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Article

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An assessment of household food consumption patterns during the COVID-19 pandemic in Bali Province

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ABSTRACT

This study analyzes changes in household food consumption patterns and socio-economic demographic characteristics during the COVID-19 pandemic in Bali Province. This study uses secondary data collected by Statistics Indonesia, namely the National Socio-economic Survey (Susenas) data with the Quadratic Almost Ideal Demand System (QUAIDS) demand model. The results showed changes in household food consumption patterns during the pandemic. The average food expenditure per capita of the population decreased, while the average non-food expenditure per capita increased slightly. The average per capita food expenditure of residents in urban areas experienced a more significant decline compared to rural areas. The highest average per capita food expenditure increase occurred in the consumption of tubers, vegetables, and beans. In contrast, the highest decline occurred in the average per capita food expenditure on fruit, processed food, and meat commodities. Socio-demographic characteristics that significantly influence the share of household food expenditure are education of the household head, occupation of the household head, and household perception of food access. The price of own goods has a positive influence on the share of food consumption expenditure but will have a negative impact on the quantity of food consumption. The government can implement policies to achieve food self-sufficiency, particularly for grains and meat, by overseeing the availability of staple foods and the distribution of fruits and meats. Policies that assist low-income household groups in rural areas should also be prioritized.

IMPACT STATEMENT

This article discusses the impact of changes in household food consumption patterns and socioeconomic demographic characteristics during the COVID-19 pandemic in Bali Province. Since the beginning of the COVID-19 pandemic, Bali Province has been considered one of the most affected areas by the COVID-19 pandemic in Indonesia as its economy relies heavily on tourism. The results showed a shift in household food consumption patterns during the pandemic in Bali Province. Average per capita food expenditure decreased, while average per capita non-food spending increased slightly. Furthermore, per capita food expenditure in urban areas decreased compared to rural areas. Meanwhile, the most significant increase in per capita food expenditure occurred in the consumption of tubers, vegetables, and nuts. In contrast, the most significant decrease occurred in fruits, processed foods, and meat commodities. Socio-demographic factors that influence the share of household food expenditure are the education level of the household head, the occupation of the household head, and the household's perception of food access. The price of goods positively affects the share of food consumption expenditure but has a negative effect on the quantity consumed.

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Introduction

COVID-19 is a worldwide epidemic that has caused significant disruptions in several sectors of life across many countries, including Indonesia (Sumarni, 2020). As of December 26, 2021, Indonesia reported 4,261,739 positive COVID-19 cases, making it the country with the highest number of cases in Southeast Asia. In overcoming and preventing COVID-19, the World Health Organization (WHO) provides protective measures for affected countries to consider (WHO Media Briefing, 2020). Some implemented measures nearly worldwide are lockdowns and quarantines (Eftimov et al., 2020). To minimize the COVID-19 spread, the Indonesian government has enforced travel restrictions, social distancing, self-isolation, and Large-Scale Social Restrictions (PSBB) (Putri, 2020).

These policies have indirectly disrupted economic activity, resulting in a decline in economic growth. This is evidenced by BPS data, which shows that the Indonesian economy experienced contractions in the second, third, and fourth quarters of 2020 consecutively (compared to the same quarter in the previous year (year-over-year/y-o-y)), wherein the second quarter slowed down by 5.32 percent, the third quarter slowed down 3.49 percent and the fourth quarter slowed down 2.19 percent. On an annual basis, Indonesia experienced a 2.2 percent economic slowdown in 2020 (BPS, 2022c). Nasution et al. (2020) explained that the restrictions during COVID-19 negatively impacted the economy in various sectors, including export-import, trade, industry, tourism, hotels, and restaurants. Additionally, the global economic slowdown significantly affected Indonesia's economic growth.

Similarly, smaller areas have also felt the effects on their economy, albeit with varying impacts. Wu et al. (2021) examined COVID-19's regional effect on China's economy. The results indicate a distinct impact on each province in China, with Hubei being the most affected. In Indonesia, Bali is one of the provinces that has had a significant economic impact. Bali experienced an economic slowdown of -9.31 percent in 2020 and -2.47 percent in 2021, representing the highest slowdown rate compared to other provinces (Badan Pusat Statistik (BPS), 2022).

The economic slowdown and increased layoffs during COVID-19 resulted in the household economy stagnating and even decreasing income (Sina, 2020). This is consistent with the study by Shahreza and Lindiatwatie (2021) on the economic resilience of families in Depok amid the COVID-19 pandemic. The study results indicate that the economic resilience of families in Depok has declined, particularly in terms of income and fulfilling family needs such as food consumption during the pandemic.

Data from BPS indicates that the proportion of food consumption for Balinese people decreased during the pandemic compared to before. During the pandemic, the average monthly per capita food consumption for Bali Province was 42.79%. This is lower than the average household consumption per capita before the COVID-19 pandemic, which was 43.92% in 2019 and 44.72% in early 2020, just before the pandemic hit Indonesia (Badan Pusat Statistik Provinsi Bali, 2022).

Table 1 reveals that food consumption expenditure decreased among residents in both rural and urban areas of Bali Province. Urban residents saw an average per capita decrease of 7.91 percent in food consumption expenditure, while rural residents experienced a decline of 5.28 percent. Regarding non-food expenditure, urban residents' average per capita expenditure also slightly declined by 1.00 percent. In contrast, rural residents exhibited a different trend, with their average per capita expenditure for non-food consumption increasing by 3.43 percent (Badan Pusat Statistik Provinsi Bali, 2022). This indicates that household consumption patterns during the pandemic in urban areas were more affected than in rural areas. In their research, Kumar and Abdin (2021) explained that this was attributed to the closure

Table 1. Average per capita monthly expenditure by residence and type of expenditure in Bali Province in 2020–2021.

Area of Residence	Type of expenditure			
	Food		Non-Food	
	2020	2021	2020	2021
Urban	724,978	667,606	973,021	963,314
Changes (%)	11.56	– 7.91	9.62	– 1.00
Rural	565,445	534,662	526,846.00	544,917.00
Changes (%)	8.67	– 5.28	– 1.69	3.43

Source: Badan Pusat Statistik Provinsi Bali (2022).

of dining establishments, restaurants, shopping centers, cinemas, and others in urban areas, which forced changes in the consumption habits of urban consumers.

Several other studies have also demonstrated a shift in consumption patterns during the pandemic. Eftimov et al. (2020) researched using artificial intelligence on people's consumption patterns before and during the COVID-19 pandemic and concluded that there had been alterations in food consumption patterns before and during the COVID-19 pandemic. A significant increase in consumption occurred in foods such as beans, pancakes/tortillas/oatcakes, and soups/thick soups, which increased by 300%, 280%, and 100%, respectively. Interestingly, the most significant decrease occurred in the consumption of foods such as *Order Perciformes* (a type of fish), corn/cereals/seeds, and wine, with a decline of 50%, 40%, and 30%. With a different method, Scarmozzino and Visioli (2020) investigated the influence of COVID-19 on the food consumption habits of the Italian population using a survey and indicated a shift in the food consumption patterns among the Italian population. Over 50% of respondents admitted that fruits and vegetables were unattractive during the lockdown. Furthermore, there was a significant decrease in prepared food purchases, reaching 50%. Ammar et al. (2020) researched the impact of social distancing, isolation, and home confinement during COVID-19 on healthy living behaviors and habits through online surveys and presented consistent results. The results showed that food consumption patterns and consumed food were more unhealthy during isolation, with only a significant reduction in alcohol consumption.

Kartari et al. (2021) explored the impact of the pandemic on potential shifts in food consumption and dietary habits in China, Portugal, and Turkey, demonstrating that the coronavirus pandemic led to an increase in the consumption of fresh fruits and vegetables and more home-cooked meals. Specifically, Portugal experienced higher consumption of seafood, bread, and butter; China saw an increased intake of rice and meat; and Turkey observed a rise in meat and egg consumption. Conversely, Profeta et al. (2021) found that the pandemic significantly altered eating behaviors in Denmark, with increased consumption of convenience foods, canned goods, alcohol, and sweets but decreased fresh produce intake. Hajipoor et al. (2023) noted varied impacts of COVID-19 on various food groups and macronutrient consumption, indicating shifts in dietary patterns. These diverse outcomes highlight inconsistent food consumption trends during the pandemic, with some studies showing an increase in food consumption while others show a decrease. Consequently, this research examines changes in household food consumption patterns and socio-economic demographic characteristics during the COVID-19 pandemic in Bali Province.

This study aims to provide significant empirical insight into the food consumption patterns during the COVID-19 pandemic in Bali Province. Bali is considered one of Indonesia's most adversely affected regions by the pandemic, primarily because its economy relies heavily on tourism. Preventive measures to curb the spread of COVID-19 significantly hindered economic activities in Bali, leading to a downturn that impacted household food consumption. Specifically, these policies caused a decrease in the average per capita expenditure for food consumption in Balinese households. Thus, this research intends to shed light on how these unique circumstances have influenced dietary behaviors in Bali during the pandemic.

Literature review

COVID-19, a worldwide pandemic that emerged in 2020, profoundly impacted global activities, reaching nearly every part of the world. Measures such as activity restrictions, isolation protocols, and lockdowns to curb the virus's spread greatly influenced economic conditions at both macro and micro levels. Public consumption was one of the most notably affected areas. Various empirical studies have reported shifts in individuals' behavior and consumption patterns due to the limitations imposed during the COVID-19 crisis. These changes reflect the pandemic's broad and profound effect on everyday life, altering how people shop, eat, and consume goods and services.

