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Elderly Nutrition in a Small Developing Country: Implications from Off-farm employment, Climate Change, and Declining Farm Sizes

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Abstract: The global community is now witnessing increased incidences of non-communicable diseases due to changes in lifestyle, poverty, and income inequality. Thus, there is renewed attention on the nutritional choices of households, particularly those in poverty. This study examines the quality of food consumed by farming households in the rural areas of Fiji. The study reveals poor quality food intake amongst females and the elderly, and identifies the critical causal factors for mitigation to improve the nutritional intake of the elderly. Empirical analysis of the causal factors points to smaller farm sizes, climate change impacts, and access to off-farm employment. The study suggests critical policy measures to mitigate the impact on elderly nutrition.

Keywords: Malnutrition, Rural Households, Elderly, Climate Change, Non-Communicable Diseases

JEL Classification Number: C5, D1, I12, Q12

1. Introduction

Adequate food and balanced nutrition have been a concern across the globe due to the prevalence of high levels of poverty and income inequality. Policymakers and health officials have rallied strongly for budgetary support for health and nutrition. Despite this, government assistance has often been diverted towards non-targeted assistance to poverty-stricken households, thus perpetuating poor nutritional aspects of the household. The 2020 Global Nutritional Report notes that one in every nine people is hungry, one in every three is overweight, and an increasing number of countries are experiencing the double burden of malnutrition, where undernutrition coexists with overweight, obesity, and other diet-related non-communicable diseases (Mannar and Micha 2020).

Global attention to malnutrition began with Millennium Development Goals (MDGs), where MDG 1 was to reduce hunger and undernutrition by half over the MDG period 2000-2015. While countries did make progress, albeit at different levels, the goal was yet to be fully achieved. In response, the 2015 United Nations Sustainable Development

Summit in New York adopted 17 Sustainable Development Goals to be delivered from2016 to 2030. Implementing strategies and action plans to achieve these goals requires more than just moral suasion from international bodies such as the United Nations. Researchers supported by policymakers must identify the critical binding constraints specific to each region and country and organize resources to address these constraints.

The Pacific region has its share of challenges, resulting in intense competition for resources to address malnutrition. The island nations are small in size, scattered over many small islands, have narrow resource bases, low per capita income, increasingly widening trade deficits, and have witnessed low levels of growth over the last three decades. Along with these economic and geographical challenges, the region has witnessed poor governance within most countries and is now grappling with another challenge beyond their control: climate change. Friel et al. (2011) and McMichael (2013) note that the effects of climate change on food and nutritional security are also likely to drive malnutrition and exacerbate the burden of diet-related NCDs. In this scenario, malnutrition is one of the many pressing areas that compete for government resources. Given that its impact is hidden and visible only in the long run, it seldom gets its fair share of resources.

While many studies have examined malnutrition amongst children, little attention has been given to the status and causes of malnutrition among the elderly. Policy making, resource allocation, and health and education facilities are all driven chiefly for children's welfare and, growth, and development. On the contrary, not much attention is paid to those who have long given their productive life to the growth and development of the country. In all fairness, after long, productive years, they need much care and support to live a dignified life as they pass through their last phase. The two most essential supports they need are adequate food with balanced nutrition and health care. Norman et al. (2021) argue that malnutrition amongst the elderly increases mortality and morbidity and contributes to a general decline in their quality of life. Now, noting United Nations' prediction that by 2050, one in six people in the world will be over age 65 (16%), up from one in 11 in 2019 (9%) (United Nations, 2019), we need to undertake region and country-specific studies on malnutrition of the elderly, identify its causes and put up a strong case for resource and policy interventions.

Therefore, first, it examines the quality of food consumed by rural households decomposed by age. Furthermore, the analysis will be extended to examine key individual, household, and farm-specific factors that contribute to the current quality of the meals consumed by these households. The second section of the paper reviews findings on nutrition status in the Pacific. The third section provides an overview of the methodology

of the study. The fourth section provides results and discussion, and the last section provides a summary and conclusion.

