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Socioecological and Dietary Change from 2001 to 2015 in Rural West Java, Indonesia

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Abstract
We assessed changes in the sociodemographic structure, land use, diet, and nutritional status of the population of a rural village in West Java, Indonesia between 2000–2001 and 2015–2017, a period of rapid socioeconomic change in the country. Over this period, the village's population increased by 50%, largely comprised of individuals engaged in non-agricultural employment in the village or in nearby cities, and the village maintained its farming characteristics without major changes in the local land use or ecosystem. In 2000, the diet, nutritional intake, and health status of the villagers were generally uniform. Indicators based on BMI, for example, classified 98% of target children and 70% of target mothers as 'normal', regardless of household economic status. However, by 2015, more people worked outside the village and dependence on a market economy had increased. Dependence on food from outside the village, such as processed foods that are cheap and easy to obtain and store, had also increased. Foods such as cassava, taro, and sweet potatoes, which were grown and consumed in 2000, were not consumed in 2015. The quantities of beans, nuts, and vegetables consumed had also decreased. Additionally, the use and sharing of natural resources and the accompanying knowledge transfer had been gradually lost. As a result, variation in diet, nutritional intake, and health conditions within the village significantly increased over time, and overnutrition and undernutrition coexisted by 2015.

Keywords Indonesia · Land use · Dietary diversity · Child growth · Double burden of malnutrition

Introduction

Population diet or nutritional intake is closely linked to agriculture, especially in agricultural societies in developing countries (Pinstrup-Andersen, 2007) where agricultural policy focused on improving nutritional intake by strengthening staple food production using price incentives and promoting improved farm technologies (Koppmair et al., 2016). The focus was primarily on cereal crops, especially wheat, rice, and maize (Pingali, 2015). This strategy has helped to reduce food shortages but has also contributed to lower levels of crop species diversity (Khoury et al., 2014). More homogeneous global food supplies may also have decreased dietary diversity (Frison et al., 2006). Low levels of dietary diversity are associated with higher rates of micronutrient deficiencies, child stunting, child mortality, and other negative health consequences (Bezner Kerr et al., 2011).

Indonesia is the fourth most populous country in the world and has experienced rapid economic growth since the Asian financial crisis (World Bank, undated). This crisis, which began primarily in Thailand in the latter half of 1997, quickly spread to Indonesia's financial sector and brought the country to an economic crisis (Iriana & Sjöholm, 2002). In response and to qualify for support from organizations like the International Monetary Fund (IMF), the Indonesian government decided to implement structural economic reforms such as rapid market liberalization and deregulation (IMF, 2023). During this rather chaotic period, the Suharto regime collapsed in 1998 after 32 years, and was followed

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by two presidential administrations (Habibie then Wahid) in rapid succession with a continuing unstable political and economic situation. Decentralization started immediately following Suharto's resignation in 1998. Laws on regional autonomy (Law of the Republic of Indonesia No. 22/1999: Regional Government) and intergovernmental fiscal relations (Law of the Republic of Indonesia No. 25/1999: Financial Balance Between the Central and Regional Government) were enacted in 1999. Various forms of power were transferred from central government to provinces, and from provinces to regency and city levels. On top of this societal upheaval, in 1997 El Niño weather patterns produced a prolonged dry season that caused significant reductions in rice production for two consecutive years (1997 and 1998), precipitating a food supply crisis that required mass imports of rice. Indonesian agriculture and farming villages were greatly affected by disruptions in food distribution (Soekirman, 2001).

The Yudhoyono administration was elected in the country's first direct election in April 2004, and continued to hold power for 10 years. The social, political, and economic situation gradually stabilized. Personal consumption expanded. The annual economic growth rate since 2005 has been a relatively high level of 5.5–6%, except in 2009 when the country was affected by the global financial and economic crisis. The national economy grew significantly, with nominal GDP per capita surpassing $3000 in 2010 (World Bank, undated).

Since 2000, nutrition and health surveys have been conducted in a rural Sundanese village in West Java, Indonesia, particularly among children (Sekiyama & Ohtsuka, 2004; Sekiyama et al., 2012, 2015, 2018). These studies recruited all children aged 0–12 years living in two communities of the village and continuously measured their physical status to 2004. The measurements from 2001 showed that the mean z-scores for height for age and weight for age of the school-age children were -2.52 ± 0.96 and -1.76 ± 0.70. These figures are similar to, or slightly lower than those of a large sample of schoolchildren in West Java studied by Pari et al. (2001). One of the most important findings of these most recent surveys was that growth of the children before the onset of puberty was retarded. This was because of poor nutritional intake and a high burden of disease, such as intestinal helminths (called *cacingan* in the local language) and anemia, which are the most serious causes of growth retardation in rural areas of both West Java (Pegelow et al., 1997) and Indonesia as a whole (National Development Planning Board, 1996).

Indonesia has experienced rapid economic growth. We compared data from previous studies obtained in 2000–2001 and 2015–2017 to examine how the rapid economic growth affected the sociodemographic structure, land use, diet, and nutritional status of the population of a rural village in West Java, Indonesia.

Methods

Study Area

The study village, S village, is in the subdistrict (*kecamatan*) of Tamansari in the district (*kabupaten*) of Bogor, West Java, Indonesia. Detailed information about the study area has been reported elsewhere (Sekiyama et al., 2012, 2015). In 2001, S village was administratively divided into 10 community units, known as *rukun warga* (RW). These were very similar in sociocultural conditions such as occupations and accessibility to nearby towns. Using the proportion of underweight children among those aged under five years (less than −2 standard deviations from the weight-for-age mean recommended by the WHO) in the records kept at the village health center, we selected RW-1 (with 33% of underweight children) as an area with a higher proportion of underweight children and RW-6 (19%) as an intermediate proportion. In our first fieldwork in August–September 2000, we identified all children aged 0 to 12 years who inhabited RW-1 and RW-6 using the village census documents from July 2000 and started to follow them up for the study. In 2015, S village was administratively divided into 11 community units. The previous RW-6 became RW-7 and RW-1 remained the same.

Field Work

We conducted the fieldwork for the research presented here during three periods. Anthropometric measurements, food consumption surveys, and questionnaires on socioeconomic status were conducted in July 2001 and August 2015. The participating children were fourth-grade elementary school children in RW-1 and RW-6 (RW-7 in 2015). The selection of fourth-grade students was based on two reasons: they would have an adequate memory of the food they had eaten in the past 24 h, and they were in the growth stages before the onset of puberty. The ages of the children were determined by the number of months after their birthday. To facilitate understanding, the scale of age is expressed in years throughout this paper; for instance, an age of 9 years refers to a month-based age from 108.0 to 119.9 months.