Sidor and Rzymiski (2020) conducted a study on the effects of a national quarantine policy in Poland on adults' nutrition and consumption behaviors, revealing that over 43% reported increased food and snack consumption, and nearly 52% indulged more frequently in these items. About 30% of the participants noticed weight gain, correlating with a reduced intake of vegetables, fruits, and nuts, alongside a heightened consumption of meat and dairy products during the quarantine period. Similarly,

Scarmozzino and Visioli (2020) explored the dietary impacts of COVID-19 containment measures in Italy, finding that 46.1% of individuals ate more during isolation, with 19.5% reporting weight gain. Notably, 56.2% of the respondents found fruits and vegetables less appealing during isolations, indicating a common trend of altered dietary preferences and potential nutritional effects during pandemic-related restrictions in different countries.

In Spain, research by Rodríguez-Pérez et al. (2020) aimed to analyze shifts in adult consumption and dietary behaviors during the COVID-19 confinement and isolation policies. Their findings indicated a shift towards healthier eating patterns among the study population during the pandemic isolation compared to their previous habits, showcasing improved dietary choices under isolation. Conversely, Ammar et al. (2020) presented contrasting findings, observing that food consumption and eating habits—including the types of food consumed, uncontrolled eating, snacking between meals, and the frequency of main meals—tended to deteriorate and become less healthy during periods of social restrictions, isolation, or self-isolation. These studies highlight the varied impacts of COVID-19-related confinement on dietary behaviors across different populations and settings.

Eftimov et al. (2020) utilized artificial intelligence to analyze changes in worldwide consumption patterns before and during the COVID-19 pandemic through food preparation recipes from the AllRecipes website, which aggregated data across 24 countries. Their findings confirmed significant shifts in dietary habits correlating with the pandemic's onset. Specifically, there was a notable increase in the consumption of items like nuts, pancakes/tortillas/flatbreads, and soups/broths, while the most substantial declines were observed in the consumption of *Order Perciformes* (a category of fish), corn/cereals/grains, and wine. As noted in other studies, these results and the varied outcomes from different regions underscore the diverse effects of the COVID-19 pandemic on consumption behaviors globally.

Beyond the unique context of COVID-19, various general factors drive changes in consumption patterns across populations, such as income levels, price fluctuations, and socio-demographic attributes (Jayati et al., 2014). This is supported by Sari (2016), which investigated the relationship between socio-economic characteristics and food consumption trends in East Kalimantan Province. The findings from this study underscored that income, as gauged through household expenditure, plays a crucial role in dictating food consumption volumes within families. Similarly, Fharuddin et al. (2015), in their analysis of food consumption dynamics in South Sumatra, found that income or expenditure elasticity for various food categories is invariably positive, suggesting that higher income levels boost food consumption. These conclusions align with the findings of Girik Allo et al. (2019), who determined that income positively and significantly impacts purchasing and consuming food commodities across households at a broader national scale in Indonesia.

Price fluctuations are a critical factor for households when deciding their consumption. Kharisma et al. (2020) found that price significantly affects the portion of expenditure allocated to the animal food commodity group, resulting in a positive value. Nonetheless, when examining price elasticity, they noted that a price increase of commodities typically reduces the household demand for these items, assuming *ceteris paribus*. This is supported by Fharuddin et al. (2015), who reported that price elasticity, whether compensated or uncompensated, has a negative value across 14 food commodity groups. This aligns with the general economic theory that a rise in the prices of goods adversely affects consumption levels as households adjust their spending in response to price changes.

Several studies have highlighted that household consumption is not solely influenced by income and prices but also by a range of internal factors, particularly the socio-demographic characteristics of the household. Research by Bangun et al. (2013), Kahar (2010), and Sari (2016) consistently shows that social attributes significantly affect consumption patterns or demand for various goods. These attributes include the household size, the education and age of the household head, and the proportions of young and school-aged children within the family. Further supporting these findings, Abdulai (2002) identified that household size is crucial in determining food consumption patterns in Swiss households. Similarly, Nugroho and Suparyono (2015) noted a specific relationship between household size and meat expenditure in Indonesia, aligning with the Deaton-Paxson Paradox, although pork was an exception in their findings.

Additionally, Mittal (2010) highlighted the positive impacts of urbanization and temporal trends on food expenditure, observing that urban households allocate larger budgets for food than rural

households. In a related study, Virgantari et al. (2017) discovered that urban households preferred consuming fresh shrimp and fish more than those in rural settings, emphasizing the influence of the living environment on consumption preferences. These studies illustrate how income, prices, and diverse socio-demographic factors shape household consumption behaviors and patterns.

The exploration of commodity consumption models incorporating socio-economic demographic characteristics has gained considerable attention in scholarly research over the years. The seminal work in this field began with Ernst Engel in 1857. Engel (1821-1896) pioneered the analysis of the relationship between income levels and consumption patterns. He discovered a key economic principle: as income increases, the percentage of income spent on food decreases, with consumers allocating more to non-food items. This observation laid the foundation for what is now known as Engel's Law (Walter & Snyder, 2007). Building on Engel's foundational work, Deaton and Muellbauer (1980) further advanced the discourse by integrating the impact of prices into the consumption analysis, leading to the development of the Almost Ideal Demand System (AIDS). This model is predicated on a cost function delineating how consumers strive to optimize their utility, achieving maximum satisfaction at minimum costs for given price levels.

The AIDS model is a cornerstone analytical framework in examining consumption patterns, and its adaptability has allowed for various modifications to suit specific research needs. Kahar (2010) applied the AIDS model, tailoring it to differentiate between household consumption patterns based on education levels and whether the households were in rural or urban settings. This study revealed notable disparities in expenditure levels between rural and urban areas and affirmed the significant impact of commodity prices and household income on expenditure on food and non-food commodities consumption. Building on this framework, Fahaiddin et al. (2015) modified the Quadratic Almost Ideal Demand System (QUAIDS) framework to examine consumption across 14 food commodity groups. Their findings suggested that the quadratic model provided a better fit than the linear alternative, revealing positive income and negative price elasticity across all food groups, aligning with economic theory. Furthermore, they observed that income elasticity was more pronounced than price elasticity, indicating a more vigorous response in consumption patterns to income changes than price elasticity. Similarly, Girik Allo et al. (2019) utilized QUAIDS to explore how price increases affect consumption behaviors and the welfare levels of farmers in Indonesia.

This research uses the QUAIDS model, integrating the Inverse Mills Ratio (IMR) as an independent variable to address a common challenge in household survey data: the occurrence of zero consumption expenditure on certain commodities. The study's findings endorse the QUAIDS model as an effective tool for forecasting food demand functions in Indonesia. Expanding on this framework at a more localized level, Kharisma et al. (2020) applied a similar methodology in West Java Province, focusing their analysis on animal food commodities. Their research validates the utility of the QUAIDS model, augmented by variables such as price, income (via the expenditure approach), demographic and socio-economic factors, and the IMR in accurately estimating household expenditure shares on animal foods. Parallel conclusions were drawn by Bopape and Myers (2007), who examined household food demand in South Africa employing three distinct demand system models: the Linear Approximate Almost Ideal Demand System (LA-AIDS), QUAIDS, and a log-linear model. Their comparative analysis identified the QUAIDS model as the most suitable for capturing consumption and expenditure patterns, particularly its capacity to incorporate demographic details, account for structural shifts, and recognize seasonal variations.

Drawing from various research findings, it is deduced that the QUAIDS model, when augmented with socio-demographic attributes and the IMR variable, is better used to describe consumption patterns than other models. This research intends to apply the QUAIDS model to changes in household consumption patterns before and during the COVID-19 pandemic and determine the relationship between income, prices, and socio-demographic characteristics.

Data and method

Data

The object of this research is the share of expenditure of 14 household food commodity groups, household income/expenditure. Commodity grouping refers to the COICOP used by BPS (2022b). The unit of analysis is households spread across nine regencies and one city in the Province of Bali. The data utilized

comes from Susenas in March 2019, representing the period before the COVID-19 pandemic, and March 2021, illustrating the situation during the pandemic. The research did not include Susenas data from 2020 because the COVID-19 outbreak in Bali Province had not yet spread significantly, affecting only a limited number of people then. This research uses secondary data from the Central Statistics Agency, namely The National Socio-economic Survey data (Susenas) with household sample units. The data comes from VSEN-KOR data (Information on Basic Household Members) and VSEN-KP Data (Household Expenditure Consumption). KOR data is used to collect explanatory variables in the form of household social information, including the age and gender of the household head, the number of household members, the education level of the household head, the region of the household's residence, the occupation of the household head, and the household's perceptions of food access. Then, the KP data is used to obtain information on household food expenditure's quantity and consumption value, both from purchases and gifts during the past week.

Method

This study employs a quantitative approach, utilizing the QUAIDS model for analysis. This model is chosen because it retains consistency with the Engel curve and accounts for the effect of relative prices in the utility maximization process. Additionally, it allows for estimating more parameters than earlier models, such as LA/AIDS (Aeppli, 2014). The QUAIDS model necessitates that all sample households consume all the commodities under study. To anticipate households with zero commodity consumption, it is necessary to merge food commodity groups into larger groups so that more sample households meet the requirements. Grouping commodities assumes that food commodity prices in one commodity group have the same movement.

According to Zheng and Henneberry (2010), if the research is conducted over large areas with diverse demographic factors, the unit value approach may introduce errors, such as biased results when making measurements. These problems can be overcome using a unit value, which is corrected by a price differential approach. Price justification in this study uses the method proposed by Cox and Wohlgenant (1986), modified by Hoang.