2. Nutritional Status of the Pacific Community: A Brief Overview

The Small Island Developing States (SIDS) are often called out for poor nutritional status, being disproportionately impacted by the triple burden of malnutrition (Hickey and Unwin, 2020). Charlton et al. (2016) argue that this status is due to overconsumption and underconsumption of energy and inadequate consumption of micronutrients, namely, overweight and obesity, nutritional deficiencies (such as anemia in women), childhood stunting, and increasing prevalence of non-communicable disease.

Secretariat of the Pacific Community (SPC), along with the World Food Programme (WFP), published a Food Security Atlas for the Pacific in 2020 and noted that the Pacific region faces the "double burden" of high undernutrition rates coupled with high obesity rates. The prevalence of overweight and obesity in some Pacific Island nations is among the highest in the world; over 80% of adults are overweight (BMI >25) in Cook Islands, Kiribati, Federated States of Micronesia, Marshall Island, Nauru, Tokelau, Tonga and Samoa. Obesity (BMI >30) rates exceed 45% in all these countries. Papua New Guinea has the lowest rates of obesity and overweight in the region at less than 15%" (SPC and WFP, 2020: 3). Mauli et al. (2023) confirm that malnutrition and food insecurity have significant social and economic impacts in small island developing states, such as the Solomon Islands. Using the Institute for Health Metrics and Evaluation (2020) report, they note that Solomon Islands malnutrition was the third leading risk factor for death and disability combined in 2017. Thornton (2023) notes from the work of a British specialist pediatrician who was posted to Kiribati in 2022 that the country has one of the highest rates of neonatal mortality in the Pacific region (i.e, 39 deaths per 1000 livebirths and argues that one of the leading causes of it is malnutrition. Severe acute malnutrition makes the children vulnerable to infections and become more malnourished because they are unwell, and thus, this becomes a vicious cycle (Thornton, 2023). Studies on Vanuatu note that the country faces the double burden of malnutrition, whereby undernutrition exists simultaneously with overweight and obesity and a high NCD burden (FAO et al., 2018; Haddad et al., 2015; and Martyn et al., 2015). The country reports a high stunting prevalence, a rate of 28.5%, for children under age 5, which is higher in rural areas (32%) than in urban areas (19%), and an adult obesity prevalence of 23.5% as compared with global estimates of 21.9% (FAO et al., 2018).

The Global Malnutrition Country Report reveals that Fiji also has a severe malnutrition problem. The report notes that 32.0% of women between the ages of 15 to 49 years are anemic, with obesity becoming a challenging issue as 38.4% of adult women (aged 18

years and over) and 28.4% of adult men are living with obesity, higher than the regional average of 31.7% for women but lower than the regional average of 30.4% for men. At the same time, diabetes is estimated to affect 21.7% of adult women and 19.1% of adult men (Global Nutritional Report, 2022). Reeve et al. (2022) make a startling revelation that most Pacific adults (88%) do not consume enough fruit and vegetables, 82% live overweight or obese, 33% live with hypertension, and 40% live with hypercholesterolemia. They argue for a nationwide campaign for the consumption of fresh produce and a reduction in sugar and salt consumption.

Hughes and Lawrence (2005) note that since 1992, many Pacific Island Countries have formulated National Plans of Action on Nutrition (NPAN) and have held several regional meetings supported by the UN to examine their food systems to implement food security and health protection measures in the Pacific. However, the rates of nutrition-related chronic diseases appear to be increasing while food security is declining (Coyne, 2000; Cannon, 2003; Lang and Heasman, 2004). This state of affairs concerning malnutrition and obesity has led to concerns about trade and the nutrition transition, a shift away from intakes of low-fat diets derived from homegrown foods such as root crops, vegetables, and river and marine food, which are available in abundance in the region to more frozen and processed foods based on refined starch and oils imported into the country (Andrew et al., 2022; Santos et al., 2019; Thow et al., 2011; Dancause, 2011 and Sievert, et. al., 2019). Haynes et al. (2022) and FAO et al. (2017) argue that the key to addressing the triple malnutrition burden is to increase sustainable, local food production that promotes intra-regional trade and links within local communities. However, an obvious challenge to this is the rapid urbanization across the Pacific as people move to towns and cities and need more space to grow food to feed themselves (Georgeou et al., 2022).