We conducted additional data collection in May–August 2017. To resolve changes at the regional level, we purchased statistical data published by the subdistrict of Tamansari, to which S village belongs, for all available years since 2000 (*Dalam Angka Kecamatan* T). We conducted additional

surveys of adults in 2017 to understand more about the dietary changes that had occurred in S village.

Data Collection and Analysis

Dietary Intake Survey of Children in 2001 and 2015

Children's dietary intakes of energy and nutrients were estimated using the recall method at both points. However, the methodology differed slightly between the two surveys. Detailed information about the 2001 survey has been reported elsewhere (Sekiyama et al., 2012). Dietary intake for each participating child was estimated using the recall method for seven consecutive days. Each day, the recall survey was conducted four times (i.e., 6:00–9:00, 9:00–12:00, 12:00–15:00, and 15:00–18:00) for the preceding 3 h and an additional interview was conducted after 18:00 if necessary.

For the 2015 survey, children's dietary intakes for a single day were assessed using a 24-h recall method. To guarantee the accuracy of the reported amounts of food estimated in this 24-h recall procedure, we used several steps, as in the 2001 survey (Sekiyama et al., 2012). The weight of each food consumed by each child was estimated to the nearest gram, and the amount of energy and nutrients were calculated. This allowed calculation of the nutrient adequacy ratios (NARs) for energy and nutrients based on the recommended dietary allowance (RDA) for age and sex (National Institute of Health Research and Development, 2013), following the procedure used in the 2001 survey.

Anthropometric measurements (height, weight, mid-upper arm circumference) were conducted by the same investigator (MS) during the two survey periods. Using each child's measured height and weight and his/her month-based age, z-scores for body-mass-index-for-age [BMIZ]) were calculated based on the WHO growth reference (de Onis et al., 2007).

Questionnaire Survey on Socioeconomic Characteristics of the Children's Households in 2001 and 2015

We obtained socioeconomic data through interviews with the parents of each child using the same structured questionnaire for both 2001 and 2015. The items included names, ages, sex, occupations, income, and education history of all household members, and details of possession of household goods, water source and sanitation, and land ownership.

We conducted Additional Dietary Intake surveys of adults in 2017 to understand more about the dietary changes in S village. Participants included 62 households in RW-1 and RW-7 hamlets in S village (RW-1: 32 households, RW-7: 30 households). Surveys on the socioeconomic circumstances of households and dietary surveys of the heads of households and their spouses were conducted using the same methodology as the child survey in 2015. Approximately half of the participants worked in agriculture in some capacity.

Land Use and Land Cover Change Analysis

An object-based image analysis using high-resolution satellite images was used to prepare a base map to enable land use and land cover change analysis. We used the satellite images taken by the Quickbird-2 satellite on 8 August 2006, and the Pléiades satellite on 9 June 2017. The timing of the images does not coincide exactly with the time of the survey, but we selected cloud-free images covering the whole area of the S village taken on the closest possible date to the survey period in each year. We used Quickbird-2's 2.4-meter resolution image for 2006 and Pléiades's 2-meter resolution image for 2017. Both images contained information from the four bands of multispectral sensors (blue, green, red, and near-infrared). These satellite images were ortho-rectified using AW3D 30-m digital elevation model and further georeferenced to be overlaid in the same geographical position.

Object-based image analysis included segmentation, classification, and accuracy assessment processes (Hara et al., 2013; Myint et al., 2011). The segmentation process in this study used the segment mean function in the ArcGIS 10.8 software (Esri, California, USA). Image segmentation identifies objects in the satellite image by grouping adjacent image pixels together that have similar spectral and spatial characteristics. It provided the basis for the land use and land cover classification analysis. We used green, red, and near-infrared bands in the segmentation process of both Quickbird-2 and Pléiades images because the segment mean function allows a maximum of three image bands. The segmentation process was conducted with the following parameter settings: spectral detail of 15.5, spatial detail of 20, and minimum segment size in pixels of 20. These parameters were determined by manually testing combinations to find the most suitable combination for the classification purpose in this study, and the spatial detail parameter was set to the maximum level to capture the highly heterogeneous landscape structure of S village. We used four land use and land cover classes: urban, surface water, farmland, and forest. Urban land use objects, including buildings and roads, and surface water objects, including ponds and rivers, were identified manually because of their small coverage in S village. Classification between farmland and forest used the train maximum likelihood classifier and classify raster functions in ArcGIS. We prepared sample objects for each of the 2006 and 2017 images, with a total number of sample objects of 197 (86 for farmland and 111 for forest) and 223 (92 for farmland and 131 for forest). The sample objects

were manually interpreted using pan-sharpened images and then used to assess the accuracy of the classification results derived from the object-based image analysis. The overall accuracy of the classification was 0.95 for the 2006 image and 0.91 for the 2017 image, and the kappa index was 0.91 for the 2006 image and 0.81 for the 2017 image, which indicate sufficient accuracy.

Changes in land use and land cover were analyzed to understand the changes in agriculture in S village between the two periods, focusing on changes in farmland areas. The change analysis was conducted from two perspectives. First, the change in the proportion of land use and land cover across S village in each period was examined. Second, areas with changes in the two figures were detected using ArcGIS to map them. In both land use and land cover change analysis, the Pléiades 2-meter resolution image was rescaled to the Quickbird-2 2.4-meter resolution.

Statistical Analysis

The normality of the distribution of data was examined using the Kolmogorov–Smirnov test. NARs of energy, protein, and fat were compared between 2001 and 2015 by Mann–Whitney U test. Statistical significance was defined as $p < 0.05$.

Ethics

Written informed consent was obtained from the parents of each child after explaining the purpose and procedures of the study. The study protocol was approved by the Ethics Committee of the Graduate School of Frontier Sciences of the University of Tokyo for the 2015 and 2017 survey.

