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Food Expenditure Patterns and Dietary Diversity in Nepal

Is Dietary Quality Improving?

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INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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Contents

Tables

Figures

ABSTRACT

The paper measures dietary diversity among different income groups in Nepal and identifies the drivers of this diversity as a first step toward addressing the widespread prevalence of nutrient deficiency. The level of diversity in household diets is an indirect measure of dietary quality and the extent to which the nutritional needs of households are being met. However, there is limited understanding of the trends, patterns, and determinants of dietary diversity in Nepal. This study is an attempt to enrich the literature on this issue. Drawing on unit-level data from three rounds (1995, 2004, and 2011) of the Nepal Living Standards Survey (NLSS), we use multilevel modeling, quantile regression, and the Blinder-Oaxaca decomposition method to decipher the trends, determinants, and drivers of dietary diversity in Nepal. Our study finds that changes in household sociodemographic and agricultural characteristics are very important in explaining the improvement in dietary quality. Changes in household characteristics account for at least 37 percent of the observed improvement, and agriculture-related changes explain at least 16 percent of the observed improvement. Variables positively associated with dietary quality are remittances, social cash transfers, parents' education, crop diversity, access to markets and paved roads, and ownership of a television and telephone, among others. Our findings are highly robust across the different model specifications. Our study concludes by calling for a multisectoral approach to tackle nutrition issues in Nepal.

Key words: Dietary diversity, consumption expenditure, multilevel model, Nepal

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1. INTRODUCTION

Widespread prevalence of nutrient deficiency and poor nutritional outcomes have been a major concern in developing countries (Smith and Haddad 2000; Kumar et al. 2016; Kumar et al. 2017; Cunningham et al. 2017). The majority of households, especially in rural areas in such countries, rely on cheap diets dominated by starchy staples, with a meager share of fruits, vegetables, and animal and plant proteins (Ruel and Menon 2002). Individuals in these households are often unable to meet the micro- and macronutrient consumption levels required for proper growth and development.

Dietary diversity is conceived as a health-related indicator of dietary quality and is associated with adequate nutrient/micronutrient intakes (Hatløy, Torheim, and Oshaug 1998; Steyn et al. 2006; Kennedy et al. 2007; Arimond et al. 2010; Kumar et al. 2016), household calorie availability (Ruel 2003), improved child and adult nutritional status (Kant 2004; Arimond and Ruel 2004; Rah et al. 2010; Disha et al. 2012; Ruel and Menon 2002; Kumar et al. 2017), increased birth weight (Rao et al. 2001), improved hemoglobin concentration (Bhargava, Bouis, and Scrimshaw 2001), reduced hypertension incidence (Miller, Crabtree, and Evans 1992), and reduced mortality rates (Bernstein et al. 2002; Lee et al. 2011; Marshall et al. 2001). Moreover, dietary diversity is widely used as a tool for measuring food security (Hoddinott and Yohannes 2002; Ruel 2003), and all three pillars of food security—availability, accessibility, and utilization—are positively linked with dietary diversity (Styen et al. 2006; Hillbruner and Egan 2008). In fact, understanding household dietary diversity can lead to new insights regarding how to address global food-security concerns (Rashid et al. 2011).

Given the importance of dietary diversity in improving dietary quality, there is a growing literature on the determinants of dietary diversity. Sharma and Chandrasekhar (2016) found that dietary diversity is higher among rural–urban commuters than noncommuters in India. Farm production diversity is associated with greater household dietary diversity in India (Kumar et al. 2016, Malawi (Jones, Shrinivas, and Bezner-Kerr 2014), and Zambia (Kumar, Harris, and Rawat 2015). Oyarzun et al. (2013) found a positive and significant relationship between farm size and household dietary diversity.

Bhagowalia, Headey, and Kadiyala (2012) found irrigation, crop diversity, and ownership of livestock to influence household dietary diversity in India. Behrman and Deolalikar (1990) found a positive elasticity of dietary diversity with respect to favorable financial transfers, suggesting that income influences dietary diversity, and the literature suggests a positive association between dietary diversity and income (Ruel and Menon 2002; Rashid et al. 2015). Beyene, Worku, and Wassie (2015) found maternal education and kitchen gardening to be important determinants of dietary diversity in northwest Ethiopia. Against this backdrop, we examine the food expenditure patterns and trends in dietary diversity, based on household-level data from three rounds (1995, 2004, and 2011) of the Nepal Living Standards Survey (NLSS). We also identify the factors responsible for the spatial and temporal variation in dietary quality (nonstaple foods and dietary diversity) in Nepal.

Nepal is an interesting case study for understanding dietary quality issues because of its high reliance on energy-dense staple foods (CBS 2011), its historically poor child nutrition outcomes, and its status as an impoverished country with increasing food deficits and high political instability. However, Nepal has recorded the fastest reduction in child stunting in the world in recent years. Between 2001 and 2011, the child-stunting rate fell from 56 percent to 41 percent (Nepal, MOHP 2011). Similarly, the share of food expenditure devoted to staples decreased by 32 percent between 1995 and 2011. However, the transition in food consumption patterns and dietary diversity in Nepal has not been studied adequately. To our knowledge, this is perhaps the first empirical study on dietary quality in Nepal.

Our study contributes to the existing literature on dietary quality on several fronts. First, we incorporated extensive variables at the community and district levels in addition to those at the household level. Second, we employed multilevel models to account for heterogeneity. Third, we used the Blinder-Oaxaca decomposition approach (Blinder 1973; Oaxaca 1973) to better understand the predicted sources of dietary quality improvement over time (from 1995 to 2011). By including a wide range of variables and modeling heterogeneity, we have achieved results that yield reliable inferences and are less prone to omitted variable bias. Our findings are expected to help policy makers, the nutrition community, and

development agencies in formulating suitable policies to improve dietary quality, food security, and nutrition outcomes in Nepal and similar developing countries.

This paper is organized as follows. Section 2 discusses the sample size and data sources. Section 3 discusses the status of and trends in dietary diversity. Section 4 describes the empirical framework of our multilevel model, the variables and descriptive statistics used in the analysis, and the results. Section 5 examines the factors influencing the observed improvement in dietary quality. Section 6 conducts robustness checks of the empirical results. Finally, Section 7 explores the policy implications of the study.

2. DATA

We used three rounds of data from the Nepal Living Standards Survey (NLSS) conducted by the Central Bureau of Statistics in 1995, 2004, and 2011. In these surveys, a two-stage stratified random sampling technique was used to select the samples. Using a well-designed questionnaire, trained enumerators collected information on households' demographic characteristics, assets, agricultural characteristics, food expenditures and consumption, migration history, nonfarm activities, and access to basic facilities. The NLSS datasets also provide information on price indexes at the community level.

A total of 12,019 households were included in the analysis—3,044 households in 1995; 3,234 households in 2004; and 5,741 households in 2011. We complement the household survey data with district-level information on road density, proportion of all-season roads, annual average rainfall, and urban population density. The road information was procured from the Department of Roads and the annual rainfall data from the Department of Hydrology and Meteorology. Data on urban population density were extracted from the 1991, 2001, and 2011 Nepal Censuses.

3. FOOD EXPENDITURE PATTERNS AND DIETARY DIVERSITY

Various indicators of dietary diversity—ranging from a simple count of food varieties and groups consumed to a listing of the types and frequency of foods consumed by household members—are used in the literature. Recent studies have examined patterns in household spending on different food groups to determine dietary diversity (Karamba, Quiñones, and Winters 2011; Nguyen and Winters 2011; Sharma and Chandrasekhar 2016; Kumar et al. 2016; Kumar et al. 2017).