Furthermore, to tackle the issue of price variability, this research adopts the methodology used by Majumder et al. (2012), which employs unit values corrected through the price differential method. This approach adjusts the unit value by incorporating the median value of each district or city and the estimated residual from the regression that accounts for differences across districts/cities influenced by socio-demographic factors. This technique helps to standardize the price variable, minimizing biases that may arise from using unadjusted unit values and providing a more accurate representation of price effects on consumption patterns across different regions. This approach presumes that households in the same district or city experience identical commodity prices. The equation used to overcome the problems that arise due to the use of the value per unit is as follows:

$$v_i = \alpha_i + \phi_i x + \theta D + \varepsilon_i \quad (1)$$

$$p_i = \bar{v}_i + \hat{\varepsilon}_i \quad (2)$$

Here, v_i indicates the value per unit of food commodity group i ($i = 1, 2, 3, \dots, 14$), \bar{v}_i is the aggregate price of the i th food commodity group, x is the total household expenditure for food consumption, D is the vector of demographic characteristics (regional classification, average length of schooling of the head of the family, household size, sex of the head of the household and income group) and ε_k is the error term.

Apart from pricing problems, household expenditure survey data has other common issues in the form of empty data (households that do not consume a particular commodity at all) or zero consumption (Girik Allo et al., 2019). According to Newman in Nugroho and Wardhani (2016), zero consumption can be attributed to economic and non-economic factors, such as household income levels, vegetarian households or individuals, and survey periods shorter than the demand cycle for goods. Omitting households with zero consumption from the survey data would reduce the dataset size and lead to biased estimation results, a phenomenon known as selection bias.

To address this issue, commodity grouping was performed, and the Inverse Mills Ratio (IMR) variable was included and treated as an independent variable, as done by Girik Allo et al. (2019) in their research.

The IMR is added to anticipate zero consumption after commodity grouping. The Heckman test derives the IMR variable through a two-step estimation process. Based on this, the model used in this study refers to the model developed by Hamzah and Huang (2023), Poi (2012), Girik Allo et al. (2019), and Kharisma et al. (2020). The QUAIDS model accommodates regional classification variables, household size, gender of the head of the household, income group, education of the head of household, and the use of the Inverse Mills Ratio (IMR) to address the zero consumption problem. Thus, the QUAIDS equation used in this study is as follows:

$$w_i = \alpha_i + \sum_{j=1}^n y_{ij} \ln p_j + \beta_i \ln \left\{ \frac{x}{a(p)} \right\} + \frac{\lambda_i}{b(p)} \left[\ln \left\{ \frac{x}{a(p)} \right\} \right]^2 + \alpha_{i1} dloc_i + \alpha_{i2} hsize_i + \alpha_{i3} gender_i + \alpha_{i4} educ_i + \alpha_{i5} inc_i + \alpha_{i6} IMR_i + \alpha_{i7} job_i + \alpha_{i8} foodaccess_i + \varepsilon_i \quad (3)$$

where w_i represents the share of expenditure from the i th food commodity group ($i = 1, 2, 3, \dots, 14$), $\ln p_j$ is the aggregate price of the j th food commodity group, x is household expenditure for food and non-food consumption, $\ln(a/p)$ is price index, $b(p)$ is price aggregator, $dloc$ is location (urban = 1), $hsize_i$ is household size, $gender_i$ is sex of head of household (male = 1), $educ$ is level of education (years of school), inc is income group (lower income = 1 as reference, middle income = 2, upper income = 3), IMR is Inverse Mills Ratio, job is business field of head of household (agricultural sector = 1), $foodaccess$ indicates people's perception of access to food (easy = 1) and ε_i is the error term.

The QUAIDS model above is then derived to obtain income/expenditure elasticity and price elasticity as follows:

- Income Elasticity

$$\mu_i = 1 + \frac{1}{w_i} \left[\beta_i + \frac{2\lambda_i}{b(p)} \left\{ \ln \left(\frac{x}{a(p)} \right) \right\} \right] \quad (4)$$

- Uncompensated price elasticity (Marshallian)

$$\varepsilon_{ij}^{NC} = \frac{1}{w_i} \left[\gamma_{ij} - \mu_i \left(\alpha_j + \sum_{k=1}^n \lambda_{jk} \ln p_k \right) - \frac{\lambda_i \beta_j}{b(p)} \left\{ \ln \left(\frac{x}{a(p)} \right) \right\}^2 \right] - \delta_{ij} \quad (5)$$

- Compensated price elasticity (Hicksian)

$$\varepsilon_{ij}^C = \varepsilon_{ij} + \mu_i w_j \quad (6)$$

where ε_{ij} is price elasticity, γ_{ij} is the food price parameter, β_i , and λ_i are linear and quadratic income parameters, and w_i is the average share of food expenditure.

Results

The average monthly per capita consumption expenditure in Bali during the pandemic (2021) was IDR 1,468,624. This is a decrease from the previous year's average expenditure of IDR 1,509,666. During the pandemic, households maintained consumption despite income and economic instability. Table 2 shows

Table 2. Average per capita monthly expenditure by residence and type of expenditure in Bali Province in 2019–2021.

Area of residence	Type of expenditure					
	Food			Non Food		
	2019	2020	2021	2019	2020	2021
Urban	649,854	724,978	667,606	887,616	973,021	963,314
Changes (%)		11.56	−7.91		9.62	−1.00
Rural	519,389	564,445	534,662	535,918	526,846	544,917
Changes (%)		8.67	−5.28		−1.69	3.43
Bali Province	609,181	675,146	628,472	777,972	834,520	840,152
Changes (%)		10.83	−6.91		7.27	0.67

Source: The National Socio-economic Survey (Susenas), 2019–2021 (Processed Data).

that, on average, households in Bali Province reduced their food consumption expenditure. The average monthly per capita household expenditure decreased by 6.91 percent during the pandemic.

The decline in the average monthly per capita expenditure in Bali Province affected both rural and urban areas. Among the urban population, the average per capita expenditure for food consumption decreased by 7.91 percent, while in rural areas, it decreased by 5.28 percent. For non-food expenditure, urban residents also saw a slight decrease in their average per capita expenditure, which dropped by 1.00 percent. The observation from Badan Pusat Statistik Provinsi Bali (2022) states that in contrast to urban consumption behaviors, the average per capita expenditure for non-food items in rural areas increased by 3.43 percent. This highlights the differential impact of the COVID-19 pandemic on urban versus rural household consumption patterns. In urban settings, the enforced closure of dining venues, restaurants, shopping malls, cinemas, and other leisure facilities due to pandemic restrictions led to a significant shift in consumer behavior. Kumar and Abdin (2021) align with this finding, suggesting that the restrictions imposed in urban areas significantly altered how urban residents allocated their spending, with a notable pivot away from services associated with closed establishments towards other expenditure categories.

Table 3 shows that consumption pattern shifts during the COVID-19 pandemic occurred across lower, middle-and upper-income groups, with a more pronounced effect on middle-income households. This finding aligns with the case in Pakistan, where the pandemic has impacted households with low to middle incomes (Baranov et al., 2022). On average, middle-income households reduced food and non-food consumption expenditures during the pandemic, while lower and upper groups only reduced expenditure on food consumption.

Furthermore, Table 3 shows that judging from the average monthly per capita consumption expenditure, households in the middle-income group experienced a more significant decrease of 9.86 percent compared to households in the lower-income group, which saw a reduction of 6.9 percent, and those in the upper-income group, which had a decrease of 3.19 percent.

Under normal circumstances, Table 4 shows that the food consumption pattern of the Balinese people is mainly based on consuming processed food, grains, tobacco, and betel nut leaf commodities. However, pandemic policies have shifted household consumption patterns in the Province of Bali, resulting in a focus on processed foods, grains, and vegetables.

In addition, when viewed from the growth rate, during the pandemic, households in the Bali Province tended to reduce most of their consumption for several commodity groups and divert it to increase consumption value for other commodity groups. The highest increase in average per capita consumption expenditure in Bali Province occurred in the food commodity group of tubers (35.78 percent), vegetables (21.47 percent), and nuts (20.5 percent). Furthermore, the highest decline occurred in the consumption of fruit food commodities (-32.53 percent), processed food and beverages (-19.94 percent), and meat (-11.64 percent). These restrictions curtailed activities outside the home, constrained religious observances, and led to the closure of public spaces such as eateries, restaurants, and shopping centers, all of which directly and indirectly affected consumption habits. In addition, the restrictions on religious activities have reduced the consumption of fruits and meat, the primary means of religious celebrations for Balinese Hindus.

Table 3. Average per capita monthly expenditure by income group and type of expenditure in Bali Province in 2019-2021.

Income group	Type of expenditure					
	Food			Non Food		
	2019	2020	2021	2019	2020	2021
40% of the population with low spending	356,478	399,661	372,073	264,566	263,062	283,264
Change (%)		12.11	-6.90		-0.57	7.68
40% of the population with medium spending	631,900	711,594	641,429	697,351	745,635	710,444
Change (%)		12.61	-9.86		6.92	-4.72
20% of the population with high spending	1,069,189	1,152,501	1,115,756	1,966,133	2,153,345	2,214,662
Change (%)		7.79	-3.19		9.52	2.85
Bali Province	609,181	675,146	628,472	777,972	834,520	840,152
Change (%)		10.83	-6.91		7.27	0.67

Source: The National Socio-economic Survey (Susenas), 2019-2021 (Processed Data).

Table 4. Average per capita monthly expenditure by food group in Bali Province 2019-2021.

