3 years in 2018 (Statistics West Papua, 2021c). However, even with these improvements, almost all areas of West Papua are considered to have an extreme, very high, or high risk of food insecurity according to the FSI (Figure 5).

The patterns of food insecurity in Indonesia defined by FSI measures have a strong geographical dimension. In 2015, 90% of the regencies identified as “severely vulnerable to food and nutrition insecurity” were located in the far east of Indonesia, such as the Papua, Maluku, and East Nusa Tenggara regions. Up until the last FSI 2020, almost all of the provinces on the western side of the country (Java and Sumatra islands) have at least a medium risk to food insecurity or better (very low risk or low risk) (Food Security Agency, 2020), but the provinces of Papua and West Papua remain under extreme risk and very high

risk categories. However, this may be a result of the fact that the components of the index capture access to basic infrastructure and government services, including electricity, education, access to clean water, and health care. The regencies identified as having high food insecurity in 2018, including Maybrat, Pegunungan Arfak, and Tambraw, were also the regencies inhabited by proportionally many Indigenous Papuans; the regencies with better food security scores (Manokwari, the province capital, and Sorong City) are urban areas with better infrastructure (Ananta et al., 2016; Figure 5).

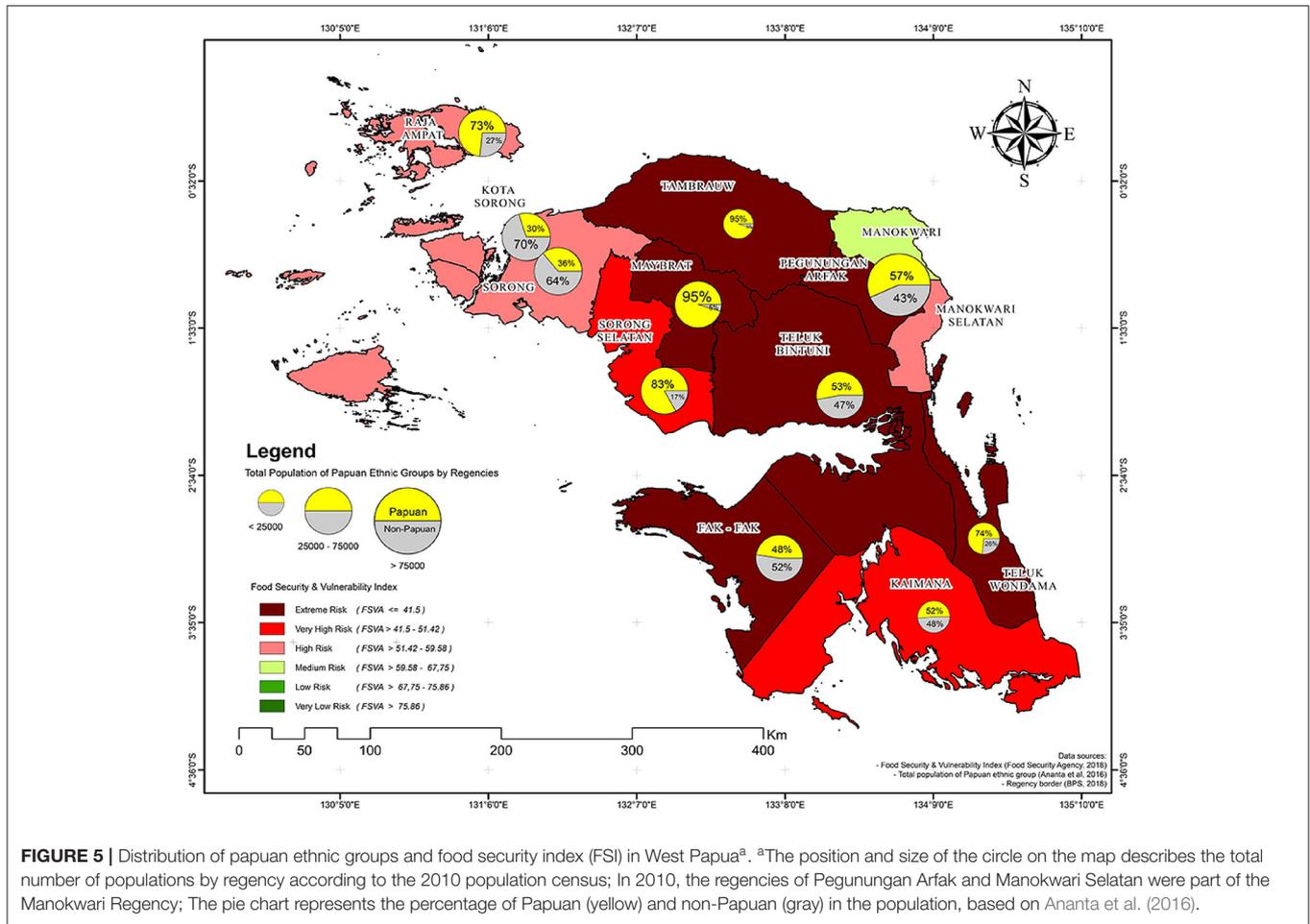
In contrast to the scores of the FSI, the institutional stakeholders view local people and Indigenous Papuans as food secure. For example, one of the institutional stakeholders said, “*In Papua, there are no malnourished or starving people because they don't have enough food*”. Another said, “*...we have everything. The production of tubers, production of local foods is [enough] to fulfill the need of the local people.*” The FSI does not capture the issues of availability, accessibility, utilization, stability, and sustainability regarding food in the surrounding environment of West Papua. The FSI also does not capture the aspect of agency, defined here as the capacity of West Papuans to make their own decisions about what foods they eat and produce, how that food is produced, processed, and distributed within the food systems, and their ability to engage in the processes that shape the food system policies and governance (HLPE, 2020). These are the aspects of food security that the institutional stakeholders appear to have in mind when discussing food security. The absence of indicators that directly measure these aspects indicates the need to revisit and propose more suitable food security indicators.