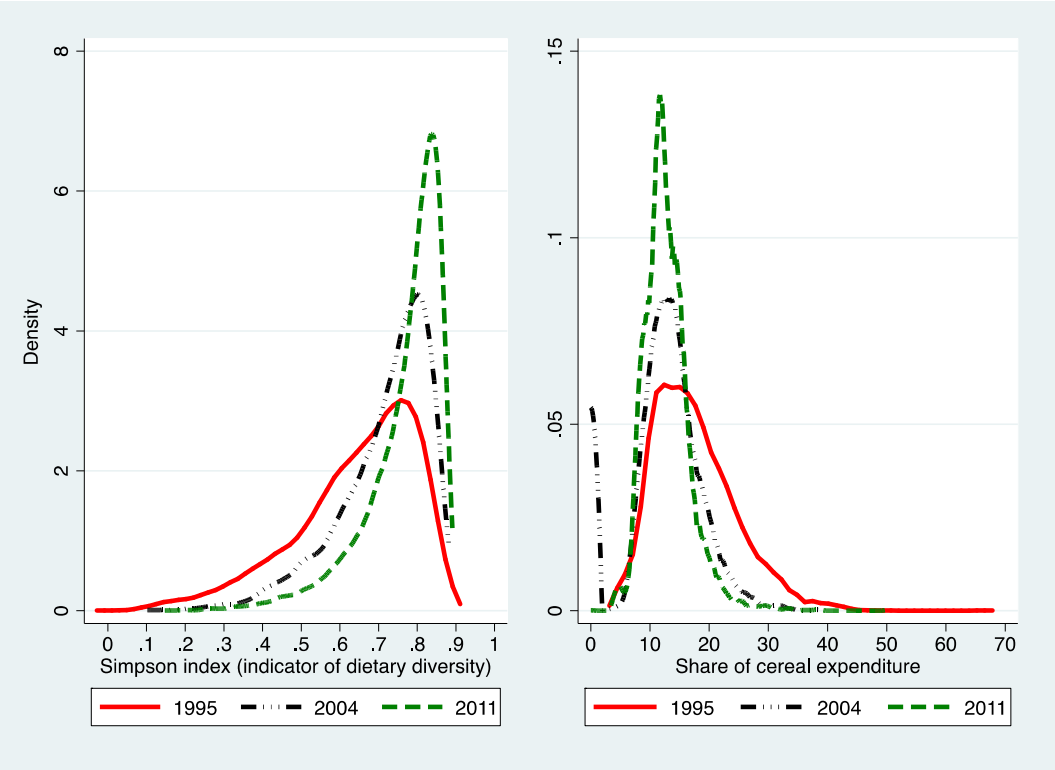
Since we do not have information on the quantities and frequency of food consumed by everyone in a household, we computed the Simpson index (SI) using the monthly expenditure shares of various food items. While calculating the food expenditure shares, we considered the value of food consumed at home as well as food purchased from markets. We selected 11 food groups (cereals, legumes/pulses, eggs, milk / milk products, fat/oil, vegetables, fruits, fish, meat, spices/condiments, and sugar / sugar products) to compute the dietary diversity. We computed the SI as $1 - \sum_i^{11} s_i^2$, where s_i is the expenditure share of a given food subgroup ($i = 1, \ldots 11$). The SI accounts for both richness (number of foods) and evenness (distribution of food expenditure share). The index lies between 0 and 1. Here, a value of 0 suggests that a household has consumed only one food item, while a higher value, possibly approaching 1, indicates more food items and more even shares. We also considered expenditure shares of nonstaple foods (fruits and vegetables and animal and plant proteins) as indicators of dietary diversity (quality).[1] In the case of animal proteins, we included eggs, milk / milk products, fish, and meat. For plant proteins, we included legumes and pulses.

We examined the status and extent of dietary diversity at the aggregate level and based on the agroecological zone, region (urban versus rural), landholding status (owned land versus landless), type of farm, poverty status (poor versus nonpoor), and ethnicity. Table 3.1 shows the status of dietary diversification in Nepal. The SI increased between 1995 and 2011, suggesting an improvement in dietary quality and food security in Nepal. Among food commodities, cereals represented the highest share of

[1] Sometimes dietary diversity and dietary quality have been interchangeably used.

food expenditure on average (42 percent), followed by meat (11 percent), vegetables (10 percent), milk (8 percent), fruits (7 percent), and pulses (7 percent). Between 1995 and 2011, a remarkable reduction in the expenditure share of cereals is observed. As shown in Figure 3.1, the distribution of the expenditure share of staple foods shifted to the left, while the SI shifted to the right over time, suggesting a significant improvement in dietary quality. The two-sample Kolmogorov-Smirnov test for equality of distribution functions suggests that the SI and cereal expenditure share across years do not have the same distribution function. We observed a significant increase in the expenditure share of fruits, meat and milk. These statistics suggest increasing consumption of high-value products in Nepal.

Figure 3.1 Dietary transition in Nepal



Source: NLSS (1995, 2004, 2011).

Table 3.2 (left panel) shows the status of dietary diversification based on agroecological zone. Overall, the SI was highest in the hilly region, followed by the Terai and mountain regions. The expenditure share of cereals was highest, followed by meat and vegetables, while the expenditure share of fish was lowest, followed by eggs and sugar / sugar products. The expenditure share of cereals decreased over time while the expenditure shares of fruits and meat increased over time in all agroecological regions. Hoddinot and Yohannes (2002) indicate that when households diversify their diets, they increase the consumption share of nutrient-dense foods instead of staple food varieties.

Table 3.1 Food expenditure patterns and dietary diversity in Nepal, 1995–2011

Commodities	1995	2004	2011
Share of different commodities in food expenditure (%)			
Cereals	51.76	42.97	35.42
Pulses	6.22	5.98	7.29
Eggs	0.79	0.83	1.25
Milk	6.58	9.10	8.57
Oil	6.75	7.74	7.18
Vegetables	9.81	10.75	9.32
Fruits	4.67	6.07	8.77
Fish	1.22	1.60	1.86
Meat	8.05	10.26	13.66
Spices/condiments	3.55	3.87	4.71
Sugar	0.58	0.83	1.98
Simpson index (food expenditures)	0.65	0.72	0.77

Source: Author's calculations based on NLSS datasets.

Table 3.2 (right panel) illustrates the status of dietary diversification in rural areas. dietary diversity as indicated by the SI was slightly higher in urban regions. This is not surprising, as urban consumers have quicker access to markets and can purchase more diverse food products than can rural consumers, who mainly depend on their own production. Among rural consumers, the expenditure share was higher for cereals and lower for vegetables, fruits, and meat. This is evidence of the cereal-dominated diets of rural consumers.

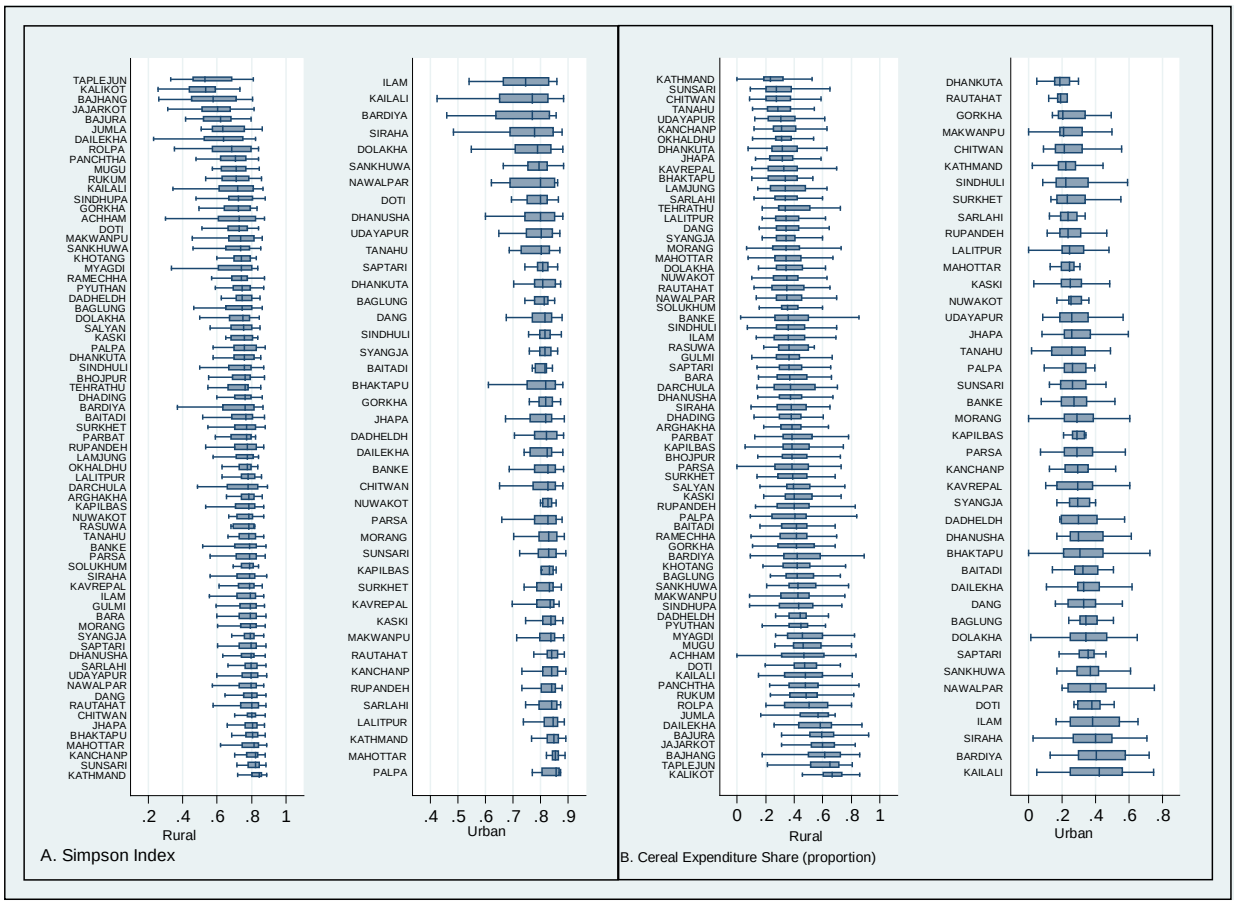
Figure 3.2 shows the distribution of the SI and cereal expenditure shares between rural and urban consumers for all districts of Nepal. The horizontal bar graph shows the lowest, 25th percentile, median, 75th percentile, and highest values of the SI and cereal expenditure shares in a district. Among urban households, the average SI was higher, while the average cereal expenditure share was lower and had a tighter distribution.