Food commodity group	Average per capita monthly expenditure by foodstuff group in Bali Province (Rupiah)			Growth rate (Percent)		Distribution (Percent)		
	2019	2020	2021	2020	2021	2019	2020	2021
Grains	72,520	77,831	86,583	7.320	11.24	11.90	11.53	13.78
Tubers	4,764	4,852	6,588	1.850	35.78	0.78	0.72	1.05
Fish	33,929	34,073	36,331	0.420	6.63	5.57	5.05	5.78
Meat	39,399	50,218	44,372	27.46	-11.64	6.47	7.44	7.06
Eggs and Milk	31,788	37,033	34,879	16.50	-5.82	5.22	5.49	5.55
Vegetables	39,779	48,936	59,444	23.02	21.47	6.53	7.25	9.46
Nuts	12,042	11,987	14,444	-0.46	20.50	1.98	1.78	2.30
Fruits	29,974	47,878	32,304	59.73	-32.53	4.92	7.09	5.14
Oils and Fats	11,708	12,918	14,896	10.33	15.31	1.92	1.91	2.37
Beverage Ingredients	13,165	14,138	15,439	7.390	9.20	2.16	2.09	2.46
Spices	9,665	11,455	12,955	18.52	13.09	1.59	1.70	2.06
Other Consumption	8,442	8,849	10,518	4.820	18.86	1.39	1.31	1.67
Food and Beverages	252,900	262,772	210,386	3.900	-19.94	41.51	38.92	33.48
Tobacco and Betel nut	49,108	52,205	49,333	6.310	-5.50	8.06	7.73	7.85
Total	609,183	675,145	628,472	10.83	-6.91	100	100	100

Source: The National Socio-economic Survey (Susenas), 2019-2021 (Processed Data).

A similar phenomenon occurs in urban and rural areas. Table 5 illustrates that in urban areas, the most significant increase in average per capita consumption expenditure in Bali Province happened in the food commodity group tubers (28.29 percent), vegetables (19.64 percent), and legumes (21.29 percent). 37 percent). Furthermore, the highest decline occurred in the consumption of fruit commodities (-33.37 percent), processed food and beverages (-20.75 percent), and meat (-9.24 percent). In rural areas, the highest increase in average per capita consumption expenditure in Bali Province occurred in tubers (54.82 percent), vegetables (25.77 percent), and nuts (17.5 percent). Furthermore, the highest decline occurred in the consumption of fruit (-30.61 percent), processed food and beverages (-20.01 percent), and meat (-17.16 percent).

The same phenomenon is shown in Table 6, which shows significant fluctuations in the average per capita consumption expenditure for several commodities among households in the three income groups. The average monthly per capita expenditure for fruits decreased 30.64 percent for the lower-income group, 35.33 percent for the middle-income group, and 27.79 percent for the upper-income group. The decline in fruit consumption in Bali during the pandemic is believed to be directly linked to the implementation of the PSBB policy, primarily due to the restrictions it imposed on religious activities. In Balinese culture, fruits and meat play significant roles in religious ceremonies as offerings and communal meals consumed after the events (Antara & Sri Sumarniasih, 2022).

Furthermore, the consumption of processed food and beverage commodities in the three income groups declined. The average monthly per capita consumption of processed food and beverage commodities decreased by nearly 20 percent in the three groups. However, different things were shown in meat consumption. In the lower and middle-income groups, the average monthly per capita consumption expenditure decreased by -20.09 percent and -16.14 percent, respectively. Households in the upper group experienced an average increase in spending on meat consumption by 5.91 percent.

The average per capita consumption expenditure on tubers and vegetables rose during the pandemic for all three income groups. In the upper-income group, there was a relatively high increase in consumption of grains, reaching 23.97 percent. PSBB has resulted in households doing more activities and home cooking.

The parameter estimation results of the QUAIDS model reveal that before the pandemic in 2019, 55.49 percent of the 546 coefficients were significant at the 1-10 percent test level (see Table 7). During the pandemic in 2021, 314 out of 546 coefficients (57.51 percent) were significant at the same test level. Regarding the price variable and the prices of other commodity groups, only 55.61 percent of the 196 estimated coefficients were significant at the 1-10 percent level before the pandemic. During the pandemic, this increased to 124 coefficients (63.27 percent), significant at 1-10 percent. This indicates that price changes significantly impacted the expenditure share of the fourteen household food commodity groups analyzed, particularly during the pandemic (see Table 8). The findings align with broader

Table 5. Average per capita monthly expenditure by region of residence and food group of the province of Bali in 2019-2021 (Rupiah).

Food commodity group	Urban			Rural		
	2019	2020	2021	2019	2020	2021
Grains	68,368	73,203	83,344	81,686	88,114	94,348
Tubers	4,854	4,993	6,406	4,566	4,538	7,026
Fish	36,024	37,355	38,829	29,303	26,781	30,341
Meat	40,024	49,878	45,268	38,020	50,974	42,226
Eggs and Milk	35,251	41,897	38,549	24,142	26,227	26,084
Vegetables	39,615	49,549	59,281	40,141	47,575	59,835
Nuts	12,161	12,343	14,981	11,780	11,197	13,157
Fruits	30,060	48,674	32,432	29,784	46,111	31,996
Oils and Fats	11,365	12,618	14,707	12,465	13,585	15,348
Beverage Ingredients	12,875	13,960	15,577	13,805	14,534	15,110
Spices	10,025	11,945	13,732	8,870	10,366	11,093
Other Consumption	9,115	9,446	11,259	6,955	7,522	8,741
Food and Beverages	288,669	306,091	242,577	173,934	166,541	133,220
Tobacco and Betel nut	51,448	53,027	50,665	43,940	50,379	46,138
Total	649,854	724,978	667,606	519,389	564,445	534,662

Source: The National Socio-economic Survey (Susenas), 2019-2021 (Processed Data).

Table 6. Average per capita monthly expenditure by income group and food group of the province of Bali in 2019-2021.

Food commodity group	Lower-income group			Middle income group			Upper-income group		
	2019	2020	2021	2019	2020	2021	2019	2020	2021
Grains	68,978	78,804	85,672	75,413	77,798	83,840	74,108	76,017	94,237
Tubers	3,006	2,873	4,250	5,046	5,363	7,027	7,863	7,685	10,526
Fish	19,877	20,598	20,251	34,320	35,619	38,136	62,434	57,108	65,942
Meat	21,109	31,809	25,418	44,296	58,353	48,935	67,715	70,026	74,166
Eggs and Milk	15,503	17,211	17,687	33,592	38,961	34,262	62,116	71,591	71,890
Vegetables	29,314	34,428	39,405	43,756	52,736	64,372	53,623	69,602	90,724
Nuts	8,950	8,646	10,081	13,495	13,135	15,472	15,577	16,219	21,350
Fruits	15,448	23,723	16,455	31,400	53,380	34,520	57,394	83,886	60,572
Oils and Fats	9,795	11,229	11,835	12,422	13,137	15,508	14,265	15,758	19,969
Beverage Ingredients	9,816	10,368	10,792	14,264	15,241	16,430	17,941	19,287	23,012
Spices	6,596	7,806	7,662	10,675	12,062	13,879	14,038	17,328	22,012
Other Consumption	5,549	5,977	6,595	9,053	9,586	11,154	13,248	12,968	17,330
Food and Beverages	119,092	118,248	91,175	253,697	265,370	210,162	530,215	536,937	458,497
Tobacco and Betel nut	26,040	26,779	25,206	56,269	56,925	51,382	82,844	92,181	95,147
Total	359,074	398,499	372,482	637,699	707,665	645,080	1,073,382	1,146,592	1,125,373

Source: The National Socio-economic Survey (Susenas), 2019-2021 (Processed Data).

observations across Indonesia, where food insecurity became a pressing issue during the same period. The study by Akbar et al. (2023) likely addresses the broader implications of the pandemic on food access and security, emphasizing how the health crisis exacerbated vulnerabilities across different population segments.

The pandemic's effect on food security in Indonesia can be attributed to various factors, including disrupted supply chains, reduced income, and job losses, which affected households' ability to procure sufficient and nutritious food. The findings from Bali highlight the connection between religious practices and food consumption, providing a nuanced perspective on how cultural factors can influence food security outcomes. These insights are crucial for understanding the full impact of the pandemic on food systems and emphasize the need for responsive policies that address both immediate food access issues and broader socio-economic and cultural dimensions of food security.

The influence of the price variable on each food commodity group shows a significant and positive impact for almost all food commodity groups except for beans both before and during the COVID-19 pandemic. Mayasari et al. (2018) concluded that the price variable significantly affected the increase in the expenditure share of food commodity groups. However, beans show an exception with a unidirectional relationship, suggesting a different consumption response than other food commodities. The positive price effect indicates that a price increase will raise the expenditure share for that food group. For example, in the grains commodity group, a coefficient of 0.1724 means that a 1 percent increase in the price of grains will increase the expenditure share for this group by 0.1724 percent, *ceteris paribus*.

Table 7. The estimating coefficient of the QUAIDS model of Bali Province 2019.