Table 1 Sociodemographic characteristics of S village

		2000	2015
Population	Total population (people)	6434	9615
	Population density (people/km^2)	2115	3161
	Total number of households	1440	1925
	Average household size	4.47	4.99
Occupation	Farming (%)	66.6	47.1
	Industrial worker (%)	1.6	16.8
	Construction worker (%)	3.3	2.1
	Commercial worker (%)	8.9	31.6
	Driver (%)	1.9	0.0
	Civil servant (%)	1.9	0.8
	Other (%)	15.9	1.5

Results

Changes in S Village Since 2000 (Regional Level)

The population of S village has increased since 2000, with a total population of 9,615 (4,797 male and 4,818 female) in 2015 and a population density of 3,161 people/km^2 (Table 1). The population density of Bogor Regency at around the same time was 2,049 people/km^2, and thus S village can be said to be densely populated by the standards of the regency. The total number of households was 1,925 in 2015, an increase of 485 over 2000. The total population increased by 3,181 compared with 2000. The average household size increased by 0.52 from 2000 to 2015.

There were therefore significant changes in population size. However, there were almost no changes in land use. Statistical data from 2016 (*Dalam Angka Kecamatan T*) show that of the 304 ha of village land area, 162 ha were used for paddy fields, and 106 ha for plowed fields, almost identical to the data obtained in the village for the year 2000. This was also clarified by comparing satellite images of the village (Figs. 1, 2 and 3). No high-resolution satellite data before 2006 could be obtained, and thus an analysis could not be conducted for that period (Fig. 1). Classifications of village land use between urban land use (including buildings), forest, farmland, and water showed that land use was visually almost identical between 2006 and 2017. Forest covered 52% of land in both 2006 and 2017; farmland 41% in 2006 and 40% in 2017; urban areas 7% in 2006 and 8% in 2017; and water less than 1% in both years. The values were therefore almost unchanged between 2006 and 2017 for all classifications (Fig. 2). Areas colored black are those that changed from forest to urban land use (2% of total), gray shows a change from farmland to urban (2% of total), green shows farmland to forest (8% of total), and yellow shows forest to farmland (8% of total). Changes between farmland and forest occurred in 16% of land and urbanization of farmland or forest occurred in 4% (Fig. 3).

Agriculture remained the primary form of employment in 2015, but the proportion engaged in it decreased from 67% in 2000 to 47% in 2015 (Table 1). The actual number of farmers was almost identical in 2000 and 2015. Therefore, most of the farmers from 2000 were likely still farming in 2015, but many of the new immigrants since 2000 were employed in professions other than agriculture. The amount of corn produced had dropped to zero in 2015, but there were no other major differences in crops produced. The occupations that had seen rapid increases since 2000 included industry (1.6% in 2000 vs. 16.8% in 2015) and commerce (8.9% vs. 31.6%). S village falls within the Cisadane River Basin, and there is a famous waterfall nearby on one of its tributaries, with many tourists visiting from urban areas such as Jakarta

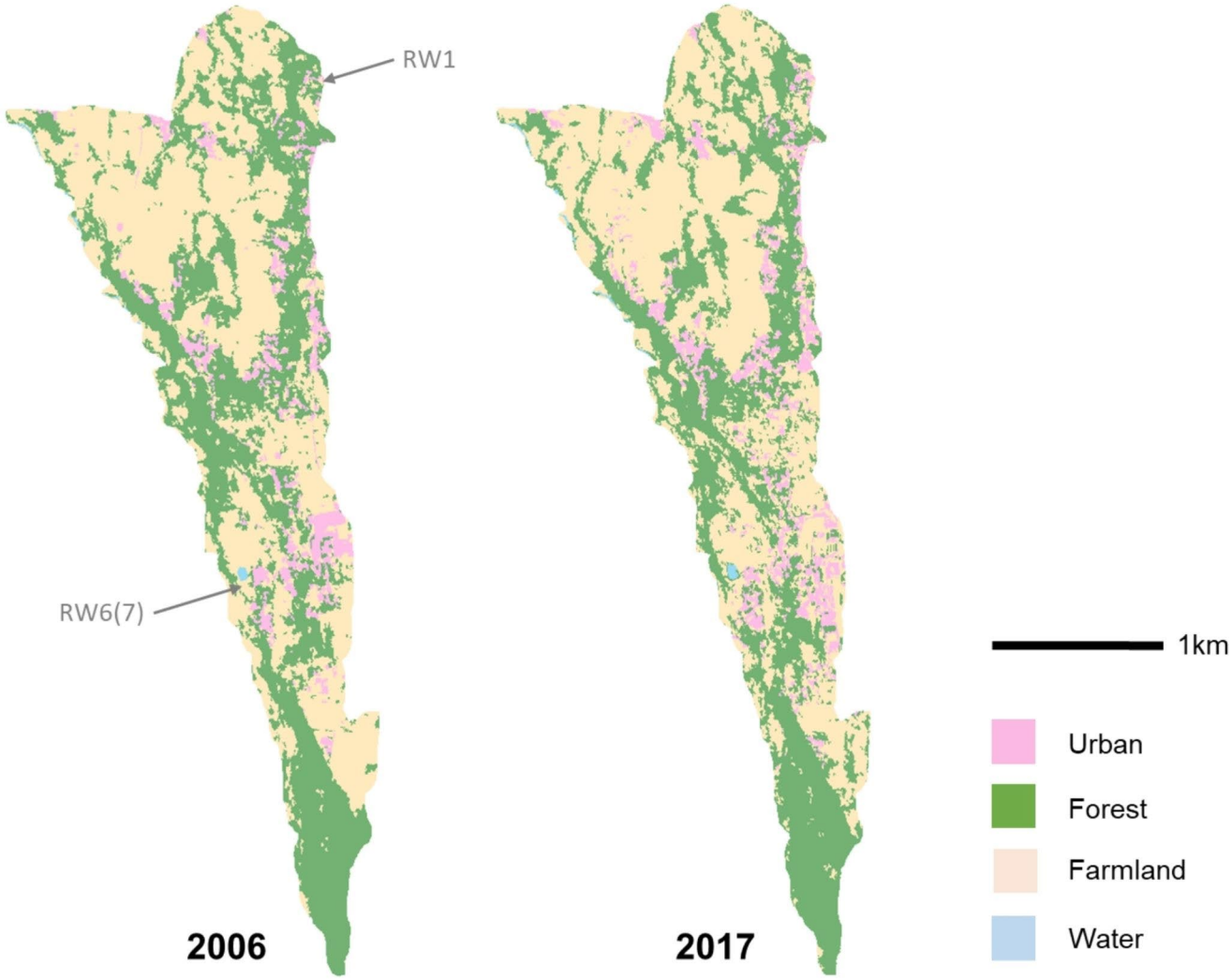

Fig. 1 Land use in the village (2006 and 2017)

even in 2000. Resorts had developed in the surrounding area over the period, centering around the waterfall. The opening of a large three-star resort hotel had probably resulted in many of the new immigrants and workers, who were commercial employees such as hotel staff.