Table 3.2 Status of dietary diversity and food expenditure patterns in different agroecological regions, rural and urban locations of Nepal, 1995–2011 (%)

	Agroecological Region									Rural and Urban Location					
	Mountain			Hills			Terai			Rural			Urban		
Indicators	**1995**	**2004**	**2011**	**1995**	**2004**	**2011**	**1995**	**2004**	**2011**	**1995**	**2004**	**2011**	**1995**	**2004**	**2011**
Share of different commodities in food expenditure (%)															
Cereals	59.71	51.33	45.03	47.71	40.77	34.16	54.99	43.25	35.48	55.18	43.48	39.33	39.44	36.00	28.00
Pulses	4.74	4.13	5.10	5.95	5.67	7.04	7.14	6.85	8.01	6.09	5.96	6.82	6.71	5.75	8.19
Eggs	0.60	0.52	1.05	1.08	0.96	1.43	0.44	0.77	1.05	0.54	0.77	0.95	1.70	1.60	1.83
Milk	5.41	8.39	6.65	8.00	10.74	9.17	4.88	7.36	8.08	5.96	9.04	7.80	8.81	10.51	10.03
Oil	6.55	6.60	6.78	7.63	7.84	7.25	5.50	7.95	7.16	6.35	7.84	7.47	8.19	5.58	6.63
Vegetables	8.38	9.10	8.99	10.29	10.93	8.97	9.62	10.99	9.85	9.22	10.64	8.99	11.94	12.14	9.95
Fruits	2.37	3.14	5.19	4.65	6.02	8.37	5.52	6.94	9.92	4.15	5.88	7.62	6.57	8.73	10.94
Fish	0.77	0.82	1.18	0.84	1.17	1.47	1.94	2.33	2.51	1.23	1.58	1.67	1.20	1.67	2.22
Meat	7.84	12.21	14.71	9.75	11.11	15.58	5.62	8.70	10.86	7.31	10.24	13.43	10.74	11.02	14.09
Spices/condiments	3.10	3.33	4.19	3.70	3.98	4.71	3.49	3.90	4.79	3.39	3.80	4.35	4.13	5.06	5.37
Sugar	0.54	0.42	1.13	0.40	0.81	1.85	0.87	0.97	2.29	0.58	0.76	1.57	0.59	1.94	2.74
Simpson index	0.57	0.65	0.70	0.68	0.73	0.77	0.62	0.72	0.78	0.62	0.71	0.74	0.75	0.77	0.81

Source: Author's calculations based on NLSS datasets.

Figure 3.2 Distribution of dietary diversity across rural and urban households in Nepal



Source: CBS (2011).

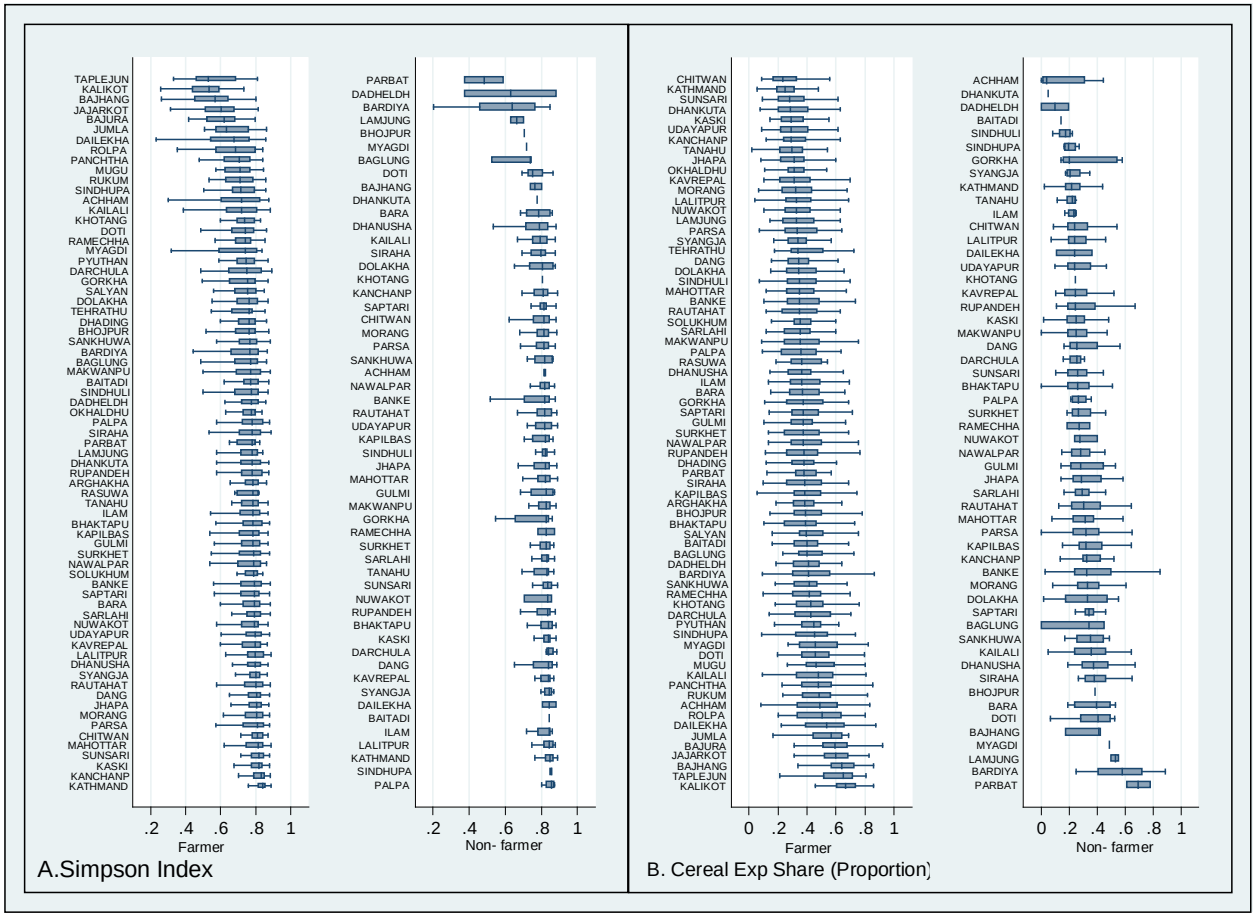
The status of dietary diversification based on a rural household's landholding status reveals an interesting picture (left panel of Table 3.3). For both landowning and landless households, the average cereal expenditure share decreased across time while the share of expenditures devoted to nonstaple foods increased. We find mixed results: for some nonstaple foods, landless households had higher expenditure shares than landowning households. The SI was higher for landless households than landowning households. One of the reasons could be that landless households may derive more income from off-farm opportunities than the majority of marginal farmers. Figure 3.3 shows that the SI was higher for nonfarmers while the cereal expenditure share was higher for farmers.