Explanatory Variables	Grains	Tubers	Fish	Meat	Eggs and Milk	Vegetables	Nuts	Fruits	Oils and Fats	Beverage Ingredients	Condiments	Other Consumption	Food and Beverages	Tobacco and Betel nut
rice price	0.1300***	-0.0017	-0.0047**	-0.022***	-0.0054***	0.0113***	0.0195***	0.5000	0.0030	0.8000	0.0014	0.0026	-0.0619***	-0.0421***
tuber price	-0.0017	0.0038***	0.0012**	0.0012	0.3000	0.1000	0.3000	-0.0036***	0.0021**	0.3000	0.7000**	0.9000	0.1000	-0.0023**
fish price	-0.0047**	0.0012**	0.0193***	-0.0091***	-0.0036***	0.3000	-0.0025***	-0.0045***	-0.0008	0.1000	0.0013***	0.0015**	-0.0020	0.0036
meat price	-0.0222***	0.0012	-0.0091	0.052***	0.0010	0.7000	-0.0020	0.0042	0.0041***	0.0039**	-0.0012	-0.0044***	-0.0142	-0.0124**
milk egg price	-0.0054***	0.3000	-0.0036***	0.0010	0.0157***	-0.0019**	0.0000	0.0010	-0.0002	0.2000	0.4000	0.9000**	0.4000	-0.0045**
vegetable price	0.0113***	0.1000	0.3000	0.7000	-0.0019**	0.0126***	0.0028	0.0025	0.0016	0.3000	0.0032***	0.0000	-0.022**	-0.0152***
bean price	0.0195***	0.3000	-0.0025***	-0.002	0.0000	0.0028	0.6000	-0.0029**	0.0001	0.3000	0.5000	0.4000	-0.0068***	-0.0076***
fruit price	0.5000	-0.0036***	-0.0045***	0.0042	0.0010	0.0025	-0.0029**	0.0278***	-0.0013	-0.0016	-0.0014**	0.9000	-0.0126**	-0.0072**
oil price	0.0030	0.0021**	0.8000	0.0041***	0.2000	0.0016	0.1000	-0.0013	0.0061**	0.0019**	0.9000**	0.3000	-0.0110**	-0.0076**
beverage prices	0.8000	0.3000	0.1000	0.0039**	0.2000	0.0042***	0.3000	-0.0016	0.0019**	0.0022**	0.6000*	0.9000	-0.0070**	-0.003**
seasoning prices	0.0014	0.7000**	0.0013***	-0.0012	0.4000	0.0032***	0.5000	-0.0014**	0.0009***	0.6000*	0.0019***	0.7000**	-0.0060***	-0.003***
other prices	0.0026	0.9000	0.0015**	-0.0044	0.9000**	0.0000	0.4000	0.9000	0.0003	0.9000	0.7000**	0.0062***	-0.0041***	0.0012
processed food prices	-0.0619***	0.1000	-0.002	-0.0142	0.4000	-0.022***	-0.0068***	-0.0126**	-0.0101***	-0.007***	-0.006***	-0.0041***	0.1129***	0.0344***
tobacco price	-0.0421**	0.0023**	0.0036	-0.0124	-0.0045**	-0.0152***	-0.0076***	-0.0072**	-0.0076**	-0.003**	-0.0023***	0.0012	0.0344**	0.065***
Income	-0.0158	-0.0092**	0.0083	-0.0453	-0.0026	-0.0170	-0.0099**	-0.0211**	-0.0054	0.0111**	-0.0015	-0.002	0.0711***	0.033**
Quadratic Income	0.0065***	0.3000**	0.2000	-0.0028	0.8000**	0.9000**	0.0000	-0.0017***	0.0007***	0.001***	0.3000**	0.1000	-0.0036**	-0.0018**
educ	0.0000	0.0000*	0.1000	0.3000**	0.3000**	0.1000	0.0000	0.1000**	0.0000	0.1000**	0.0000	0.0000	0.0000	0.5000***
dloc	0.8000*	0.2000*	0.4000	0.0020	0.6000*	0.9000**	0.0000	0.9000**	-0.0004**	0.1000	0.2000**	0.0000	-0.0019**	0.6000
gender	0.0024	0.7000	-0.0002	0.0067***	0.0047***	-0.0027*	0.3000	0.0033**	0.0017***	-0.0017**	-0.001**	-0.0011*	-0.0048*	0.0045*
hsize	-0.0028***	0.0000	0.1000	0.9000**	0.1000	0.2000	0.1000	0.0011**	0.0000	0.1000	0.0000	0.1000	0.90000*	0.0018***
job	-0.0011***	0.0000	0.4000*	0.1000	0.3000	-0.0012**	0.1000	0.3000	-0.0003***	0.1000	0.3000***	0.0000	0.0033***	0.3000
food access	-0.0017***	0.2000**	0.2000	0.0019**	0.6000**	0.4000**	0.0000	0.2000	0.0001	0.0000	0.2000**	0.0000	0.1000	0.7000
middle-income	-0.0319***	0.7000***	-0.0033***	0.0048***	0.9000	-0.0123***	-0.0035***	0.0025***	-0.0044**	-0.0039***	-0.0031***	0.1000	0.0239***	0.0329***
High-income	-0.0385***	0.9000***	-0.0042	0.0043**	-0.0031**	-0.0152***	-0.0043**	0.0031**	-0.0054**	-0.0043**	-0.0036***	0.2000	0.0264**	0.0457***
instrumental variable	0.0033***	0.2000**	0.1000	0.5000	0.2000	0.6000*	0.1000	-0.0012	0.0003***	0.0000	0.2000**	0.2000	-0.004***	0.7000
rice mills	0.0237***	0.7000	0.0067***	0.8000	0.0067**	0.0045**	0.0012	-0.0048*	0.0017**	0.0033**	0.1000	0.0019**	-0.0398***	-0.0036
tuber mills	-0.0014	0.7000	0.0028***	0.0021	0.0015	0.0022**	0.0018**	0.0055**	-0.0004	-0.0010	0.4000	0.5000	-0.0054*	-0.0084***
fish mills	0.5000	0.5000	0.9000	-0.0018	0.0076***	0.0047***	0.5000	0.4000	0.0024***	0.0020**	0.1000	0.3000	-0.0094	-0.0066*
meat mills	0.0067*	-0.0021**	-0.0048**	-0.0115**	-0.0046*	-0.0013	-0.0029**	-0.0137***	0.0001	0.0031**	0.1000	0.0011	0.0036	0.0265***
dairy egg mills	0.0221**	0.0031***	0.0136**	-0.0021	0.1000	0.0029	0.0021	0.0069*	0.0013	-0.0031**	0.0020**	0.9000	-0.0348**	0.0151**
vegetable mills	-0.0147**	-0.0026*	0.4000	0.0162**	-0.0033	0.0070*	0.0048**	-0.0040	-0.0029*	-0.0073***	-0.0021*	-0.0036**	0.0081	0.0047
bean mills	0.0241***	-0.0035***	-0.0017	-0.0145***	0.6000	-0.0026	-0.0017	-0.0027	-0.0003	0.4000	0.5000	0.0000	0.0085	-0.0059
fruit mills	-0.0124***	0.0021***	-0.0068***	0.0150***	0.0044**	0.0065***	0.0015	0.017***	-0.0012	-0.0039***	-0.0017***	-0.0023**	0.0119**	-0.0171***
oil mills	-0.0149*	0.8000	0.1000	0.0027	-0.0151**	0.0110*	0.0028	-0.0136*	-0.0005	0.0058**	0.0018	-0.0029	-0.016	0.0337**
beverage mills	-0.0088***	-0.0011	0.3000	-0.0066*	0.0017	-0.0061**	-0.0037**	-0.0059**	-0.0012	0.0034**	-0.0019***	-0.002**	0.0245**	0.0190**
condiment mills	0.0036	0.0049**	0.2000	0.8000	0.0134*	-0.0088	-0.0036	0.0271**	0.0044*	0.3000	0.0037*	0.0057**	-0.045**	-0.0379**
other mills	-0.0168***	0.2000	-0.0043***	0.0075***	-0.0016	-0.0035***	0.0011	0.8000	-0.0026**	-0.002***	0.3000	0.002***	0.0171***	0.0022
processed food mills	0.0150	0.0013**	0.7000	0.0027	0.3000	-0.0053	-0.0011	0.0019	0.0016	0.0022	-0.0012	0.0013*	-0.0037	-0.0112
tobacco mills	0.0087***	0.6000	-0.0036**	0.0097***	0.0054***	-0.0029	0.1000	0.0039*	0.0026**	-0.0018*	-0.0012**	-0.0014	-0.0173***	-0.0014

Notes: * significant at the 10 percent level, ** significant at the 5 percent level, *** significant at the 1 percent level.

Table 8. The estimating coefficient of the QUAIDS model of Bali Province 2021.