At the third International Conference on Small Island Developing States, held from 1-4 September 2014 in Apia, Samoa, the leaders at the forum noted the "Samoa Pathway", and listed 14 critical areas to be addressed immediately. Out of these 14 areas, the 5th area was Food Security and Nutrition, which noted seven concrete actions to advance food and nutritional security in their respective countries, which are as follows:

a) To promote the further use of sustainable practices relating to agriculture, crops, livestock, forestry, fisheries, and aquaculture to improve food and nutrition security while ensuring the sustainable management of the required water resources;
b) To promote open and efficient international and domestic markets to support economic development and optimize food security and nutrition;
c) To enhance international cooperation to maintain access to global food markets, particularly during periods of higher volatility in commodity markets;

d) To increase rural income and jobs, with a focus on the empowerment of smallholders and small-scale food producers, especially women;
e) To end malnutrition in all its forms, including by securing year-round access to sufficient, safe, affordable, diverse and nutritious food;
f) To enhance the resilience of agriculture and fisheries to the adverse impacts of climate change, ocean acidification, and natural disasters; and,
g) To maintain natural ecological processes that support sustainable food production systems through international technical cooperation (United Nations, 2014: 15).

The Pathway reflects the magnitude of the problem and, in summary, calls for a transition back to the consumption of locally available fresh produce vis-à-vis imported processed foods. While these actions require a substantial number of resources to be allocated for mitigation works, the Pacific region needs a sound nutrition monitoring system to develop and strengthen policies and actions so effective interventions can be made, resources are not duplicated, and regular updates are received on progress made (Tolley et al., 2016).

3. Methodology

3.1. Data Source and Survey Period

This study utilizes the latest Fiji Agriculture Census (FAC) 2020 data. The FAC 2020 was designed, pilot-tested, and administered under the purview of the author of this paper. Prior to the design of the questionnaire, the analytic plan was specified, and all data-driven analyses were clearly identified and discussed appropriately. In 2019, the survey instrument, the survey questionnaire, was designed, pilot tested, and enumerators selected and trained. The questionnaire had thirteen sections. These sections were arrived at after finalizing the various hypotheses to be tested. The sections are as follows: Section 1: Household Composition; Section 2: Housing Particulars; Section 3: Land; Section 4. Crops on Farm Land; Section 5: Livestock; Section 6: Forestry; Section 7: Fishing; Section 8: Aquaculture; Section 9: Climate Change and Challenges; Section 10: Equipment; Section 11: Agriculture Services; Section 12: Food Security; and, Section 13: Labor.

Fiji Agriculture Census was undertaken from 10 to 29 February 2020, covering 70,991 agricultural households in the rural sector and selected peri-urban boundary areas where agricultural activities are commonly practiced. This comprises 99.1% of the households interviewed in rural and peri-urban areas where agriculture is commonly practiced. This was the first time that all four sub-sectors of agriculture: crop, livestock, fisheries, and forestry were covered on a complete enumeration basis. For this survey, a *household* is defined as a small group of persons who share the same living accommodation, contribute their income and wealth to acquire certain goods and services, and share the same eating arrangement. An "agricultural household" is defined as a household where the main

economic activity identified is farming, i.e., it practices any agricultural activity (such as crop, livestock, fisheries, and forestry) during the reference period of the 2020 (Fiji Agriculture Census, 2020 FAC).

The 2020 FAC reveals that 15.4% of the farmers are 60 years and above. This is much higher than the national average of 9.1% in 2017, which increased from 7.5% in 2007 (Fiji Bureau of Statistics, 2020). The disparity is because many younger people migrate to urban areas, thus leaving their parents to look after the farm. Using a sample of 63601, who responded to the question of quality of meals, Table 1 reveals meal quality by age group. The results show that farmers in higher age brackets primarily consume unbalanced meals. Of those 60 years and above, only 17.1% consume balanced meals always, while 20.6% consume balanced meals sometimes. The rest, 62.3%, reveal they never consume nutritionally balanced meals.