Table 3.3 Status of dietary diversity and food expenditure patterns by farming and nonfarming households of Nepal, 1995–2011 (%)

	Farming and Nonfarming (Rural) Households						Farming Households											
	Landless			Own land			Marginal			Small			Medium			Large		
Indicators	1995	2004	2011	1995	2004	2011	1995	2004	2011	1995	2004	2011	1995	2004	2011	1995	2004	2011
	Share of different commodities in food expenditure (%)																	
Cereals	55.52	40.13	33.94	55.14	44.08	40.13	54.78	47.06	40.37	54.61	44.50	38.66	53.48	41.83	36.56	51.36	37.81	30.24
Pulses	6.34	6.56	7.70	6.06	5.86	6.69	5.77	5.72	6.86	5.71	5.92	7.07	6.21	5.90	6.85	7.06	6.17	7.75
Eggs	0.65	1.33	1.46	0.53	0.67	0.87	0.58	0.73	1.11	0.66	0.69	0.93	0.61	0.64	0.86	0.55	0.78	1.04
Milk	4.29	7.37	6.15	6.17	9.33	8.04	5.15	7.64	7.11	6.61	9.27	8.31	7.09	10.65	9.88	7.31	11.41	11.07
Oil	6.08	6.70	6.63	6.38	8.04	7.60	6.40	7.61	7.17	6.54	8.04	7.85	6.53	8.26	7.84	6.69	8.27	7.66
Vegetables	8.98	11.71	10.18	9.25	10.45	8.82	9.92	10.37	8.86	8.84	10.51	9.00	9.37	10.56	8.85	9.80	10.58	10.04
Fruits	4.17	6.92	9.49	4.15	5.70	7.35	3.95	5.16	7.26	3.99	5.17	7.79	4.60	6.17	8.54	5.62	8.72	11.02
Fish	2.11	2.38	2.89	1.12	1.44	1.49	1.00	1.55	1.56	0.98	1.28	1.50	1.20	1.33	1.54	1.41	2.13	1.97
Meat	7.22	10.89	13.49	7.32	10.13	13.42	8.19	9.60	13.64	7.88	10.38	13.10	7.22	10.53	13.48	6.64	9.77	12.68
Spices/condiments	3.96	4.84	5.57	3.32	3.62	4.17	3.67	3.76	4.46	3.66	3.68	4.18	3.11	3.48	4.05	2.84	3.48	4.30
Sugar	0.68	1.17	2.51	0.57	0.68	1.43	0.59	0.80	1.61	0.53	0.57	1.59	0.00	0.00	0.00	0.72	0.89	2.23
Simpson index	0.62	0.74	0.78	0.62	0.71	0.74	0.62	0.69	0.74	0.62	0.71	0.75	0.63	0.72	0.76	0.65	0.75	0.79

Source: Author's calculations based on NLSS datasets.

Figure 3.3 Distribution of dietary diversity across farmers and nonfarmers in Nepal



Source: CBS (2011).

Table 3.3 (right panel) presents the status of dietary diversification among different categories of farming households.[2] The SI was highest for large farms and lowest for small farms, indicating a positive relationship with farm size. For all farm types, the SI increased over time, indicating the increasing dietary diversity trends. Cereal expenditure share decreased over time for all farm types, suggesting the shift toward noncereal diets. As expected, the share of cereal expenditure was highest among marginal farms, followed by small, medium, and large farms. The cereal expenditure share was higher for farmers.

[2] Households farming less than 0.33 hectares are categorized as marginal farms, between 0.33 and 0.66 hectares are categorized as small farms, between 0.66 and 2 hectares are categorized as medium farms, and more than 2 hectares are considered large farms.

This could be because farmers may have relatively cheap access to staples compared to nonfarmers, since they may grow them.

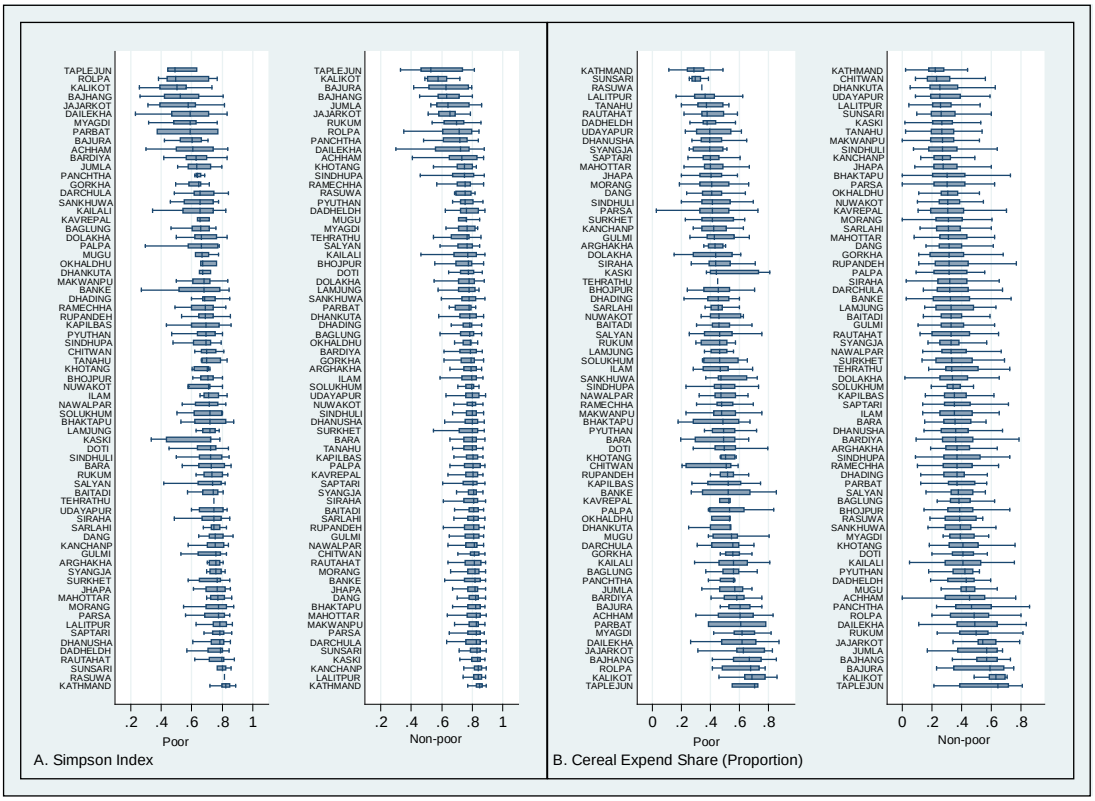
Table 3.4 illustrates the status of dietary diversification based on the poverty status of a household. We find that poor households had a lower SI compared to nonpoor households. For poor households, the share of cereal expenditure was higher while the expenditure shares of nutrient-dense food products (such as fruits, vegetables, and meats) were lower. For both poor and nonpoor households, the cereal expenditure share decreased over time. Figure 3.4 presents the distribution of the SI and cereal expenditure share for households in a district based on poverty status. The average SI was higher for nonpoor households, while average cereal expenditure share was higher for poor households.

Table 3.4 Status of dietary diversity and food expenditure patterns based on poverty status (poor versus nonpoor) of households in Nepal, 1995–2011 (%)

	Nonpoor			Poor		
Indicators	**1995**	**2004**	**2011**	**1995**	**2004**	**2011**
	Share of different commodities in food expenditure (%)					
Cereals	47.22	39.56	32.65	61.57	53.29	47.46
Pulses	6.44	6.23	7.52	5.76	5.20	6.28
Eggs	1.00	0.91	1.35	0.35	0.59	0.82
Milk	7.99	10.41	9.33	3.54	5.12	5.27
Oil	7.27	8.06	7.37	5.61	6.78	6.35
Vegetables	10.61	11.14	9.56	8.09	9.58	8.28
Fruits	5.34	6.82	9.41	3.23	3.80	5.97
Fish	1.30	1.62	1.96	1.06	1.56	1.41
Meat	8.44	10.30	13.96	7.23	10.13	12.36
Spices/condiments	3.80	4.03	4.80	3.02	3.41	4.28
Sugar	0.60	0.93	2.08	0.55	0.53	1.52
Simpson index	0.69	0.74	0.79	0.56	0.64	0.69

Source: Author's calculations based on NLSS datasets.

Figure 3.4 Distribution of dietary diversity across poor and nonpoor households in Nepal



Source: CBS (2011).

In Nepal, each ethnic group has unique food habits that are often influenced by its culture. Most Brahmin households strictly avoid meat products. Generally, households from unprivileged ethnic groups are poorer than those from other ethnic groups, which may lead to variation in dietary diversity across ethnic groups. Table 3.5 presents the status of dietary diversification based on ethnicity. The Brahmin ethnic group consumed the most diversified diet, and unprivileged ethnic groups consumed the least, as the SI was highest for the Brahmin ethnic group and lowest for unprivileged ethnic groups. The expenditure share of cereals was highest for unprivileged ethnic groups and lowest for the Brahmin ethnic group. However, for all ethnic groups, the expenditure share of cereals decreased over time.