There were also several changes in village facilities. A new junior high school established in the village during the period is run as a private school, and we have no information about its fees. However, statistical data showed that there were approximately 350 students attending this school. The number of maternal health centers (which provide vaccinations, infant health check-ups, and nutritional guidance), called *Posyandu*, had roughly doubled. There was therefore increased activity in this sector.

Changes in S Village Since 2000 (Individual Level)

We also investigated how people's lives and health changed over the same period, and particularly the lifestyles of the villagers and the health of the children. We compared the results of physical measurements (data on height, weight, upper arm circumference, and thickness of subcutaneous fat taken from a survey in July 2001), and questionnaire surveys on socioeconomic circumstances, and dietary surveys conducted from 2000 to 2001 and 2015 to analyze changes in growth, nutrition, and background factors of children over a period of approximately 14 years. The changes in physical growth and background factors have previously been reported (Sekiyama et al., 2018), and here we report only on the dietary change in detail.

Overall, the data covered 83 children (41 boys, 42 girls) in 2001 and 165 children (88 boys, 77 girls) in 2015. Their average ages were 113.1 ± 6.9 months in 2001 and

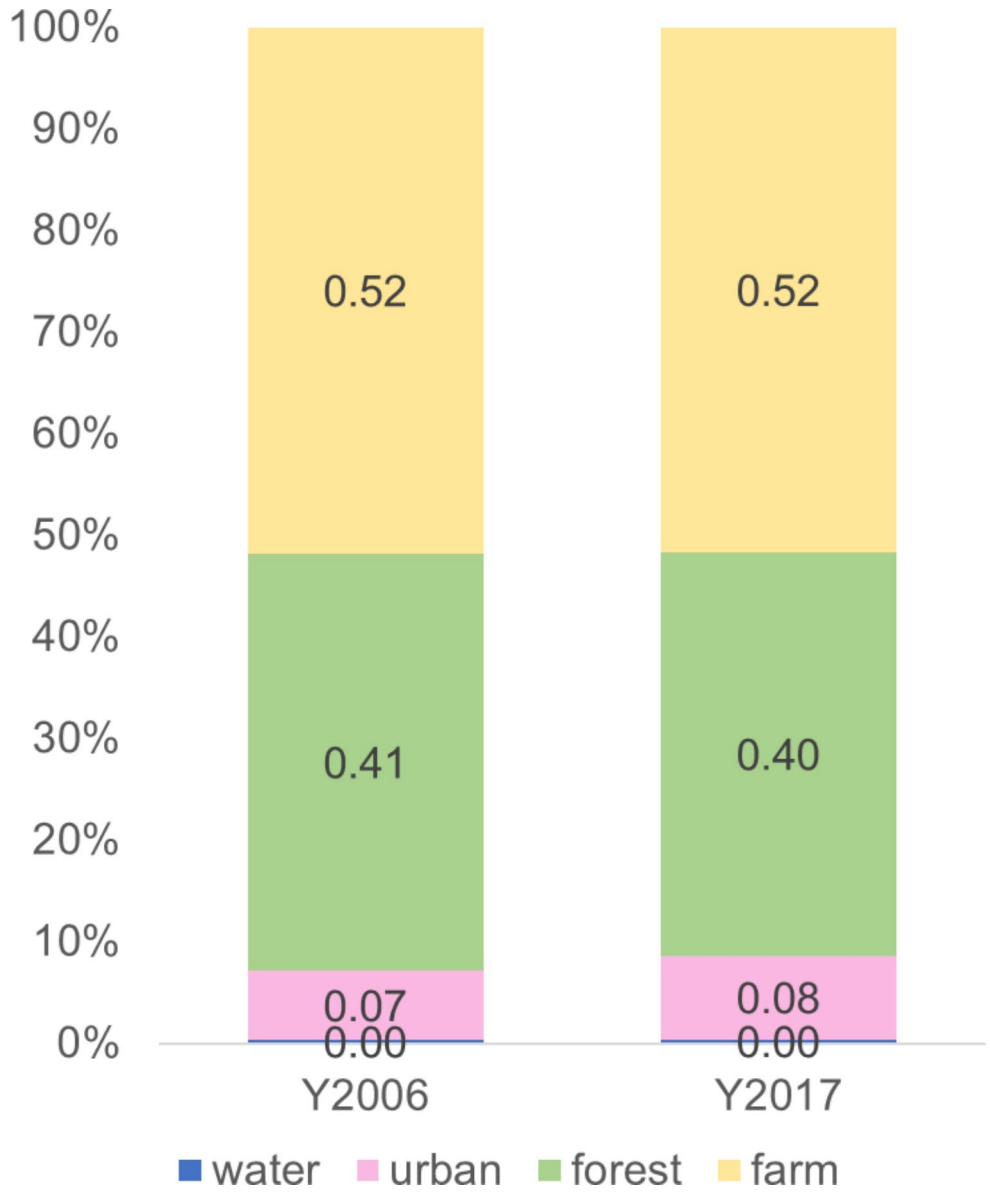

Fig. 2 Land use categories in the village (2006 and 2017)

114.9 ± 8.3 months in 2015, and there were no significant differences between the two study years. The main occupations of their fathers were farming (32.9%), self-employment (23.2%), and employment by companies (20.7%) in 2001. By 2015, these had shifted to factory labor (33.5%) and self-employment (22.6%). Large decreases were seen in the proportion farming, from 32.9% in 2001 to 7.9% in 2015. The changes in the occupational structure of the village overall were reflected in these percentage changes. More fathers with elementary school children were likely to be wage-earners by 2015. The main occupation of the mothers was housewives in both 2001 and 2015. Household income in 2015 was approximately five times that of 2001. The minimum wage in West Java Province in 2015 (1.177.000RP) was also around five times that of 2001 (255,000RP). The average number of years of schooling for parents increased from 4.1 to 5.7 years for fathers and from 3.0 to 5.3 years for mothers, indicating that more parents of elementary school children had been enrolled in primary school.