Table 1: Quality of Meal by Age

Quality of Meal	No	Percentage
Years: 19 to 29		
Balanced three meals in a day: Never	4431	32.6
Balanced three meals in a day: Sometimes	3846	28.3
Balanced three meals in a day: Always	5312	39.1
Total	13589	100.0
Years: 30 to 39		
Balanced three meals in a day: Never	5092	35.8
Balanced three meals in a day: Sometimes	3835	27.0
Balanced three meals in a day: Always	5277	37.2
Total	14204	100.0
Years: 40-49		
Balanced three meals in a day: Never	4707	36.4
Balanced three meals in a day: Sometimes	3475	26.9
Balanced three meals in a day: Always	4743	36.7
Total	12925	100.0
Years: 50-59		
Balanced three meals in a day: Never	4756	36.0
Balanced three meals in a day: Sometimes	3545	26.8
Balanced three meals in a day: Always	4927	37.2
Total	13228	100.0
Year: 60 and above		
Balanced three meals in a day: Never	6012	62.3
Balanced three meals in a day: Sometimes	1991	20.6
Balanced three meals in a day: Always	1654	17.1
Total	9657	100.0

Source: Analysis from 2020FAC raw data.

These farmers are engaged in full-time farming, with 65% having farms that are 1 hectare or less in size (Ministry of Agriculture, 2022).

3.2. Theoretical Model

In this study, we wish to estimate and explore the relationship between a dependent variable and a number of explanatory variables, such as:

$$y^*_i = \beta' x_i + \varepsilon_i \ldots. \quad (1)$$

Where y_i= response variable, which can take any value, and the subscript i refers to the observation number; β_i= refers to a vector of parameters to be estimated; x_i = refers to a set of explanatory variables; ε_i = refers to the disturbance assumed to be independent across observations. Standard Ordinary Least Squares (OLS) model estimation can be undertaken when the dependent variable is normally distributed. This, however, is not the case for this study. The dependent variable is not normally distributed but ordinal. Where the dependent variable is in two categories only, a Binary Choice model, Logit or Probit model could be estimated. Where the dependent variable is of more than two categories, then the Ordinal Logit or Probit models can be estimated to ascertain the values of the vector of parameters. Following Zhang, et al. (2015), the basic form of the Ordered Logit model is as follows:

$$P\ (y=j/x_i) = \frac{1}{1+\exp[-(\boldsymbol{\alpha}+\boldsymbol{\beta X_i})]} \quad (2)$$

Where y represents a dependent variable, and the value is assigned to y (j=1,2,…,n); n is the sample size., x_i is a factor I (i=1,2,….m) is the explanatory variables; m is the number of the variables. As noted in Zhang, et al (2015), the cumulative model is established as follows:

$$\text{Logit}\ (P_j) = \ln [\ P(y \leq j) / P(y \geq i+1)] - \alpha_j + \beta x \quad (3)$$

Where P_j is the probability of occurrence of the dependent variable; $P_j = P(y=j)$, j=1, 2,3; $x1, x2, \ldots, x_m^T$ represents a set of independent variables; α_j is the intercept of the model; β represents a set of corresponding regression coefficients. As noted in Zhang, et al (2015), after the parameter estimation, the probability of occurrence in some specific cases can be obtained by the following formula:

$$P\ (y \leq j/x) = \frac{\exp[-(\boldsymbol{\alpha_j}+\boldsymbol{\beta X_i})]}{1+\exp[-(\boldsymbol{\alpha_j}+\boldsymbol{\beta_x})]} \quad (4)$$

The vector of β parameters is estimated by the Maximum Likelihood method. Early papers on regression models for ordinal data include McKelvey and Zavoina (1975), McCullagh (1980), and Winship and Mare (1984) while some of the recent paper include Eboli, et al.