Table 3.5 Status of dietary diversification and food expenditure patterns based on ethnicity (%)

	Chettry			Brahmin			Mongolian			Madhesi			Unprivileged		
Indicators	**1995**	**2004**	**2011**	**1995**	**2004**	**2011**	**1995**	**2004**	**2011**	**1995**	**2004**	**2011**	**1995**	**2004**	**2011**
Share of different commodities in food expenditure (%)															
Cereals	53.23	40.41	35.39	45.33	34.57	29.30	50.16	43.04	34.25	55.33	46.03	37.80	57.91	48.60	39.73
Pulses	6.09	5.95	7.04	6.60	6.21	8.24	5.61	5.29	6.90	7.31	6.63	7.49	6.22	6.48	7.29
Eggs	0.59	0.64	1.10	0.59	0.53	0.88	1.25	1.22	1.83	0.54	0.63	1.05	0.51	0.74	0.97
Milk	6.92	11.92	9.87	11.05	15.95	14.06	5.99	7.93	7.32	3.87	5.72	6.62	4.42	5.78	6.37
Oil	7.13	8.65	7.96	8.53	10.02	8.96	6.99	6.89	6.58	5.02	6.88	6.56	5.32	7.17	6.49
Vegetables	9.26	10.35	8.64	10.47	11.05	9.50	10.46	11.26	9.47	9.78	11.05	10.42	8.59	10.10	9.12
Fruits	4.32	5.86	8.24	5.91	7.81	10.55	3.59	5.52	7.99	5.71	6.94	10.04	4.48	5.56	8.51
Fish	0.93	1.27	1.50	0.79	0.84	1.17	0.96	1.32	1.67	2.06	3.22	2.80	1.71	1.99	2.39
Meat	7.60	10.53	13.91	6.66	8.24	10.49	10.81	12.73	17.43	5.86	7.97	9.91	6.77	8.95	12.40
Spices/condiments	3.36	3.69	4.45	3.58	3.93	4.48	3.79	4.00	4.86	3.57	3.89	4.95	3.34	3.81	4.74
Sugar	0.57	0.74	1.90	0.51	0.85	2.36	0.38	0.81	1.69	0.95	1.05	2.36	0.75	0.84	1.99
Simpson index	0.63	0.73	0.76	0.70	0.76	0.80	0.66	0.71	0.78	0.63	0.70	0.76	0.60	0.68	0.75

Source: Author's calculations based on NLSS datasets.

The disaggregated qualitative analysis based on region, location, income, occupation, and ethnicity reveals an explicit gradual shift in dietary patterns toward more diverse, nutrient-dense foods in Nepal. We also statistically tested whether dietary quality significantly changed over time within the following important categories: farmers, nonfarmers, rural, urban, poor, and nonpoor (Table 3.6). Unequivocally, the SI and nonstaple food expenditure share increased while cereal expenditure share decreased between 1995 and 2011 for all groups. The difference is statistically significant at less than the 1 percent level.

Table 3.6 Simpson index and cereal expenditure share in 1995 and 2011

		1995	2011	Difference	t-stat
Simpson index	Farmer	0.63	0.74	.12***	37.88
	Nonfarmer	0.70	0.81	.11***	23.66
	Rural	0.62	0.74	.13***	37.86
	Urban	0.75	0.81	.06***	17.43
	Poor	0.56	0.69	.13***	21.10
	Nonpoor	0.68	0.79	.10***	36.84
Staple food share	Farmer	55.31	38.36	-14.98***	-38.72
	Nonfarmer	45.71	27.99	-17.72***	-25.80
	Rural	55.31	39.31	-15.99***	-38.91
	Urban	40.25	27.97	-12.28***	-19.55
	Poor	61.69	47.50	-14.20***	-21.36
	Nonpoor	47.82	32.60	-15.23***	-38.48
Nonstaple food share	Farmer	35.42	48.20	-12.77***	-35.51
	Nonfarmer	42.19	57.11	-14.93***	-23.72
	Rural	34.40	47.28	-12.88***	-35.79
	Urban	46.93	57.29	-10.36***	-17.59
	Poor	29.16	40.36	-11.20***	-19.47
	Nonpoor	40.58	53.14	-12.56***	-35.13

Source: Author's calculations based on NLSS datasets.
Note: ***statistically significant at less than the 1% level.

4. DETERMINANTS OF DIETARY DIVERSITY

Empirical Framework

We employed a multilevel model to study the determinants of dietary diversity. We considered three levels: household (first level and unit of the analysis), community (second level), and district (third level). At the household level, we included socioeconomic characteristics, agricultural characteristics, and access to basic facilities as variables. Our decision to implement a multilevel model stems from the clustered and nested nature of the data: clusters of households belonging to the same community share similar topography, weather, ethnicity, food prices, wage rates, market access, and socioeconomic characteristics. Likewise, communities from the same district share similar characteristics in terms of agroecology, infrastructure, and so on, compared to communities from different districts. For such hierarchical data, a multilevel model considers the effects arising from higher levels and can better account for the heterogeneity in the data. Our full three-level random-intercept linear regression model that includes household, community, and district characteristics is expressed as follows:

$$\mathrm{DI_{ikl}} = \beta_{000} + \beta_{1kl}(\mathrm{Y2004}) + \beta_{2kl}(\mathrm{Y2011}) + \sum_{p=3}^{P} \beta_{p,kl}\, \mathrm{H_{pkl}} + \sum_{c=1}^{C_p} \beta_{0,cl}\, \mathrm{A_{c,kl}} + \sum_{n=1}^{N_{ps}} \beta_{00n}\, \mathrm{D_{n,l}} + \gamma_{00l} + \gamma_{0kl} + \mathrm{e_{ikl}} \quad (1)$$

where DI_{ikl} represents the indicator of dietary quality (the SI and expenditure shares of cereals, fruits and vegetables, and animal and plant proteins) and $Y2004$ and $Y2011$ are the dummy variables representing the years 2004 and 2011, respectively. Here, β_{000} is the average dietary quality in a sample, H_{pkl} is a vector of household characteristics, $A_{c,kl}$ is a vector of community characteristics, and $D_{n,l}$ is a district-level characteristic, while γ_{00l} is a district-level error term, γ_{0kl} is a community-level error term, and e_{ikl} is a household-level error term. All these error terms are assumed to be independently and identically distributed and are not correlated across levels. We also computed the intraclass correlation coefficient

(the observed variation in the indicator of dietary quality that can be explained by community and district levels) as follows:

$$\rho_c = \frac{\sigma_u^2}{\sigma^2+\sigma_u^2+\sigma_s^2} \quad (2)$$

$$\rho_d = \frac{\sigma_s^2}{\sigma^2+\sigma_u^2+\sigma_s^2} \quad (3)$$

where the variance of e_{ikl} is denoted as σ^2, γ_{0kl} as σ_u^2, and γ_{00l} as σ_s^2, and ρ_c and ρ_d are the intraclass correlation coefficients for the community and district levels, respectively. After estimating ρ_c and ρ_d, the proportion of variance explained at the household level can be calculated as $(1-\rho_c-\rho_d)$. Finally, we tested whether the variance components (σ_u^2, σ_s^2) are significantly different from zero. We did not consider random slopes. Any omitted variables at the district and cluster levels are captured by the unobserved heterogeneity parameters (random intercept).

The full model illustrated by equation (1) mainly examines the determinants of dietary quality. However, we are also interested in knowing what factors help explain the observed improvement in dietary quality between 1995 and 2011. To accomplish this, we first ran a parsimonious model including only the year dummy variables, as illustrated by equation (4):

$$DI_{ikl} = \beta_{000} + \beta_{1kl}(Y2004) + \beta_{2kl}(Y2011) + \gamma_{00l} + \gamma_{0kl} + e_{ikl} \quad (4)$$

Then we added household-related variables in equation (4) and examined how adding these variables changed the magnitude of the coefficient of $Y2011$. Then, we dropped household variables and did the same for agriculture, access to facilities, and community- and district-level variables. Variables leading to the greatest reduction in the coefficient of $Y2011$ in equation (4) are responsible for explaining the greatest improvement in dietary quality between 1995 and 2011.

Nevertheless, we can also use coefficients from equation (1) to understand the drivers of dietary quality change over time. Assuming the coefficients at the household, community, and district levels are time invariant, and that the error term has a mean zero, we can take the first difference of equation (1) between 2011 and 1995 as follows:

$$\Delta\overline{\mathrm{DI}}_{\mathrm{iklt}} = \beta_{\mathrm{H}}\left(\overline{\mathrm{H}}_{\mathrm{pklt=11}} - \overline{\mathrm{H}}_{\mathrm{pklt=95}}\right) + \beta_{\mathrm{A}}\left(\overline{\mathrm{A}}_{\mathrm{cklt=11}} - \overline{\mathrm{A}}_{\mathrm{cklt=95}}\right) + \beta_{\mathrm{D}}\left(\overline{\mathrm{D}}_{\mathrm{nlt=11}} - \overline{\mathrm{D}}_{\mathrm{nlt=95}}\right) \quad (5)$$

Here, bars represent sample means. Using this approach, we can know what level of the observed improvement in dietary quality is explained by the change in the time-variant variables. However, if the coefficients vary across time, then we need to use the Blinder-Oaxaca decomposition method to examine what variables explain the dietary quality change between 1995 and 2011.[3]

Definition and Descriptive Statistics

Table 4.1 defines the variables and presents the descriptive statistics for all rounds of the survey. The dependent variables of interest are the expenditure shares of cereals, fruits and vegetables, animal proteins, and plant proteins, and the SI. The SI increased from 0.64 to 0.72, while the cereal expenditure share decreased from 52.40 percent to 35.40 percent between 1995 and 2011. Similarly, the expenditure shares of fruits and vegetables, animal proteins, and plant proteins increased substantially during this period. Overall, the expenditure share of nonstaple foods increased from 36.82 percent to 50.74 percent.