Changes in Dietary Intake of Children in S Village

Energy and nutrient intake of the children showed notable change between 2001 and 2015 (Fig. 4). The NAR for energy increased from 71.3% in 2001 to 90.4% in 2015 ($P < 0.05$). The NAR for protein also increased in 2015 ($P < 0.05$), though it remained below 70% of the recommended value. The NAR for fat increased in 2015 ($P < 0.05$). It was lower than the recommended value, but fat intake contributed 25.1% of total energy intake. Overall, energy and nutrient intake increased over the period, but so did its variation.

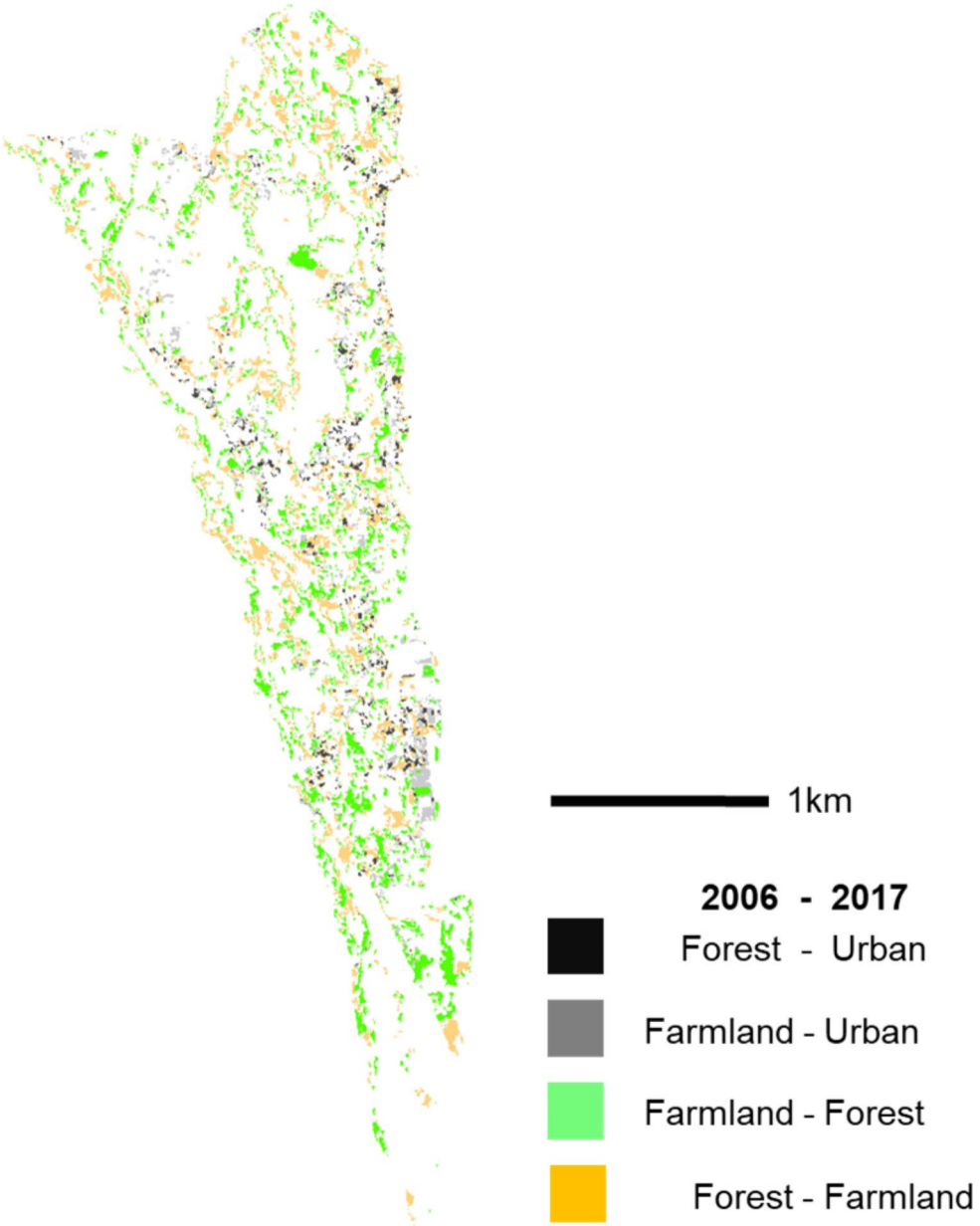

Fig. 3 Change in land use from 2006 to 2017

The Indonesian diet is highly dependent on carbohydrates, which contribute 70% of caloric intake (National Institute of Health Research and Development, 2013). This was also the case for the study participants. Carbohydrates provided 73% of caloric intake in 2001 and 65% in 2015. The contribution of fat to total energy intake increased from 19% in 2001 to 26% in 2015. The contribution of protein intake to total energy intake did not change over the period.

There were changes in the types of carbohydrate eaten over this period (Fig. 5). The contribution of rice remained at 36–37% over the 14 years. However, foods such as cassava, taro, and sweet potatoes, which were consumed in 2001, were not consumed in 2015. The consumption of instant noodles doubled during the period, implying that this change also contributed to the increase of fat intake in the village.

The amounts of beans, nuts, and vegetables consumed also decreased (Table 2). This suggests that there was an ongoing loss of dietary diversity. Variability in the amount of nutrient intake also increased in 2015.

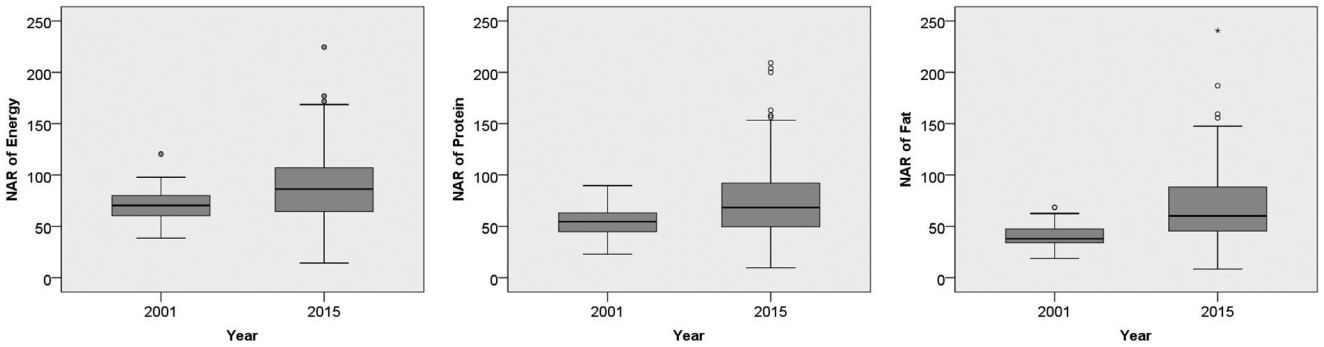

Fig. 4 Energy, protein, and fat intake among participating children in 2001 and 2015. The boxes show the median (black middle line) limited by the 25th (Q1) and 75th (Q3) percentiles. The whiskers are the upper and lower adjacent values, which are the most extreme values within Q3 + 1.5 (Q3 − Q1) and Q1 − 1.5 (Q3 − Q1). The black dots are outliers