## Conserving the Forest, Securing Food for West Papua

Forests provide various benefits that can be used directly or indirectly for food provision. Direct benefits are the foods that people harvest and collect from the forest, such as fruits, insects, tubers, wild meat, and mushrooms, making forests “free organic supermarkets” for the people who live nearby. Several studies have shown links between forests and diets (Powell et al., 2015; Rowland et al., 2017) and others have shown how changes in land use can affect diets. In Indonesia, changes in farming practices from the production of diverse crops to greater specialization is linked with lower dietary diversity of rural Indonesian households (Mehraban and Ickowitz, 2021). Another study in Northern Laos found that a decrease of uncultivated lands due to commercialization reduced wild food consumption and subsequently also reduced dietary diversity (Broegaard et al., 2017).

West Papuan land is comprised of forests and other intact ecosystems, with 89% forest cover in 2020 (Figure 1). Living in a province primarily covered by forest, the stakeholders in this study explained that “*The indigenous people still depend on their forests.*” Even the local stakeholders in the coastal area near the city center said they often go to forests to collect wood fuel and foods, such as vegetables. When asked about forest ownership, they laughed and said, “*The forest belongs to the community. No one will be angry [at them taking wood and food from the forest].*”

<sup>4</sup>This indicator only applied to regencies and not cities.



**FIGURE 5 |** Distribution of papuan ethnic groups and food security index (FSI) in West Papua<sup>a</sup>. <sup>a</sup>The position and size of the circle on the map describes the total number of populations by regency according to the 2010 population census; In 2010, the regencies of Pegunungan Arfak and Manokwari Selatan were part of the Manokwari Regency; The pie chart represents the percentage of Papuan (yellow) and non-Papuan (gray) in the population, based on Ananta et al. (2016).

The changing landscapes, such as the conversion of forests into plantations, could affect hunting and gathering activities which are an essential part of the food culture of West Papua.

The institutional stakeholders expressed concern regarding the future use of their forests for plantations and large-scale agriculture. This concern may be well-grounded because there has been recent deforestation due in large part to the expansion of oil palm and timber plantations (Andrianto et al., 2019; Runtuboi et al., 2021). Additionally, a national government program that converted forests to produce food and other crops in the neighboring province of Papua (Hadiprayitno, 2017) is seen by many local people as an example of something that West Papua should not follow. The stakeholders suggested that they should avoid similar large scale land conversion for any kind of plantation because of the damage it could cause to forests, as one stakeholder said “... it is impossible to implement activities that would change our nature on a large scale. For example, large-scale planting of cassava and sweet potatoes is the same as planting oil palm. They can damage the forest, too.”