Explanatory variables	Grains	Tubers	Fish	Meat	Eggs and Milk	Vegetables	Nuts	Fruits	Oils and Fats	Beverage Ingredients	Condiments	Other Consumption	Food and Beverages	Tobacco and Betel nut
rice price	0.1724***	-0.017***	-0.0125***	-0.0242***	-0.0116***	-0.0034***	0.0041	-0.0241***	0.0078***	0.0037*	0.2000	-0.0017	-0.0552***	-0.0446***
tuber price	-0.017***	0.0088***	0.0025***	0.0031**	0.8***	-0.0024***	0.0015	0.3000	-0.0016*	0.3000	0.1000	0.0024***	-0.0017	-0.0015*
fish price	-0.0125***	0.0025***	0.0223***	-0.002	-0.0025***	0.5000	0.5000	-0.0019	0.0003	0.8000	0.0010**	0.0019***	-0.0085***	-0.0024
meat price	-0.0242***	0.0031**	-0.002	0.0517***	0.1000	-0.0039	-0.0057***	-0.0025	-0.004***	-0.0013	-0.0016*	-0.0034**	-0.014**	0.0042
milk egg price	-0.0116***	0.8***	-0.0025***	0.1000	0.0165***	-0.0019**	0.9000**	-0.0033***	-0.0004	0.1000	0.2000	0.4000	0.0042	0.0012
vegetable price	-0.0034	-0.0024***	0.5000	-0.0039	-0.0019**	0.0246***	0.5000	0.0078***	0.0016*	0.0025***	0.0018***	-0.002**	-0.0048	-0.0159***
bean price	0.0041	0.0015	0.5000	-0.0057***	0.9000**	0.5000	0.4000	0.0024**	0.0018*	0.0010	0.0012***	0.0021**	-0.0047	-0.0038***
fruit price	-0.0241***	0.3000	-0.0019	-0.0025	-0.0033***	0.0078***	0.0021*	0.037***	-0.0014	0.0024**	0.6000	-0.0016	-0.0183***	0.0089***
oil price	0.0078***	-0.0016*	0.3000	-0.004**	0.4000	0.0016*	0.0018*	-0.0014	0.0022	0.0018**	0.6000**	0.0011	-0.0041***	-0.0058***
beverage prices	0.0037*	0.3000	0.8000	-0.0013	0.1000	-0.0025***	0.001	0.0024**	0.0018*	0.0053***	0.9000**	0.0013*	-0.0083***	-0.0055***
seasoning prices	0.2000	0.1000	0.0010**	-0.0016*	0.2000	0.0018**	0.0012***	0.6000	0.0006**	0.9000**	0.0020***	0.2000	0.8000	-0.0052***
other prices	-0.0017	0.0024***	0.0019***	-0.0034**	0.4000	-0.002**	0.0021**	-0.0016	0.0011	0.0013*	0.2000	0.0045***	-0.0026*	-0.0016*
processed food prices	-0.0552***	-0.0017	-0.0085***	-0.014**	0.0042*	-0.0048	-0.0047**	-0.0183***	-0.0041***	-0.0083***	0.8000	-0.0026*	0.086***	0.0289***
tobacco price	-0.0446**	-0.0015*	-0.0024	0.0042	0.0012	-0.0159***	-0.0038***	0.0089***	-0.0058***	-0.0055***	-0.0052***	-0.0016*	0.0289***	0.0431***
Income	-0.088***	-0.0034	-0.0135**	0.0288**	0.0389***	-0.0147**	-0.0076**	0.0332***	-0.0097***	-0.0126***	-0.0028	0.9000	0.1275***	-0.0024***
Quadratic Income	0.0040	0.1000	-0.0015***	0.7000	0.0010	0.0010	0.0000	0.4000	0.0007*	0.0000	0.0000	0.0000	0.1000	-0.0061***
educ	0.2000***	0.0000	0.0000	0.1000*	0.1000	0.0000	0.0000	0.2000***	0.0000	0.0000	0.1000***	0.0000	0.0000	0.3000***
dloc	0.9000***	0.1000	0.5000**	0.0000	0.3000	0.7000***	0.2000	0.3000	0.0001	0.3000***	0.0000	0.1000	-0.0045***	0.0023***
gender	0.5000	0.1000	0.9000	-0.0021	-0.0022*	0.0047***	0.7000	-0.0038***	0.0027**	0.0024**	0.0021***	0.2000	-0.014**	0.0160***
hsize	-0.0036***	0.1000	0.1000	0.1000	0.4000***	0.8000***	0.0000	0.2000*	0.0001*	0.1000**	0.3000***	0.0000	0.6000	0.0028***
job	-0.0015***	0.5000**	0.8000***	0.5000**	0.5000**	-0.0011**	0.0000	0.7000***	-0.0004**	0.2000***	0.1000**	0.0000	0.0043***	0.9000***
food access	0.5000**	0.1000**	0.5000**	0.001***	0.1000	0.4000**	0.0000	0.2000	0.0001	0.0000	0.2000***	0.1000**	0.4000	-0.0012***
middle-income	-0.0239***	0.8000***	0.4000	0.0035***	0.8000	-0.0067***	-0.0024**	0.0011	-0.0021***	-0.0012***	-0.0014***	0.3000	0.0028	0.0321***
High-income	-0.0465***	-0.0013***	-0.0017	0.0084***	0.7000	-0.0115***	-0.0041***	0.0042***	-0.0044**	-0.0027***	-0.0025***	0.8000*	0.0072*	0.0549***
instrumental variable	0.0055***	0.2000**	0.4000*	-0.0016***	0.4000	0.4000	0.4000***	-0.0018***	0.0004***	0.3000***	0.2000**	0.0000	-0.0052***	0.0024***
rice mills	-0.0141**	0.4000	0.0000	0.0022	0.0096**	0.0050	0.4000	0.5000	0.0026**	0.0033***	0.3000	0.8000	-0.0197**	0.0111*
tuber mills	0.8000	-0.0014**	0.1000	-0.0013	0.0011	0.0000	0.5000	0.0010	-0.0002	-0.0011**	0.001***	-0.0022***	0.0092***	-0.0063***
fish mills	0.0029	0.2000	-0.0033*	-0.0157***	-0.0019	0.0021	-0.0037***	-0.008***	-0.0001	-0.0019**	0.9000	0.5000	0.0228**	0.0069**
meat mills	0.9000	0.0000	-0.0044***	0.3000	0.1000	0.0038**	0.6000	-0.0019	0.001*	0.1000	-0.001**	0.0017***	-0.0030	0.0039
dairy egg mills	0.0165***	-0.0011	0.0028	0.0069*	0.0014	-0.0023	0.2000	0.0052*	0.0007	0.6000	0.0017**	0.8000	-0.0140*	-0.0176***
vegetable mills	-0.0048	-0.0019	0.0084**	0.0091*	0.1000	0.0057	0.0071***	0.0034	0.0006	0.0031**	0.4000	0.9000	-0.0448***	0.0128
bean mills	0.0042	0.0036***	-0.0042	-0.0157***	-0.0029	0.0125***	0.0022	-0.0053*	-0.0007	-0.0014	0.0000	0.0025**	0.0015	0.0037
fruit mills	0.004*	0.6000	0.2000	0.0025	-0.0025	-0.0077***	0.6000	0.0057***	0.0002	0.4000	0.001**	-0.0017***	0.0018	-0.0028
oil mills	0.0378***	0.0037*	0.0048	-0.0051	-0.0245***	0.0031	-0.0078**	0.0094	-0.0019	-0.0113**	0.0043**	0.0055**	0.0313	-0.0491***
beverage mills	-0.011***	-0.0021***	0.1000	0.012**	0.0044***	-0.0126***	0.2000	-0.0056***	-0.0017***	0.0026***	-0.0012***	0.1000	0.0075*	0.0100***
condiment mills	-0.0213**	0.0010	-0.0018	0.0087	0.0212***	0.0034	0.0049	0.1000	0.0030	0.007***	-0.0014	-0.0072**	-0.0296	0.0122
other mills	-0.0011	-0.0037***	0.0049***	0.0093***	0.5000	-0.0082***	0.2000	0.5000	-0.0014*	0.3000	0.4000	0.1000	-0.0076	0.0091***
processed food mills	-0.0174***	0.0028**	0.0029**	-0.0038*	-0.0010	-0.0046***	0.5000	0.0066***	0.0006	0.0011*	0.2000	-0.001*	0.0182***	-0.0052**
tobacco mills	0.0024	0.0011	-0.0020	-0.0035	-0.004**	0.0065***	0.8000	-0.0052***	0.0036***	0.0034**	0.0026***	0.2000	-0.0235	0.0176**

Notes: *significant at the 10 percent level, ** significant at the 5 percent level, *** significant at the 1 percent level.

Based on the description above, price significantly influences the expenditure share of food commodity groups, which aligns with the research from Kharisma et al. (2020) and Abdulai (2002). This shows that price policy is a fundamental agricultural policy instrument. Differences in food expenditure shares between households are closely related to socio-demographic characteristics. In the model before the pandemic, out of 126 coefficients, only 57.94 percent significantly affected the share of household food expenditure in Bali Province. Then, in the model during the pandemic, 79 coefficients (62.7 percent) significantly affected the share of household expenditure in Bali Province.

Before the pandemic, the Inverse Mills Ratio (IMR) parameter significantly affected 52.55 percent of the parameters. In comparison, the IMR parameter affected 46.94 percent of the parameters during the pandemic. This implies that the problem of sample selectivity bias in the model during the pandemic is evident in 46.94 percent of the parameters, and the use of the IMR ensures that the estimates in the equation remain unbiased. The insignificant effect of the IMR variable—47.45 percent before the pandemic and 53.06 percent during the pandemic—indicates that selectivity bias is not an issue in this group. These results align with previous research (Girik Allo et al., 2019).

The income variable is obtained through the household expenditure approach. Before the pandemic, the income variable significantly affected only seven food commodity groups (50 percent); then, during the pandemic, 11 out of 14 income coefficients (78.57 percent) were significant at the 5 percent level. This indicates that income is crucial for households in determining their consumption patterns, especially during a pandemic. Interestingly, 11 out of 14 quadratic coefficients significantly affect the pre-pandemic model. The finding that 8 out of 14 quadratic coefficients in the QUAIDS model are significant underscores the model's enhanced appropriateness for capturing the nuances of household expenditure patterns during the pandemic compared to a linear model. This observation aligns with the research conducted by Bopape and Myers (2007), Girik Allo et al. (2019), and Kharisma et al. (2020), all of which endorse the QUAIDS model's effectiveness in depicting household expenditure shares with greater accuracy.

Income is a vital factor in households' consumption regulation. In general, there is a positive correlation between income and household consumption. Income elasticity measures a household's response to consumption when there is a change in income. This study obtained income elasticity using the household expenditure approach presented in Tables 9 and 10 below.

Income elasticity has a positive value for the fourteen commodity groups. An increase in household income typically results in greater consumption levels for the fourteen food commodity groups studied. The highest income elasticity was in the egg and milk commodity group (1.854). This indicates that any boost in household income will result in increased expenditures for this commodity (Hartoyo et al., 2021). When the income elasticity value for a commodity exceeds one, it is categorized as a luxury good, suggesting that consumption of this good increases at a proportionally higher rate than income.