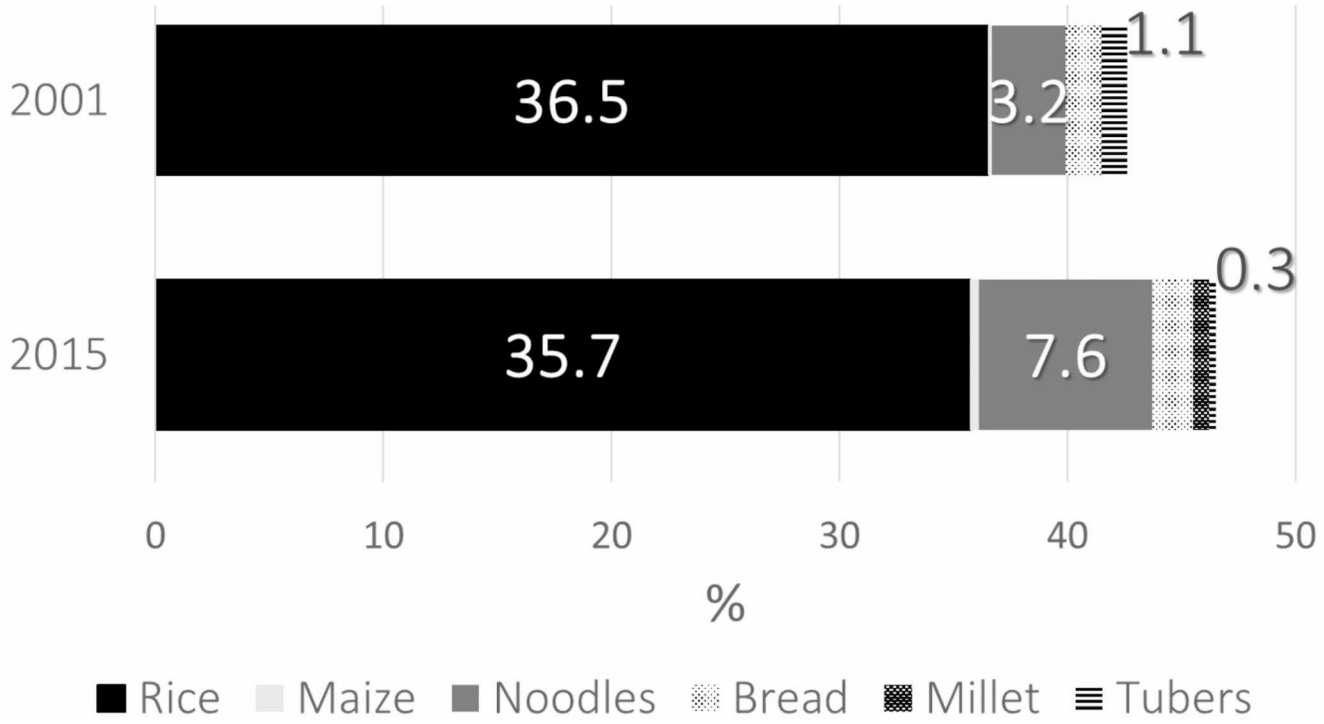

Fig. 5 Child dietary energy intake from cereals and tubers in 2001 and 2015

Table 2 Changes in dietary consumption of the children in S village

	Food category
Food items increased from 2001 to 2015	Eggs
	Fish
	Milk
	Oil
Food items decreased from 2001 to 2015	Pulses
	Nuts and seeds
	Meat
	Vegetables
	Fruit

Associations between socioeconomic variables and nutritional status or nutritional intake were then analyzed (Fig. 6). In 2015, the disparity of income and nutritional status clearly widened compared to 2001. The relationship between per capita income/household size and children's nutritional intake was also analyzed (Fig. 7). In 2015, NAR for Energy were 93.5 ± 34.3, 91.6 ± 37.2 and 82.7 ± 35.8 for tertiles 1, 2, and 3 of household size, respectively, indicating that there is competition for resource allocation in 2015. Such relationships were not observed in 2001.