(2016), Eboli and Mazzulla (2009) and Zhang, et al. (2018).The paper of Fullerton (2009) reviews ordered logistic regression models and their use in sociology. The textbook of Agresti (2010) thoroughly treats ordinal data, while O'Connel (2006) provides applied researchers in the social sciences with accessible and comprehensive coverage of analyses for ordinal outcomes. Other valuable books devoted to ordinal outcomes are Johnson and Albert (1999) in a Bayesian perspective and Greene and Hensher (2010) in the setting of choice theory. Books on statistical modeling often have a chapter on ordinal regression models, for example, Long (1997), Skrondal and Rabe-Hesketh (2004) and Hilbe (2009).

3.3. Empirical Model: Ordered Logit Regression Model (OLR)

As explained in the preceding section, the ordered logit regression model (OLR) is applied to determine the relationship and determinants of the quality of food consumed by several explanatory variables:

$$Logit\ BFS_i = \beta_0 + \beta_1 Gen_1 + \beta_2 HHS_2 + \beta_3 AG_3 + \beta_4 LA_4 + \beta_5 CCObs_5 + \beta_6 OFFEm_6 \quad (5)$$

where: BFS= Balanced food status is measured from 0= Very poor nutrient meal to 2= Highly balanced meal. Details are as follows:

0= Never consume balanced three meals in a day.
1= Sometimes consume balanced three meals in a day.
2= Always consume balanced three meals in a day.
Gen= Gender measured, 0= Female, 1= Male.
HHS= Household size is measured in the number of persons living and eating together.
AG= Age of the respondent measured in years;
OFEm= Off-farm employment is measured as 0= if no one from the household is working outside the farm on a full-time basis and 1= if any household member is working outside the farm full-time.
CCObs=Measured in terms of the number of changes/impacts noted on the farm over the last 12 months from 0= no changes/impact to 9= 9 changes from the list below:

1) Loss of soil fertility
2) Decline in crop yield
3) New pest and disease
4) Increased Soil erosion
5) Reduced water quality and supply
6) Change in the cropping season
7) Increased weather uncertainty

8) Increased Drought
9) Saltwater intrusion

LA= Land area under agriculture measured in hectares.

The descriptive statistics of the variables are provided in Table 2.

Table 2: Descriptive Statistics

Variables	Mean	St. Dev	Min	Max
BFS	0.9514	0.8574	0.0	2.0
Gen	0.9023	0.2968	0.0	1.0
HHS	4.2086	2.1629	1.0	25.0
AGE	43.277	14.496	19.0	94.0
OFEmp	0.6042	1.0102	0.0	11.0
LA	2.2614	55.2896	0.800D-06	8890.9
CCObs	4.387793	2.8667	0.0	9.0

A priori, the following signs are expected from the explanatory variables. The Gender (Gen) variable is expected to have a positive sign indicating that males are more likely to have balanced meals due to the prevalence of a patriarchal society in Fiji. The Household Size (HHS) variable is expected to be a negative sign indicating that larger households will be more likely to have less balanced meals due to more considerable food expenditure. The Land under Agriculture (LA) variable is expected to have a positive sign, implying that larger farms will provide more food and income, which can provide balanced nutrition. The Off-Farm Employment (OFEmp) variable is expected to have a positive sign, implying that additional income from off-farm employment can assist in providing balanced nutrition. The Climate Change Impact (CCObs) variable is expected to be negative, implying that the more observed changes on the farm due to climate change, the less likely to have balanced nutritional meals. Lastly, the Age (AG) variable is expected to be positive, implying that older people are served more balanced and nutritious meals.

4. Results and Discussion

The results of the Logit Balanced Food Nutritional Status model are presented in Table 3 below. The results are highly robust, with all variables significant at 1%. The Gender variable is positive, implying that males, relative to females, are 1.6% more likely to have a balanced meal. This result is very concerning given that females in Fijian households work long hours and thus could severely impact their health status. The Household size variable is negative, implying that larger households are likely, 2.2%, not to have balanced meals. The reason is that larger households place additional pressure on the limited household budget.