It is intriguing that several essential food commodity groups, like grains, vegetables, nuts, oils and fats, and spices, exhibit income elasticity values greater than one. This phenomenon likely stems from the increased home cooking activities during the confinement periods, boosting the demand for ingredients necessary for meal preparation. The difference in income elasticity between rural and urban areas highlights the variation in income responsiveness. Rural households show higher elasticity, meaning any increase in income significantly impacts their food expenditure. In contrast, urban households, generally with higher income levels, might allocate additional income towards more diverse or non-essential categories, reflecting different priorities and accessibilities.

The own-price elasticities of the fourteen food commodity groups before and during the pandemic are presented in Tables 11–14. Overall, the value of compensated elasticity is lower than that of uncompensated elasticity. This indicates that the impact of rising food prices can be mitigated with compensation. The own-price elasticity for the fourteen commodity groups is negative, except for the grain, tobacco, and betel nut groups.

Table 12 shows that the grain commodity category has a positive value. This can be attributed to the significant diversity in rice preferences among regional customers. Myers et al. (2014) explain that some consumers rely on alternative sources of carbohydrates, such as corn, cassava, certain tubers, and sago, as their main meals. In addition, during the COVID-19 pandemic, the price elasticity of the rice-grain

Table 9. Income elasticity 2019.

Food commodity group	Total	Area		Education Level		Income Group		
		Urban	Rural	<=9 Years	>9 Years	Lower	Middle	Upper
Grains	1.890	1.787	1.534	1.565	1.876	1.508	1.890	2.380
Tubers	-0.597	-0.491	-0.071	-0.123	-0.601	-0.009	-0.597	-0.795
Fish	1.020	1.013	0.992	1.002	1.008	1.006	1.020	1.002
Meat	-0.162	-0.181	0.036	-0.062	-0.132	-0.141	-0.162	-0.247
Eggs and Milk	1.548	1.410	1.455	1.464	1.392	1.451	1.548	1.359
Vegetables	0.935	0.926	0.932	0.936	0.920	0.974	0.935	0.916
Nuts	0.491	0.534	0.619	0.622	0.490	0.715	0.491	0.313
Fruits	-0.065	0.001	0.171	0.119	0.002	0.128	-0.065	-0.082
Oil and Fat	1.408	1.332	1.239	1.241	1.392	1.232	1.408	1.614
Beverage Ingredients	1.910	1.815	1.567	1.590	1.912	1.523	1.910	2.296
Spices	1.190	1.148	1.118	1.125	1.159	1.137	1.190	1.231
Other Consumption	0.826	0.849	0.854	0.857	0.840	0.871	0.826	0.799
Prepared Food and beverage	0.857	0.880	0.876	0.877	0.877	0.864	0.857	0.854
Tobacco and Betel nut	1.509	1.615	1.546	1.489	1.727	1.404	1.509	1.848

Source: The National Socio-economic Survey (Susenas), 2019 (Processed Data).

Table 10. Income elasticity 2021.

Food commodity group	Total	Area		Education Level		Income Group		
		Urban	Rural	<=9 Years	>9 Years	Lower	Middle	Upper
Grains	1.147	1.165	1.127	1.133	1.177	1.139	1.233	1.332
Tubers	0.752	0.740	0.764	0.767	0.728	0.783	0.708	0.681
Fish	0.330	0.309	0.358	0.352	0.298	0.388	0.238	0.162
Meat	0.937	0.935	0.940	0.935	0.936	0.924	0.913	0.913
Eggs and Milk	1.854	1.816	1.926	1.970	1.773	1.874	1.969	1.895
Vegetables	1.096	1.115	1.074	1.083	1.117	1.085	1.132	1.173
Nuts	1.033	1.036	1.029	1.032	1.037	1.048	1.057	1.070
Fruits	0.928	0.926	0.930	0.925	0.929	0.919	0.910	0.907
Oil and Fat	1.242	1.270	1.207	1.208	1.296	1.192	1.336	1.482
Beverage Ingredients	0.922	0.922	0.922	0.928	0.916	0.947	0.922	0.899
Spices	1.086	1.090	1.081	1.088	1.088	1.103	1.114	1.127
Other Consumption	1.002	0.997	1.010	1.006	0.998	1.005	1.009	1.013
Prepared Food and beverage	1.056	1.039	1.095	1.076	1.040	1.071	1.058	1.032
Tobacco and Betel nut	0.205	0.184	0.230	0.188	0.197	-0.127	0.130	0.079

Source: The National Socio-economic Survey (Susenas), 2021 (Processed Data).

commodity group indicates that price increases have little impact on household consumption, especially those living in urban areas and belonging to the upper middle class.

Before the pandemic, the own-price elasticity for fourteen food commodity groups was negative. During the pandemic, these groups' own-price elasticity remained negative except for grains, tobacco, and betel nuts. This finding supports previous research indicating that when the price of a food commodity rises, its consumption decreases (Green et al., 2013).

Interestingly, the own-price elasticities for grains, tobacco, and betel nuts are positive. This means that even as household prices for these commodities rise, their consumption continues to increase. The grain commodity group has an elasticity value of 0.244, meaning that a 1 percent price increase will boost the quantity consumed by 0.244 percent. The increase likely reflects a shift in household behaviors due to movement restrictions and a preference for home cooking, particularly among urban and upper-middle-income groups. In urban areas and among the middle and upper-income classes, the positive price elasticity for grain suggests that as prices increase, so does the expenditure share for grains, possibly due to lower price sensitivity or a lack of suitable substitutes. Conversely, the negative price elasticity observed in rural areas and lower-income groups indicates a more typical economic response where an increase in price leads to a decrease in consumption, reflecting greater price sensitivity or financial constraints.

Then, the own price elasticity of the tobacco and betel nut commodity group is also positive. This indicates that an increase in the price of tobacco and betel nut commodities has little effect on cigarette consumption during the pandemic. This result is in line with previous findings that an increase in nicotine consumption during a pandemic can be caused by boredom, stress, and anxiety (Almeda & Gómez-Gómez, 2022). In addition, the intensity of spending on cigarettes remains high due to easy access and the large selection of cigarettes sold on the market.

Table 11. Estimated uncompensated own price elasticities 2019.

Food commodity group	Uncompensated	Area		Education Level		Income Group		
		Urban	Rural	<=9 Years	>9 Years	Lower	Middle	Upper
Grains	-0.238	-0.119	-0.371	-0.342	-0.040	-0.426	-0.100	0.868
Tubers	-0.597	-0.535	-0.666	-0.639	-0.525	-0.636	-0.578	-0.143
Fish	-0.652	-0.633	-0.677	-0.659	-0.642	-0.669	-0.625	-0.681
Meat	-0.263	-0.215	-0.327	-0.242	-0.293	-0.107	-0.361	-0.310
Eggs and Milk	-0.681	-0.698	-0.650	-0.646	-0.718	-0.631	-0.667	-0.914
Vegetables	-0.838	-0.821	-0.859	-0.856	-0.805	-0.869	-0.807	-0.721
Nuts	-1.047	-1.050	-1.042	-1.042	-1.054	-1.036	-1.052	-0.977
Fruits	-0.489	-0.457	-0.532	-0.490	-0.489	-0.446	-0.516	-0.453
Oil and Fat	-0.742	-0.712	-0.777	-0.776	-0.678	-0.801	-0.702	-0.881
Beverage Ingredients	-0.930	-0.922	-0.940	-0.938	-0.917	-0.942	-0.927	-0.760
Spices	-0.893	-0.887	-0.901	-0.900	-0.882	-0.909	-0.882	-0.897
Other Consumption	-0.569	-0.578	-0.555	-0.575	-0.562	-0.603	-0.577	-0.715
Prepared Food and beverage	-0.609	-0.644	-0.535	-0.567	-0.649	-0.547	-0.604	-0.778
Tobacco and Betel nut	-0.367	-0.373	-0.353	-0.377	-0.332	-0.120	-0.412	0.418

Source: The National Socio-economic Survey (Susenas), 2019 (Processed Data).

Table 12. Estimated compensated own price elasticity 2019.

Food commodity group	Compensated	Area		Education Level		Income Group		
		Urban	Rural	<=9 Years	>9 Years	Lower	Middle	Upper
Grains	0.014	0.117	-0.093	-0.072	0.190	-0.133	0.157	0.591
Tubers	-0.600	-0.539	-0.667	-0.641	-0.529	-0.636	-0.583	-0.576
Fish	-0.596	-0.580	-0.618	-0.602	-0.588	-0.610	-0.572	-0.608
Meat	-0.269	-0.225	-0.324	-0.246	-0.302	-0.115	-0.372	-0.414
Eggs and Milk	-0.617	-0.631	-0.590	-0.586	-0.648	-0.574	-0.602	-0.692
Vegetables	-0.765	-0.754	-0.775	-0.774	-0.744	-0.775	-0.741	-0.711
Nuts	-1.033	-1.039	-1.026	-1.026	-1.043	-1.016	-1.041	-1.063
Fruits	-0.485	-0.456	-0.522	-0.484	-0.489	-0.440	-0.520	-0.573
Oil and Fat	-0.710	-0.683	-0.742	-0.740	-0.650	-0.762	-0.670	-0.559
Beverage Ingredients	-0.884	-0.879	-0.890	-0.889	-0.875	-0.892	-0.880	-0.865
Spices	-0.872	-0.867	-0.879	-0.878	-0.863	-0.884	-0.861	-0.846
Other Consumption	-0.557	-0.566	-0.543	-0.562	-0.550	-0.589	-0.565	-0.447
Prepared Food and beverage	-0.287	-0.283	-0.273	-0.283	-0.278	-0.280	-0.274	-0.260
Tobacco and Betel nut	-0.254	-0.258	-0.244	-0.266	-0.220	-0.036	-0.285	-0.159

Source: The National Socio-economic Survey (Susenas), 2019 (Processed Data).