About 48 percent of the total sample comes from 2011; 27 percent comes from 2004; and 25 percent comes from 1995. The dummy variables capture the yearly fixed effects. Households headed by a female are likely to spend more on expensive nutrient-dense foods (Rogers 1996). Thus, we expect female-headed households to have higher dietary diversity. The proportion of households headed by a

[3]Whether or not coefficients systematically vary across the survey rounds is tested later. For a detailed discussion on the methods and formulas of the Blinder-Oaxaca decomposition technique, please refer to Jann (2008).

male decreased from 88 percent to 73 percent between 1995 and 2011. The effect of the household head's age on dietary quality can be either positive or negative, depending on the educational and income status of the household head. In our sample, the average age of household head hovered around 44 to 46 years. Larger families can have increased dietary diversity due to the varying food preferences of household members. However, larger households may also face poverty, making them more likely to consume lower-quality food items. Thus, the effect of household size on dietary diversity is ambiguous. In our sample, the average household size decreased slightly over time. Households with a higher dependency ratio (the number of family members under age 16 and over age 65, divided by family size) can have lower dietary diversity due to fewer people contributing to the total household income. However, if a family member older than 65 receives a pension, social transfer, or retirement fund payment, the household may have higher dietary diversity. The average dependent ratio decreased from 0.42 to 0.38 between 1995 and 2011. Migrated households, especially those migrating from rural to urban regions or from mountainous/hilly regions to the Terai region, can be better off in terms of access to basic facilities. As a result, such households are likely to have good-quality diets. The percentage of migrated households increased from 13 percent to 50 percent between 1995 and 2011. The literacy rate increased by about 16 percent for fathers and 25 percent for mothers between 1995 and 2011. Since women are typically more involved in food preparation, educated mothers select higher-quality foods rich in micronutrients (Smith and Haddad 2000). We included the education-related variables for both fathers and mothers to examine whether mothers' education matters more for improving dietary quality. Every ethnic group has its own food habits. We controlled for the ethnicity variable. In 2011, Brahmin families represented 16 percent of the sample, Chhetry families represented 19 percent, Mongolian families represented 31 percent, Madhesi families represented 10 percent, and unprivileged families represented 25 percent.

The asset-related variables such car, telephone, and TV ownership were included to assess the effects of living standards on dietary quality. We expect that vehicle-owning households have better living standards. Similarly, households owning a TV and telephone should be more conscious of their diet quality and health. The percentage of households owning a car, TV, and telephone increased by 11

percent, 38 percent, and 64 percent, respectively, between 1995 and 2011. Households receiving remittances are likely to have higher household income, higher purchasing power, and higher-quality diets. Between 1995 and 2011, the number of households receiving remittances increased from 11 percent to 31 percent, while the average annual remittance received by a household increased from 0.06 lakh rupees to 0.55 lakh rupees. We also included cash transfer variables to see whether such assistance helps improve dietary quality. Cash transfers are likely to boost household income, which can lead to an increase in household dietary diversity. The average annual cash transfer received by a household was about 0.01 lakh rupees in 2011. Poor households are expected to have less dietary diversification than rich households. The average poverty rate fell from 33 percent to 19 percent between 1995 and 2011. Households from urban regions are more likely to have higher-quality diets than those from rural regions. In 2011, 35 percent of the sample households were from urban regions while 65 percent were from rural regions.

We included the annual crop diversity variable to examine its influence on dietary quality. Annual crop diversity (measured as the number of different crops cultivated) increased from 6.69 to 8.52 between 1995 and 2011. Households that are net buyers from urban regions should have higher dietary diversity, while households from rural regions should have lower dietary diversity. Therefore, we created an interaction term between net buyers and region. The percentage of net-buyer households increased from 73 percent to 79 percent between 1995 and 2011. Kitchen gardening can also influence dietary quality, and a household can grow a variety of crops such as tubers, vegetables, and fruits. On average, the proportion of households with a kitchen garden decreased from 63 percent to 58 percent between 1995 and 2011. The average amount of agricultural land owned by a household decreased from 0.88 hectare in 1995 to 0.46 hectare in 2011, indicating the increasing land fragmentation trend in Nepal. We expect that households owning more agricultural land will have higher-quality diets, while households with mothers employed in agriculture may have lower-quality diets. The proportion of mothers engaged in agricultural work decreased from 63 percent to 21 percent between 1995 and 2011. A household's ability to hire labor should indicate a higher-quality diet. The proportion of households hiring labor decreased over time. The

use of improved seeds, fertilizer, and irrigation should suggest higher agricultural production and household income, translating to higher dietary diversity. The proportion of households using improved seeds, applying commercial fertilizers, and having access to irrigation facilities increased over time, indicating increasing technology adoption. Households receiving agricultural loans, receiving agricultural advice, and owning agri-machinery increased by 42 percent, 3 percent, and 63 percent, respectively. We included the variable on the indicator of agricultural commercialization (that is, the ratio of crops sold to harvested). Only about 7 percent of the total harvested amount was sold in 2011, indicating a low degree of agricultural commercialization.

We included variables on access to basic facilities such as schools, bus stops, paved roads, market centers, and agricultural centers, as well as access to banks. The average time (in hours) required to reach a school, bus stop, paved road, market center, agricultural center, and bank decreased over time, indicating better infrastructure and improved access. We expect that access to a market center, paved roads, and bank can have an important influence on dietary quality.

At the community level, we included a food price index, average annual agricultural wages, annual nonagricultural wages, the percentage of households with access to irrigation, and the average time required to reach a paved road and market center. These variables are all expected to influence the dietary diversification of a household. In Nepal, the majority of households are net buyers of food. The average price index increased from 1.01 to 1.11 between 1995 and 2011. Higher annual agricultural wages from the sale of labor can boost the incomes of rural households, which is expected to increase dietary diversity. The average annual agricultural and nonagricultural wage in a community in 2011 was about 1.08 lakh rupees and 1.74 lakh rupees, respectively. The average time required to reach a market center and paved road decreased over time. However, the average time required to reach the nearest market center and paved road by foot in 2011 was still about 7 hours and 12 hours, respectively. These numbers indicate the rural and remote nature of the country. About 45 percent of households in a community have access to irrigation facilities.

At the district level, we included agroecological indicators, road infrastructure variables (proportion of all-season roads and road density), average annual rainfall, and urban population density. In 2011, 7 percent of households surveyed were from mountainous regions, 54 percent of households were from hilly regions, and 39 percent were from the Terai region. The percentage of all-season roads increased from 47 percent to 58 percent between 1995 and 2011. The average rainfall density decreased from about 173 millimeters to 141.21 millimeters between 1995 and 2011. Both the average road density and the average urban population density increased over time. We expect that these district characteristics influence the dietary quality of households. Although not presented, we also included the dummy variables for the month of interview to capture seasonal variations in dietary patterns in all models.