Table 3: Ordered Logit Model for Food Nutritional Status

Variable (Dep Variable: BFS)	Coefficient	Standard Error	Marginal Effects (Prob Y=2)
Constant	0.9656***	0.0227	
GEN	0.0458***	0.0157	0.0164***
HHS	-0.0620***	0.0023	-0.0224***
LA	0.0008***	0.0002	0.0003***
CCObs	-0.0348***	0.0016	-0.0124***
OFFEmp	0.4307***	0.0049	0.1555***
AG	-0.0128***	0.0003	-0.0046***

Note: *** ==> Significance at 1% level and estimation based on N = 63601. Log likelihood function -63987.30, Rest. log likelihood -69022.09, Chi squared [6] (P= .000) 10069.57, Significance level 0.0. McFadden Pseudo R-squared 0.0729.

The Land area variable has a positive sign implying that larger farms are more likely to provide more food and income and thus balanced meals. The longer-term implication is that as land parcels are passed on to the next generation, they are divided amongst the children, and therefore, farm size falls. Smaller farms will have implications on household nutrition. As leases expire in an area, and farmers leave for urban areas or migrate, these parcels of land can then be amalgamated into single leases before leasing out. This will increase farm size and contribute to improved food security and nutrition. Creating larger parcels will also assist in transitioning to commercial agriculture farming. The climate change variable is negative, implying that those farms affected by climate change are likely (1.2%) to provide poorly nutritious meals. This calls for immediate mitigation to protect the vulnerable rural and coastal communities. The doable mitigation works include drainage provision and river bank and coastal protection works. Not only will this improve households' nutrition, but it will also prevent farmers' erosion of arable land. The Off-farm employment variable is positive, implying that a household with a member working off-farm and thus bringing in additional income has a high likelihood, 15.6%, of providing balanced meals. The policy implication from this result is that the government should incentivize the private sector to establish commercial/industrial and service operations closer to rural areas so that rural household members can participate in it without migrating to urban centers. A household member working in the formal sector acts as social security for the household, as farm incomes are volatile. A successful example is the tourism sector around the coastal and small islands. It has successfully retained its area's rural/coastal and island population by employing them in various positions. At the same time, the other members are engaged on their farms to supply fresh produce to the hotel and the urban centers and for exports. Lastly, the Age variable is negative and highly significant, implying that older people are less likely to have balanced meals. The

marginal effect shows that the likelihood of getting a poor, unbalanced meal is 0.5% for every year of additional age. This is a significant revelation: all the studies previously focused on children's nutrition, while the elderly, who have worked hard during their productive days, received no attention. With this result, government support for rural dwellers can be fine-tuned to include elements of nutrition, a voucher specifically for fruits and cereals, and multivitamin tablets, which could go a long way to improve the health and nutrition status of the elderly.

5. Summary and Conclusion

There is a growing concern throughout the world about increasing incidences of malnutrition and non-communicable diseases. The Pacific region has been signaled out as one of the regions with the worst cases of malnutrition and NCDs. While many studies have been undertaken to determine the extent of malnutrition, it has been limited to examining the level of malnutrition and on children in particular. This paper utilizes Fiji's latest Agriculture Census data to examine some household and farm-specific determinants of malnutrition. The results present some significant revelations. It demonstrates that females are more likely to receive poor nutrition; hence, targeted measures are required to improve their nutrition. Smaller farms are less likely to provide balanced meals. The situation can worsen in the future, given that farm sizes are falling over time, and malnutrition can worsen. As suggested, this trend can only be reversed by amalgamation of leases when it expires, and lessors are unwilling to continue. The new, more significant farm lease, with larger acreage, can then be offered to new farmers who can have higher production and improve household nutrition.

The results also demonstrate the challenges posed by Climate change which exacerbates the issue of malnutrition via its effect on reduction in both land area and land quality thus affecting production. Governments must allocate resources and mitigate climate change impacts such as flooding, river bank erosion, and coastal erosion. The study also reveals that older people are likelier to have meals that are not balanced in nutrients. Apart from the above suggestions, off-farm employment can greatly help provide balanced meals as it provides additional income to the household. Furthermore, this study builds a case for females and aged farmers to be assisted by the government as part of the government pension for those who have not worked in the formal sector and thus are not on social pension. Current government pensions have cash transfers for recipients to spend on goods or services. A compulsory nutrient component could be topped up, enabling the recipients to buy nutrient-enhancing foods.

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