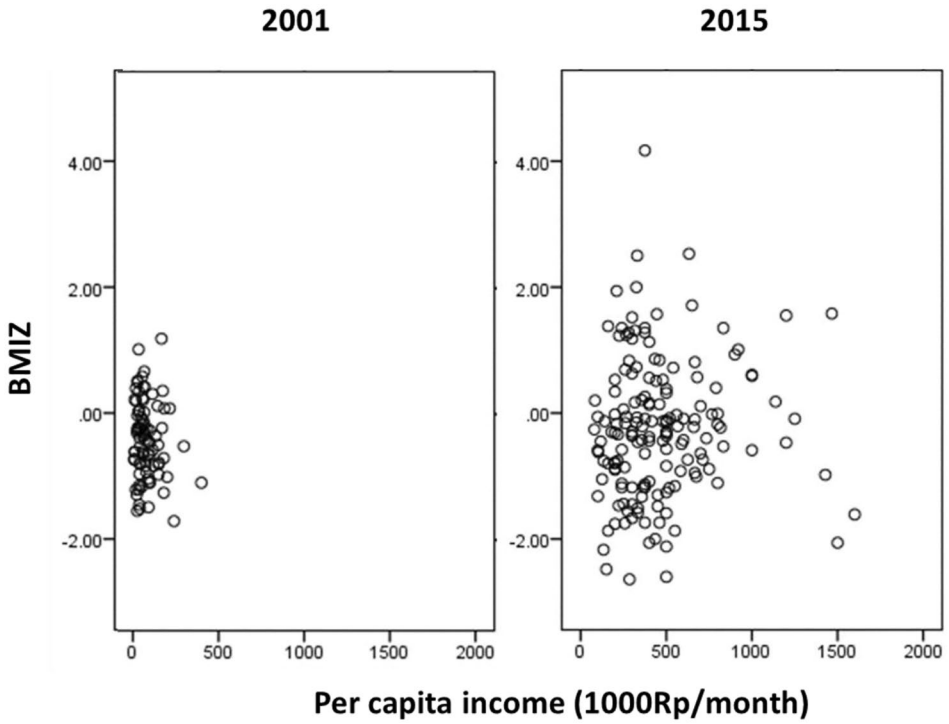

Fig. 6 Per capita income (1000Rp/month) and BMIZ of children in 2001 and 2015

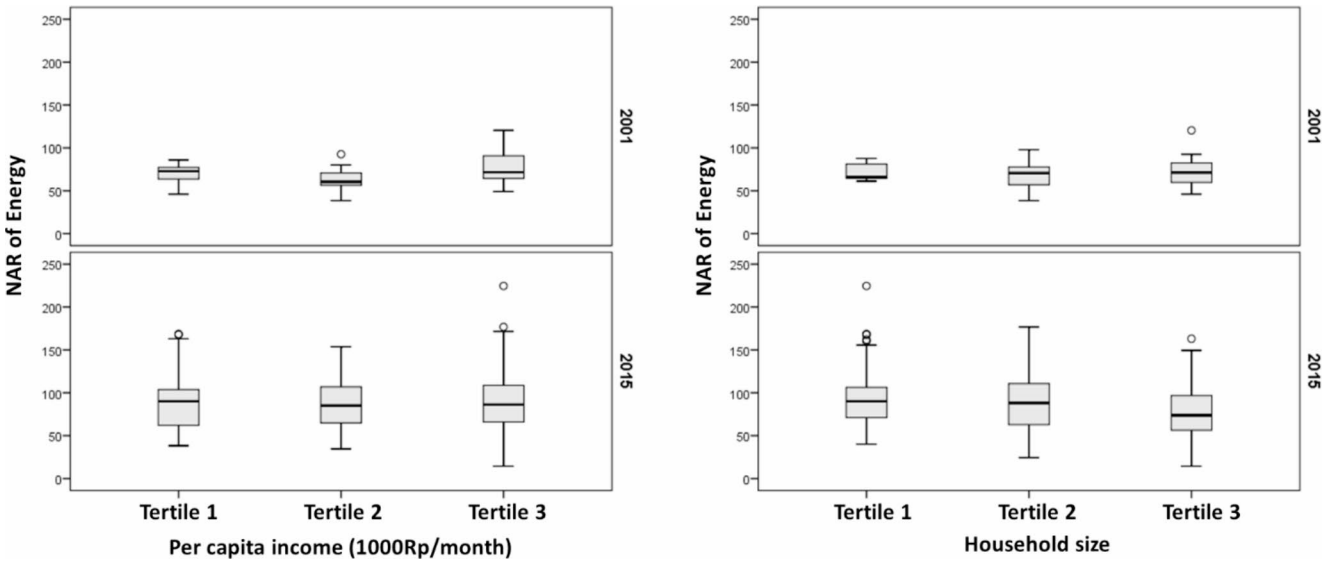

Fig. 7 Energy intake of participating children in 2001 and 2015 by per capita income (left) and household size (right). The boxes show the median (black middle line) limited by the 25th (Q1) and 75th (Q3) percentiles. The whiskers are the upper and lower adjacent values, which are the most extreme values within Q3 + 1.5 (Q3 – Q1) and Q1 – 1.5 (Q3 – Q1). The black dots are outliers

Dietary Sources in S Village

The additional surveys of adults conducted in 2017 showed a high dietary dependency on carbohydrates among adults as well, with 67% of caloric intake from them. Figure 8 shows the percentages of calories and the three macronutrients by source (self-production, sharing, and purchase). Overall, 84.5% of caloric intake was sourced from purchases, with self-production contributing only 14.2%. The main foods that were self-produced included rice, glutinous rice, cassava, and bananas. Almost no participants ate taro and sweet potatoes and those who did had purchased them. The dietary surveys in 2000 were conducted among children, and no detailed data on food sources were collected, and thus quantitative comparisons cannot be made. However, based on observations during the dietary survey, corn, cassava, taro,