The stakeholders also were concerned about the potential impacts of government plans for forest conservation on their food security. Their worries about conservation are linked to the adoption at the provincial level of the Manokwari

Declaration in 2018, an important milestone in the effort to conserve Papuan forests. The institutional stakeholders largely approved the plan to maintain 70% of their forests as stated in Manokwari declaration. However, they voiced concerns that conserving forests could mean fencing out local people from their own forests and their food sources. In 2019, the Manokwari Declaration, was embodied in Special Provincial Regulation Number 10 (2019) about Sustainable Development in West Papua, issued by the Governor of West Papua. The regulation, which aimed to accommodate the declaration’s goals, stated that West Papua will maintain a minimum of 70% of tropical forest ecosystem areas and other essential ecosystems in the land area of the province. This seems to indicate that the provincial government’s intention is to maintain the natural ecosystem, with the rights of the Indigenous Papuans in mind, and not necessarily to change the status of the forest into a conservation area.

Under the article on agriculture and food security in the special provincial regulation, the first section stated that “agricultural land designated as permanent rice fields shall be maintained, as long as it still functions as rice fields.” The statement addressed the issue of land that had been cleared for paddy fields but had never functioned as such, which the institutional stakeholders mentioned as a “burden” on West

Papua (see section The link between dietary transition and forests). The section indicates that new land clearing for paddy fields will not be supported. The following section stated, “*Local governments are obliged to promote and improve local food to maintain food security stability in West Papua Province.*” Together, the sections indicate that the provincial government intends to encourage more use of local foods.

In 2021, the West Papua Province government revoked the plantation permits of 16 oil palm companies. The revocation was based on an evaluation since 2018, which showed that the license holders had not conducted any operation on the land and had not obtained land rights. This saved at least 346,000 hectares of land, ~80% of which is still covered by forests.<sup>5</sup> There are ongoing efforts to ensure the return of revoked concession areas to the Indigenous people, including participatory mapping of community land and mapping of social and economic potential in the revoked concession areas. The intention is to ensure that the land will be secured for the Indigenous people of West Papua.

Efforts to conserve Papua’s forest are in line with the central government policies, such as: (i) the National Movement on Saving Natural Resources (Syarif, 2020), (ii) the Oil Palm Moratorium, which was based on Presidential Instruction Number 8 (2018) regarding the postponing and evaluation of Oil Palm Plantation Licensing, and (iii) the revocation of 192 land-use permits on 3,126,439.36 hectares of forest area in the country in 2022 through Minister of Environment and Forestry Decree Number SK.01/MENLHK/SETJEN/KUM.1/1/2022 (2022). The challenges of maintaining over nine million hectares of natural forest cover come not only from private plantation companies, but could also come from the disharmony between the interest of local people and government policies. Conserving Papua’s forests requires substantial investment in human resources, extraordinary commitment from all parties concerned, improved science and monitoring, and more effective law enforcement (Cámara-Leret et al., 2019). Conserving these forests means securing food sources for West Papuans. These forests are also important for Indonesia and the global community since they play a vital role in climate change mitigation and biodiversity conservation. Hence, the central government and the international communities should strengthen their support of conservation of the Papua’s forests.

## CONCLUSIONS

The evidence presented here from the SUSENAS food consumption data for 2008 and 2017 and the FGDs involving institutional and local stakeholders showed that there is a dietary transition under way in West Papua. This transition is away from fresh foods and traditional foods, such as sago, tubers, fish, fresh meat, fresh vegetables, and fruits, and toward rice, broiler chicken, processed foods, UPFs, and RTE foods. Some of the dietary transition characteristics, such as the higher consumption of rice, chicken, and processed legumes, are more typical of a

Javanese diet than Western cuisines. In other respects, the changing diet in West Papua also reflects the more “typical” pattern of diet transitions seen across the world toward increased consumption of UPFs.

From a nutritional perspective alone, the modernization of diets could benefit West Papuans. For example, the increase in chicken consumption contributes to increased animal-source food intake, although it may also decrease the consumption of wild meats in some places. A nutritional perspective alone may not capture other undesirable facets of the transition away from traditional foods, as expressed by the institutional stakeholders in our study. Furthermore, the displacement of minimally processed foods and freshly prepared dishes and meals using ultra-processed products is associated with unhealthy nutrient profiles. The high consumption of UPFs was also problematic from a socioeconomic point of view. Although the consumption of UPFs and RTE foods contributed to only 17% of the total energy, the stakeholders raised concerns about the health, social, and economic impacts. The stakeholders were also concerned that the increasing proportion of diets from food produced outside Papua, such as rice, broiler chicken, and UPF, weakens their power over their food systems. Considering the widely recognized impact of high UPF consumption, we recommend that the central government regulates the production and distribution of UPF in Indonesia. Behavior change communication programs should be initiated that target all community members and focus on the risk of consumption of UPFs concerning non-communicable diseases later in life.