Table 4.1 Definitions and descriptive statistics of variables used in empirical analysis

	1995		2004		2011	
Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Dependent variable						
Fruit and vegetable expenditure share (%)	14.28	8.03	16.73	7.98	18.08	7.99
Animal protein expenditure share (%)	16.31	10.61	21.79	11.71	25.37	11.49
Pulse expenditure share (%)	6.22	4.29	5.95	4.11	7.29	4.63
Nonstaple food expenditure share (%)	36.82	14.75	44.48	14.37	50.74	14.11
Simpson index (calculated using expenditure share)	0.64	0.16	0.72	0.12	0.77	0.10
Independent variable						
Year						
If surveyed year is 1995, then 1, otherwise 0![c]	0.25	0.43				
If surveyed year is 2004, then 1, otherwise 0!			0.27	0.44		
If surveyed year is 2011, then 1, otherwise 0!					0.48	0.50
Sociodemographic household (HH) characteristics						
Gender (1 if male, otherwise 0)	0.88	0.32	0.82	0.39	0.73	0.44
Age of HH head (year)	44.53	14.22	45.64	14.01	45.89	14.09
Size of HH (no. of individuals)	5.79	2.73	5.35	2.50	4.71	2.23
Dependency ratio	0.42	0.21	0.40	0.22	0.38	0.25
Migration (Yes=1, No=0)	0.13	0.33	0.40	0.49	0.53	0.50
If father is uneducated, then 1, otherwise 0!	0.57	0.50	0.46	0.50	0.30	0.46
If mother is uneducated, then 1, otherwise 0!	0.82	0.38	0.78	0.41	0.31	0.46
If Brahmin HH, then 1, otherwise 0!	0.16	0.37	0.14	0.35	0.16	0.36
If Mongolian HH, then 1, otherwise 0!	0.29	0.45	0.32	0.47	0.31	0.46
If Madhesi HH, then 1, otherwise 0!	0.13	0.33	0.10	0.31	0.10	0.29
If unprivileged HH, then 1, otherwise 0!	0.22	0.42	0.23	0.42	0.25	0.43
If Chhetry HH, then 1, otherwise 0![c]	0.20	0.40	0.20	0.40	0.19	0.39

Table 4.1 continued

	1995		2004		2011	
Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
If farm HH, then 1, otherwise 0!	0.79	0.40	0.83	0.38	0.71	0.45
Having car (Yes=1, otherwise=0)	0.00	0.07	0.00	0.07	0.01	0.11
Having TV (Yes=1, otherwise=0)	0.12	0.33	0.24	0.43	0.50	0.50
Having landline telephone (Yes=1, otherwise=0)	0.02	0.14	0.07	0.25	0.66	0.47
Annual remittance received (lakh rupees)	0.06	0.49	0.14	0.51	0.55	6.85
Receives remittance (Yes=1, otherwise=0)	0.11	0.31	0.10	0.30	0.31	0.46
Social transfers in lakh rupees	0.02	0.13	0.04	0.17	0.01	0.03
Poor (Yes=1, otherwise=0)	0.33	0.47	0.25	0.43	0.19	0.39
Annual nonfarm income (lakh rupees)	0.12	0.80	2.02	105.55	0.72	7.63
Location (urban=1, otherwise=0)	0.19	0.39	0.05	0.22	0.35	0.48
Agricultural characteristics						
Crop diversity (no. of different crops)	6.69	4.76	8.82	5.04	8.52	7.46
HH is net buyer (Yes=1, otherwise=0)	0.73	0.45	0.71	0.45	0.79	0.41
Has kitchen garden (Yes=1, otherwise=0)	0.63	0.48	0.68	0.47	0.58	0.49
Size of agricultural land (ha)	0.88	1.85	0.64	0.97	0.46	0.92
Mother involved in farming (Yes=1, otherwise=0)	0.63	0.48	0.31	0.46	0.21	0.41
Used hired labor (Yes=1, otherwise=0)	0.56	0.50	0.72	0.45	0.33	0.47
Used improved seeds (Yes=1, otherwise=0)	0.11	0.31	0.22	0.41	0.28	0.45
Access to irrigation (Yes= 1, otherwise=0)	0.41	0.49	0.52	0.50	0.43	0.50
Used fertilizer (Yes= 1, otherwise=0)	0.46	0.50	0.58	0.49	0.49	0.50
Received agricultural loan (Yes= 1, otherwise=0)	0.04	0.20	0.69	0.46	0.12	0.32
Received agricultural advice (Yes=1, otherwise=0)	0.04	0.18	0.06	0.25	0.07	0.25
Owns agri-machinery (Yes=1, otherwise=0)	0.03	0.18	0.89	0.32	0.72	0.45
Marketed surplus (ratio of marketed and harvested quantity)	0.05	0.32	0.09	0.16	0.07	1.01
Access to facilities						
Time required to reach school (hr.)	0.41	1.21	0.32	0.70	0.23	0.52

Table 4.1 continued

	1995		2004		2011	
Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Time required to reach bus stop (hr.)	10.50	26.75	14.97	96.74	2.35	8.44
Time required to reach paved road (hr.)	6.90	7.34	6.76	7.30	4.65	6.69
Time required to reach market center (hr.)	3.58	3.65	4.26	3.90	3.51	3.82
Time required to reach agricultural center (hr.)	6.93	45.54	12.37	61.08	6.30	21.60
Time required to reach bank (hr.)	4.80	6.20	8.38	7.49	6.39	7.22
Community characteristics						
Price index	1.05	0.15	1.03	0.17	1.11	0.42
Annual nonagricultural wage (lakh)	1.10	0.90	1.84	4.83	1.74	2.44
Annual agricultural wage (lakh)	0.39	0.22	1.50	0.57	1.08	0.85
Time to reach market center (hr)	8.73	11.81	8.78	12.93	6.96	11.16
Time to reach paved road (hr)	21.26	27.10	18.97	26.45	11.71	21.21
Percentage of HHs with access to irrigation	41.03	29.63	52.04	29.31	43.25	29.83
District characteristics						
If HH from hilly region, then 1, otherwise 0!	0.50	0.50	0.49	0.50	0.54	0.50
If HH from mountainous region, then 1, otherwise 0!	0.13	0.34	0.12	0.32	0.07	0.25
If HH from Terai region, then 1, otherwise 0![c]	0.37	0.48	0.40	0.49	0.39	0.49
Proportion of all-season roads	47.28	29.65	52.08	25.26	58.19	22.52
Annual average rainfall (mm)	172.64	57.65	149.54	54.69	141.21	63.00
Road density (length of road / district area)*100	17.33	18.42	36.8	55.61	62.78	88.34
Urban population density (urban population / district area)*100	4,302	10,562	15,888	44,619	40,456	87,438

Source: Authors.

Note: ! indicates dummy variable; !c indicates reference category. 3,044 households were surveyed in 1995; 3,234 households were surveyed in 2004; and 5,741 households were surveyed in 2011.

Empirical Results

Determinants of Dietary Diversity (Simpson Index)

Table 4.2 presents the results for the determinants of dietary diversity (SI) using a multilevel model. We estimated the intraclass correlation coefficient and tested its significance for all three levels: household, community, and district. The intraclass correlation coefficient was 0.19 at the district level and 0.27 at the community level. This indicates that the district level and community level account for about 19 percent and 27 percent of the total variation of the SI, respectively, while the household level accounts for the remaining 54 percent. These intraclass correlation coefficients are statistically significant at less than the 1 percent level.

Here, we predicted seven models. The average SI was higher by 0.05 in 2004 and 0.06 in 2011 in comparison to 1995. Household characteristics explain the largest share of improvement in dietary diversity, followed by agricultural- and community-related variables. We interpret only significant results from Model 7 that incorporate variables from all levels so that it the results are less likely to suffer from the omitted variable bias.

Family size and age of household head are negatively correlated with dietary diversity. dietary diversity is lower among the Madheshi and unprivileged ethnic groups compared to Chhetry, and among farm households compared to nonfarm households. TV and telephone ownership are positively associated with dietary diversity. Increases in remittance and cash transfers are positively associated with dietary diversity, and dietary diversity is lower among poor households compared to nonpoor households. All these results indicate that income is a clear determinant of dietary diversity. Parent illiteracy is also negatively correlated with dietary diversity, though dietary diversity is higher in households containing an illiterate father than in those containing an illiterate mother. Gebremedhin et al. (2017) also found education to positively influence dietary diversity in Bangladesh.

Our examination of agriculture-related variables reveals that crop diversity is positively correlated with dietary diversity. The interaction term between net buyers and urban location is positive

and significant, suggesting that net-buyer households from urban regions have higher dietary diversity. An increase in agricultural land is positively associated with dietary diversity. The presence of a mother employed in agriculture is negatively correlated with household dietary diversity. The use of improved seeds is correlated with higher dietary diversity, while household ownership of livestock is associated with lower dietary diversity. A higher marketed surplus (a proxy for agriculture commercialization) is correlated with higher dietary diversity, underscoring the importance of agriculture commercialization in improving food security.

An examination of the variables related to access to facilities reveals only that an increase in the time required to reach a bus stop is negatively correlated with dietary diversification; all remaining variables were found to be insignificant. At the community level, we found average agricultural wages to be positively correlated with dietary diversity, while an increase in the average time required to reach a paved road is significantly and negatively correlated with dietary diversity. A higher percentage of households with access to irrigation is negatively correlated with the dietary diversity of the individual household. None of the district-level variables were found to be statistically significant. Survey months were included as dummy variables to account for possible seasonal influences on diet composition. We presented the Akaike information criterion (AIC) test statistics that indicate the overall fitness of the model. A model with a lower AIC value is considered a better-fit model.