Table 13. Estimated uncompensated own price elasticities 2021.

Food commodity group	Uncompensated	Area		Education Level		Income Group		
		Urban	Rural	<=9 Years	>9 Years	Lower	Middle	Upper
Grains	0.042	0.153	-0.094	-0.098	0.246	-0.206	0.208	0.868
Tubers	-0.207	-0.105	-0.326	-0.292	-0.093	-0.283	-0.147	-0.143
Fish	-0.632	-0.622	-0.648	-0.631	-0.635	-0.617	-0.644	-0.681
Meat	-0.249	-0.242	-0.260	-0.209	-0.286	-0.129	-0.304	-0.310
Eggs and Milk	-0.809	-0.824	-0.784	-0.766	-0.845	-0.753	-0.845	-0.914
Vegetables	-0.773	-0.751	-0.800	-0.792	-0.749	-0.801	-0.760	-0.721
Nuts	-0.985	-0.984	-0.986	-0.986	-0.983	-0.987	-0.983	-0.977
Fruits	-0.417	-0.391	-0.453	-0.418	-0.416	-0.374	-0.434	-0.453
Oil and Fat	-0.921	-0.914	-0.930	-0.931	-0.908	-0.937	-0.911	-0.881
Beverage Ingredients	-0.816	-0.805	-0.831	-0.836	-0.789	-0.840	-0.809	-0.760
Spices	-0.907	-0.905	-0.909	-0.908	-0.904	-0.910	-0.906	-0.897
Other Consumption	-0.736	-0.745	-0.720	-0.734	-0.737	-0.749	-0.731	-0.715
Prepared Food and beverage	-0.722	-0.749	-0.662	-0.684	-0.752	-0.664	-0.733	-0.778
Tobacco and Betel nut	0.085	0.144	0.009	0.051	0.148	0.354	0.069	0.418

Source: The National Socio-economic Survey (Susenas), 2021 (Processed Data).

Discussion

The measures implemented during the COVID-19 pandemic have influenced shifts in household food consumption patterns in Bali Province. Before and during the pandemic, most household expenditures were allocated to processed foods, grains, tobacco, and betel nuts. During the pandemic, the focus shifted to processed foods, rice, grains, and vegetables. Significant variations in average consumption expenditure across different commodity groups are evident when examining the details. The expenditures for tubers, vegetables, and nuts were the most substantial increases. Conversely, the highest

Table 14. Estimated compensated own price elasticity 2021.

Food commodity group	Compensated	Area		Education Level		Income Group		
		Urban	Rural	<=9 Years	>9 Years	Lower	Middle	Upper
Grains	0.244	0.339	0.133	0.131	0.421	0.054	0.402	1.012
Tubers	-0.198	-0.098	-0.316	-0.283	-0.086	-0.274	-0.140	-0.136
Fish	-0.614	-0.605	-0.627	-0.611	-0.618	-0.595	-0.631	-0.672
Meat	-0.183	-0.177	-0.193	-0.147	-0.217	-0.073	-0.235	-0.240
Eggs and Milk	-0.717	-0.728	-0.697	-0.682	-0.744	-0.671	-0.746	-0.797
Vegetables	-0.655	-0.641	-0.668	-0.664	-0.640	-0.668	-0.644	-0.616
Nuts	-0.958	-0.959	-0.958	-0.958	-0.959	-0.957	-0.957	-0.955
Fruits	-0.368	-0.344	-0.400	-0.369	-0.366	-0.328	-0.384	-0.401
Oil and Fat	-0.885	-0.880	-0.890	-0.891	-0.876	-0.894	-0.876	-0.850
Beverage Ingredients	-0.790	-0.780	-0.802	-0.806	-0.766	-0.809	-0.784	-0.740
Spices	-0.882	-0.881	-0.884	-0.884	-0.881	-0.884	-0.881	-0.874
Other Consumption	-0.718	-0.727	-0.703	-0.717	-0.720	-0.731	-0.714	-0.699
Prepared Food and beverage	-0.421	-0.415	-0.413	-0.418	-0.414	-0.412	-0.421	-0.401
Tobacco and Betel nut	0.099	0.156	0.026	0.064	0.161	0.347	0.079	0.424

Source: The National Socio-economic Survey (Susenas), 2021 (Processed Data).

declines were observed in the fruit, processed food, beverage, and meat commodity groups. The enforcement of the PSBB policy significantly altered consumption patterns due to its stringent limitations on public outings and communal activities. These restrictions, which curtailed access to restaurants, eateries, and shopping centers, naturally led households to minimize their consumption of outside-prepared food and beverages, pivoting instead towards in-home meal preparation. Moreover, the PSBB's impact extended into the cultural and religious domains, particularly affecting the Balinese Hindu community, for whom fruits and meats are not merely dietary staples but also crucial components of religious observances. Therefore, the restrictions on religious gatherings directly diminished the communal consumption and demand for these products (Dewi et al., 2022; Spranz & Schlüter, 2023).

The QUAIDS estimation results indicate that income, approximated by the average expenditure value, and the price of own goods significantly and positively impact the share of household food expenditure in Bali Province during the pandemic. Among socio-demographic characteristics, the occupation of the household head had the most significant influence. Households with heads working in the agricultural sector allocated a smaller share of their expenditure to food than those working in the non-agricultural sector. The findings align with observations from Czechia, where agrarian workers' incomes are lower than other sectors, an insight often mirrored in the equivalized household income data (Zdeněk et al., 2022). Further reinforcing this pattern, the research by Hartoyo et al. (2021) in Boyolali Regency, Indonesia, delineates a similar scenario where households in rainfed areas—typically reliant on agriculture—derive a substantial portion of their income from non-agricultural activities.

Income elasticity is positive for all 14 food commodity groups, indicating that these commodities are considered normal goods. This suggests that increased income will increase the quantity of food households consume (Girik Allo et al., 2019). Own-price elasticity is negative for the food commodity group except for the grain and tobacco/betel nut commodity groups. The own-price elasticity of the grain and tobacco/betel nut commodity group is positive, indicating that households consume more of these food commodities despite a price increase.

The observed increase in grain consumption among urban households and those in the upper-middle-income bracket during the pandemic can be attributed to the constraints imposed by PSBB policy. This policy reduced the consumption of prepared foods and a corresponding increase in home cooking. Furthermore, the shift towards more time spent at home may have also influenced an uptick in the consumption of tobacco and betel nuts among active smokers. These trends align with observations from Iran, as reported by Hajipoor et al. (2023), where there was a notable increase in the consumption of grains and vegetables in urban areas during the COVID-19 quarantine. However, consuming fruits, dairy, meats, fats, and sweets decreased.

Conclusion

The results revealed a shift in household food consumption patterns during the pandemic in Bali Province. The average food expenditure per capita decreased, while the average non-food expenditure per capita

slightly increased. Notably, the per capita food expenditure in urban areas decreased more significantly than in rural areas. The most considerable increase in per capita food expenditure was observed in the consumption of tubers, vegetables, and nuts, whereas the most significant decline occurred in fruit, processed food, and meat commodities. Socio-demographic factors that significantly influenced the share of household food expenditure included the education level of the household head, their occupation, and the household's perception of food access. The price of one's goods positively affected the share of food consumption expenditure but negatively impacted the quantity consumed.

Future research should disaggregate data by region of residence, income group, and gender to identify how variables such as income, price, and socio-demographic characteristics influence household expenditure in the different areas and income groups. This study focused solely on household food consumption patterns during the abnormal conditions of the COVID-19 pandemic. Therefore, future research should compare estimation results from before, during, and after the pandemic. Additionally, this study is limited to food consumption patterns; future research should include non-food commodity variables to provide a more comprehensive view of household consumption patterns. This will allow for an analysis of the impact of COVID-19 on non-food commodities consumed by households during the pandemic.

Policy implications

During The Large-Scale Social Restrictions (PSBB) policy, households in Bali, like many others globally, experienced significant shifts in their consumption patterns, primarily due to increased home cooking activities. This behavioral shift underscores the government's need to ensure price stability for essential commodities such as grains, vegetables, meat, beans, seasonings, and oils. Price stability is crucial for consumer protection and maintaining the economic viability of local producers and the broader agricultural sector. To effectively address these needs, the government can adopt several strategic measures, such as monitoring the supply of essential foods in the field and implementing distribution strategies for fruits and meats. This approach aims to prevent losses among producers, especially since these items were less favored by the Balinese population during the pandemic. Moreover, the government must prioritize policies that aid low-income village households, emphasizing community-based food initiatives that foster local empowerment. By implementing these strategies, the government can help ensure the population has stable access to affordable and nutritious food, supporting public health and economic stability during challenging times like a pandemic.

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Author contributions

Bayu Kharisma: conceptualization of the idea, methods, analysis, and writing; approved and revised the final manuscript and revisions from the review results. Alfiah Hasanah: Analyze and interpret results and writing. Sutyastie Soemitro Remi provided administrative and financial support and writing. I Gusti Gede Gusna Yoga Sanjaya: data collection, estimation, and interpretation of data and writing.

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Data availability statement

Data supporting this study's findings can be accessed on the Central Statistics Agency (BPS) website at <https://silas-tik.bps.go.id/v3/index.php/mikrodata/detail/U1BGcE5sYzFvaml2SGw0YmVUYUIDZz09>. Data available upon reasonable request from the corresponding author, BK.

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