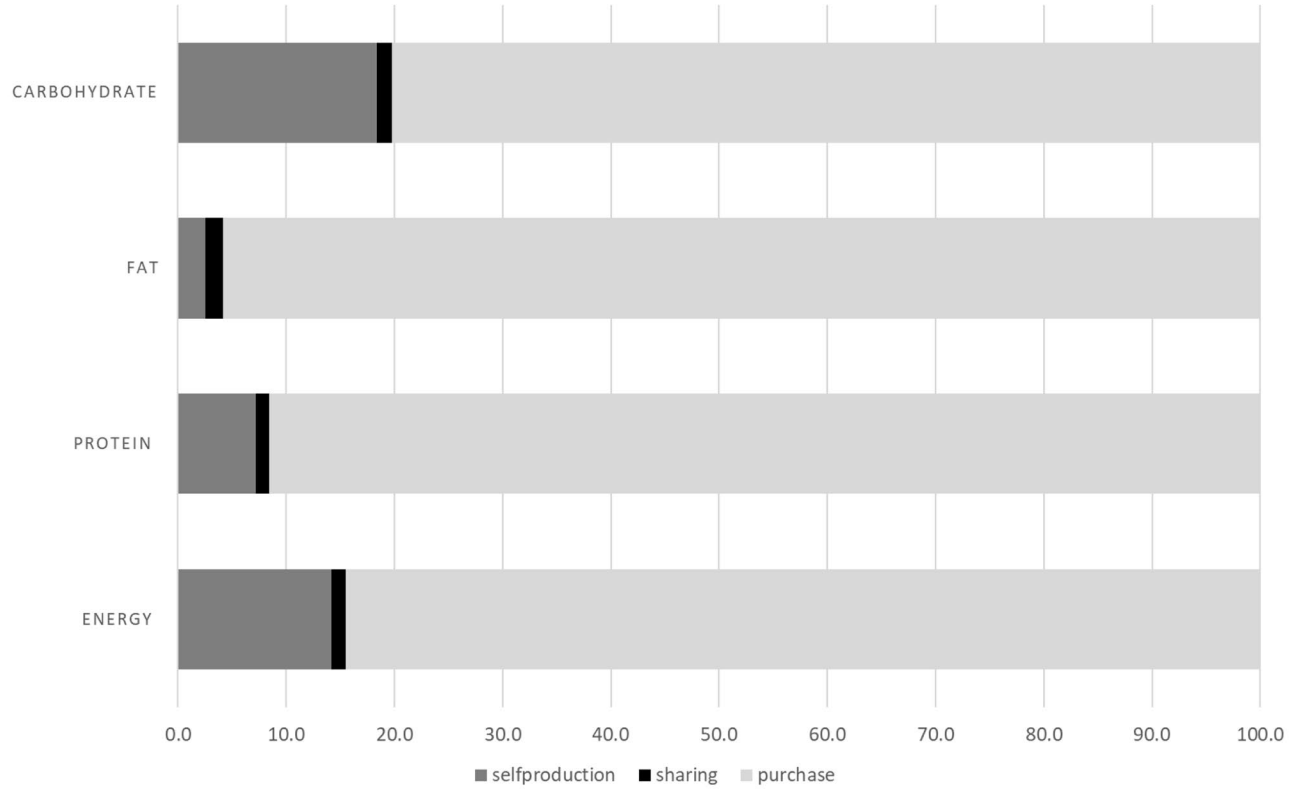

Fig. 8 Sources of nutrient intake in 2016

and sweet potatoes were frequently consumed in the village in 2000, and many people routinely shared food with relatives and neighbors. These results suggest that there were significant changes in the dietary habits of the villagers over these 15 years, and there was likely increasing dependency particularly on foods purchased from outside the village.

Our findings clearly show that S village still appears to be a rural village in terms of land use. However, its adults are now largely employed in non-agricultural labor, and the diet of the villagers is almost entirely composed of purchased food.

Discussion

The new proportion of the growing population of village S was largely engaged in non-agricultural employment within the village or in nearby cities. The village continued to function as a farming village without major changes in its land use or ecosystem. Over the 14-year period of the study, the land use of the village hardly changed at all. The population increased by approximately 3,000 (from 6,434 in 2000 to 9,615 in 2016), which was possible not only because more densely packed houses were built in the existing residential areas but also because of the increased household size. We suggest that much of this was due to young married couples building a new house on their parents' land or living with their parents in larger households.

The growing population appears to have seized commercial labor opportunities in nearby and easily accessible parts of Bogor and resort developments around tourist attractions promoted within the village. Previous studies have found that rural areas in West Java tend to support an increasing population by improving agricultural productivity through technological improvements and securing employment opportunities in neighboring cities (Mardiansjah et al., 2021). Our observations in S village are consistent with this.

Over the past decade or so, the country's socioeconomic situation has changed dramatically (World Bank, undated). As we have previously reported (Sekiyama et al., 2018), the height of prepubescent children in S village has increased at similar rates during the period of maximum economic growth in Japan and China. Weight also increased during this period, whereas increased variations in weight was apparent. In 2001, the incidence of both underweight and overweight/obese was almost zero. However, in 2015, the rate of overweight/obese was 13.7% and underweight was 4.3% (Sekiyama et al., 2018). The divergence in nutrient intake also increased in 2015 compared to 2001 (Fig. 4).

There has therefore been considerable variation in nutrition and growth within the village over the past decade or so.

In 2000, based on observations during fieldwork, the village had a rich food culture using local natural resources, and there was also an established system to share those resources and knowledge within the village. The villagers all consumed a well-balanced Sundanese diet that included rice, soy products, and vegetables like other Sundanese villages in West Java (Koene, 1996). Those foods were shared either between producers in the village or as part of the diet at festivals such as marriage ceremonies and after childbirth. This meant that indicators based on BMI, for example, classified 98% of children and 70% of their mothers as 'normal', regardless of household economic status. The diet, nutritional intake, and health status of the villagers were therefore generally uniform (Sekiyama et al., 2018).

Over the past decade or so, the socioeconomic situation of the country has changed dramatically. There is much more dependence on off-farm labor and use of a market economy, and both the use and sharing of natural resources and the accompanying knowledge transfer have gradually been lost in the village. The economic disparity within the village has widened (Fig. 6). Increased household size was associated with decreased nutrient intake, indicating competition for resource allocation within households (Fig. 7). Some people have access to adequate nutritious diets while others do not, leading to greater variability in nutrient intake and nutritional status. Overnutrition and undernutrition coexisted by 2015. As the dependence on external food resources has increased, the villagers eat more processed foods such as noodles, which are cheap and easy to obtain and store. This is likely to be especially true for off-farm workers, who may have had difficulty accessing food produced in the village.

Mehraban and Ickowitz (2021) reported similar dietary changes in Indonesia, including increasing consumption of simple carbohydrates and fats and less use of complex carbohydrates, fruits, legumes, and vegetables. Moreover, such dietary changes in Indonesia, especially among children, have been reported to be associated with the double burden of malnutrition,[1] which is a serious public health challenge in most developing countries (Popkin et al., 2020). Indonesia is no exception to this challenge, where rates of household level double burden of malnutrition as high as 30.6% have been reported (Rachmi et al., 2016). While previous studies in Indonesia defined double burden of malnutrition at the household level as evidenced by the coexistence of overweight adults and underweight children (Oddo et al., 2012), we observed the coexistence of overnutrition (overweight/obesity) and undernutrition (underweight) in a single age group (4th grade of elementary school) within the village. More importantly, we observed this phenomenon only in 2015 and not in 2001 due to the significant socioeconomic and subsequent changes described above. Such findings could only be obtained by the longitudinal observation of the specific population.

[1] The coexistence of overnutrition and undernutrition within country, communities, and household (Lowe et al., 2021).

Conclusion

We assessed changes in the sociodemographic structure, land use, diet, and nutritional status of the population of a rural village in West Java, Indonesia between 2000 and 2001 and between 2015 and 2017, a period of rapid socioeconomic change in the country. As the village's population grew, newcomers were largely employed in non-agricultural work within the village or in nearby cities, and farming continued without major changes in the land use or ecosystem. However, the use and sharing of natural resources and the accompanying knowledge transfer have gradually been lost. The economic disparity within the village has widened and an increase in household size was associated with competition for resource allocation within households. This has led to much more variation in diet, nutritional intake, and health conditions within the village, and the coexistence of overnutrition and undernutrition.

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Data Availability Data will be made available on request.

Declarations

Competing interests The authors declare that there are no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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