The institutional stakeholders expressed a strong desire to revert to a traditional diet. This desire, as well as their concern about the power over the local food systems, could be addressed by creating local, sustainable dietary guidelines that extend the current Indonesian national dietary guidelines into the local context, including sustainability considerations. The local stakeholders in our study tend to accept that rice is now their staple food. These local stakeholders include the women who process and prepare foods in the family, who may be more concerned over the practicalities of preparation and cooking time. Food policies to support communities in increasing sago and tuber consumption should consider the food processing and preparation burden on women. Additionally, research to improve the practicality of sago processing and preparation should be encouraged.

Although West Papua is categorized as highly food insecure by the FSI, the institutional stakeholders in this study tend to think otherwise. There seems to be a disconnect between the food security indicators used by the central government and the perspective of the institutional stakeholders. The national food security indicators do not adequately measure direct aspects of food security, such as the availability and accessibility of healthy foods surrounding the West Papuan contexts. The West Papuan food systems are well-supported by the nearby environment, which is rich in natural resources such as forest plants, wild meat, fish, and fertile soil that is suitable for growing local foods. The West Papuans living in forested areas understand the food and nutritional security benefits that the forests provide. These benefits are recognized in the Manokwari Declaration, which

<sup>5</sup>Personal communication with Cindy Junicke Simangunsong, a legal expert on the West Papua license review process and the Policy and Advocacy Manager of EcoNusa Foundation, Jakarta, 02/10/2021.

commits to conserving at least 70% of the forest cover, and the Special Provincial Regulation Number 10 Year 2019 (Perdasus No. 10/ 2019) by the Governor of West Papua. However, the local government needs support to operationalize these objectives.

The global community has begun to understand the problems associated with the current global food system, including its deleterious effects on health, the environment, and its lack of resilience (Willett et al., 2019; Fanzo et al., 2021). One of the problems associated with modern food systems is their homogeneity in the types of foods produced and how they are produced. This, in turn, results in limited diversity of foods consumed and vulnerability of the production systems to external shocks. The international community should be seeking to learn from the thousands of local food systems that still exist around the world and to support people who choose to maintain them before they disappear. This does not mean rejecting all changes in the production and consumption of non-traditional foods. Instead, it means working with communities to maintain the characteristics that benefit their nutrition and health, support their cultural identity, and promote sustainability and resilience. There is much to be learned from traditional West Papuan food systems—yet unless actions are taken soon, many of their unique features will likely disappear.

## DATA AVAILABILITY STATEMENT

The quantitative datasets presented in this article are not readily available because the dataset was obtained from Statistics Indonesia under an agreement that it was used only for the purpose of relevant research by the institution. Interested readers can obtain access at <https://www.bps.go.id/>. The qualitative dataset (transcript of the FGDs) is not published due to possible identifiable attributes in parts of the comments. Interested readers may contact the corresponding author for further information.

## ETHICS STATEMENT

The study was approved by the Research and Development Agency (Balitbangda) of the West Papua Province, Indonesia, through an official decree. The participants of the FGD provided consent to participate in the study.

## AUTHOR CONTRIBUTIONS

MN contributed to the design of the study, conducted the fieldwork, led the analysis of the qualitative and quantitative data, and led the drafting process. AM analyzed the qualitative data, created the map, and contributed to the drafting process. DA

analyzed the quantitative data and contributed to the drafting process. AU contributed to the design of the study, conducted the fieldwork, and contributed to the drafting process. LN contributed to the design of the study and contributed to the drafting process. FH contributed to the drafting process. AR conducted the fieldwork and contributed to the drafting process. CH contributed to the design of the study, oversaw the qualitative data collection process, and contributed to the drafting process. AH contributed to the design of the study, and contributed to the drafting process. AI contributed significantly to the drafting process and oversaw the overall quality of the research. All authors contributed to the article and approved the submitted version.

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## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2021.789186/full#supplementary-material>

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