Table 4.2 Determinants of dietary diversity (Simpson index) in Nepal

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
2004	0.0723***	0.0639***	0.0686***	0.0765***	0.0695***	0.0711***	0.0511***
	(0.0079)	(0.0069)	(0.0076)	(0.0080)	(0.0087)	(0.0091)	(0.0085)
2011	0.1159***	0.0791***	0.0836***	0.1150***	0.1063***	0.1143***	0.0649***
	(0.0092)	(0.0084)	0.0686***	(0.0089)	(0.0089)	(0.0095)	(0.0101)
Male headed		0.0024					0.0001
		(0.0025)					(0.0021)
Age		-0.0002**					-0.0003***
		(0.0001)					(0.0001)
Family size		-0.0038***					-0.0046***
		(0.0006)					(0.0005)
Dependent ratio		-0.0039					0.0015
		(0.0044)					(0.0039)
Brahmin		0.0033					-0.0002
		(0.0032)					(0.0029)
Mongolian		-0.0099***					-0.0028
		(0.0033)					(0.0031)
Madhesi		-0.0147***					-0.0165***
		(0.0048)					(0.0049)
Unprivileged		-0.025***					-0.0162***
		(0.0033)					(0.0031)
Farmer		-0.0130***					-0.0277***
		(0.0036)					(0.0041)
Car		0.0008					-0.0009
		(0.0077)					(0.0072)
TV		0.0214***					0.0154***
		(0.0026)					(0.0025)
Telephone		0.0089***					0.0080**
		(0.0033)					(0.0035)
Annual remittance (continuous)		0.0003***					0.0002***
		(0.0000)					(0.0000)
Remittance (dummy)		0.0064***					0.0034
		(0.0023)					(0.0021)
Cash transfer		0.0220***					0.0176**
		(0.0081)					(0.0071)
Poor		-0.0597***					-0.0504***
		(0.0031)					(0.0032)
Nonfarm income		-0.0000					0.0000
		(0.0000)					(0.0000)
Migrated household		0.0045*					0.0031
		(0.0023)					(0.0022)

Table 4.2 continued

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Illiterate mother		-0.0129***					-0.0104***
		(0.0024)					(0.0023)
Illiterate father		-0.008***					-0.0067***
		(0.0020)					(0.0019)
Urban		0.0227***					-0.0202**
		(0.0034)					(0.0083)
Net buyer # Urban			-0.0695***				-0.0639***
			(0.0039)				(0.0038)
Crop diversity			-0.0003				0.0007**
			(0.0004)				(0.0004)
Net buyer			0.0484***				-0.0639***
			(0.0052)				(0.0038)
Kitchen garden			0.0055**				0.0034
			(0.0027)				(0.0025)
Agricultural land			0.0023**				0.0034***
			(0.0010)				(0.0011)
Mother employed in agriculture			-0.0236***				-0.0128***
			(0.0027)				(0.0024)
Hired labor			-0.0012				-0.0022
			(0.0036)				(0.0030)
Improved seed			0.0095***				0.0071***
			(0.0028)				(0.0027)
Agricultural loan			0.0049**				0.0029
			(0.0024)				(0.0023)
Agricultural advice			0.0094***				0.0042
			(0.0036)				(0.0035)
Own livestock			-0.0286***				-0.0092*
			(0.0060)				(0.0054)
Marketed surplus			0.0020				0.0018*
			(0.0013)				(0.0010)
Access to school				-0.0025			-0.0022
				(0.0016)			(0.0016)
Access to bus stop				-0.0001***			-0.0000**
				(0.0000)			(0.0000)
Access to paved road				-0.0017***			-0.0003
				(0.0003)			(0.0004)
Access to market center				0.0003			0.0004
				(0.0004)			(0.0004)
Access to agricultural center				0.0000			0.0000
				(0.0000)			(0.0000)
Access to bank				-0.0009***			-0.0003

Table 4.2 continued

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
				(0.0003)			(0.0003)
Price index					0.0216		0.0166
					(0.0161)		(0.0136)
Average annual nonagricultural wage					0.0009***		0.0005*
					(0.0003)		(0.0003)
Average annual agricultural wage					0.0026		0.0075***
					(0.0030)		(0.0023)
Average time to reach a market center					-0.0006**		-0.0001
					(0.0003)		(0.0003)
Average time to reach a paved road					-0.0009***		-0.0005**
					(0.0002)		(0.0002)
Percentage of households with access to irrigation					-0.0001		-0.0003***
					(0.0001)		(0.0001)
Hill						-0.0015	0.0093
						(0.0127)	(0.0084)
Mountain						-0.074***	-0.0331
						(0.0274)	(0.0212)
All-season road						0.0003	0.0001
						(0.0003)	(0.0002)
Annual rainfall						-0.0000	-0.0000
						(0.0001)	(0.0001)
Road density						0.0004	0.0001
						(0.0003)	(0.0003)
Urban population density						-0.0000**	-0.0000
						(0.0000)	(0.0000)
Constant	0.6230***	0.7109***	0.7029***	0.6453***	0.6392***	0.6264***	0.7898***
	(0.0115)	(0.0116)	(0.0147)	(0.0131)	(0.0277)	(0.0295)	(0.0316)
Observations	12,019	12,019	12,019	12,019	12,019	12,019	12,019
Number of groups	74	74	74	74	74	74	74
Fit statistics (AIC)	-1990.85	-21423.77	-21114.36	-20062.24	-20087.17	-20019.98	-22308.11
Survey month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Random intercept							
District (variance)	0.004	0.002	0.003	0.003	0.002	0.002	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Community (variance)	0.003	0.002	0.002	0.002	0.002	0.003	0.002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Residual (variance)	0.010	0.009	0.009	0.010	0.010	0.010	0.008
	(0.001)	(0.001)	(0.001	(0.001)	(0.001)	(0.001)	(0.001)

Source: Authors.

Note: Robust standard errors in parentheses; *** p < 0.01, ** p < 0.05, * p < 0.1.

Determinants of the Expenditure Share of Nonstaple Foods

We estimated four models: expenditure shares of fruits and vegetables, animal proteins, plant proteins, and nonstaple foods, using multilevel models (Table 4.3). Regarding the expenditure shares of fruits and vegetables and animal protein, our intraclass correlation coefficients suggest that the district level and community level account for 13 percent and 18 percent of the variation observed at the household level, respectively. For plant protein expenditure share, the intraclass correlation coefficients suggest that the district level and community level account for 9 percent and 13 percent of the variation observed at the household level, respectively. All intraclass correlation coefficients are statistically significant at less than the 1 percent level. As in our previous models, we interpreted coefficients to be statistically significant at less than the 10 percent level.

We observe a significant increase in the expenditure share of nonstaple foods over time. The greatest increase (about 6 percent) is found in the share of animal proteins between 1995 and 2011. A male household head is linked to a higher animal protein expenditure share. An increase in family size is negatively and significantly correlated with expenditure on nonstaple foods. A higher dependent ratio is negatively associated with expenditure on fruits and vegetables. Among Brahmin households, expenditure shares of fruits and vegetables and plant proteins are higher, while the expenditure share of animal proteins is lower. This is not surprising, since most Brahmin families avoid meat products. Among Mongolian and Madhesi families, the expenditure share of animal proteins is lower. The expenditure share of nonstaple foods is lower in farm households. The expenditure share of animal proteins is higher among households that own a car, TV, and telephone, while the expenditure share of plant proteins is lower among households owning a car. The expenditure shares of fruits and vegetables and animal proteins are higher among households receiving remittances. Receipt of a social cash transfer is positively associated with the expenditure share of nonstaple foods, and that share is lower in poor households. The expenditure shares of plant proteins and fruits and vegetables are lower among households that have migrated. The expenditure share of fruits and vegetables is lower in households with an illiterate father and in those with an illiterate mother. The expenditure share of plant proteins is also lower in households

with an illiterate mother. The expenditure share of fruits and vegetables is higher among urban households. Ruel and Menon (2002) noted that the diets of rural households in developing countries tend to be dominated by starchy staples, lacking animal products and fresh fruits and vegetables.

Crop diversity is associated with a higher expenditure share of fruits and vegetables. The expenditure share of nonstaple food products is lower among net-buyer households. We observe a higher expenditure share of fruits and vegetables and lower expenditure share of plant proteins among households with a kitchen garden. An increase in agricultural land is positively and significantly associated with the expenditure share of fruits and vegetables. The presence of a mother employed in agriculture is negatively correlated with the expenditure shares of fruits and vegetables and animal proteins. The use of improved seeds is correlated with a higher expenditure share of animal proteins. The expenditure shares of fruits and vegetables and plant proteins are lower among households that own livestock. However, the expenditure share of animal proteins is higher for households that own livestock. Marketed surplus positively influences the expenditure share of animal proteins. Quick access to schools is associated with an increase in the expenditure share of fruits and vegetables, while access to markets and banks is linked to an increase in the expenditure share of plant proteins.

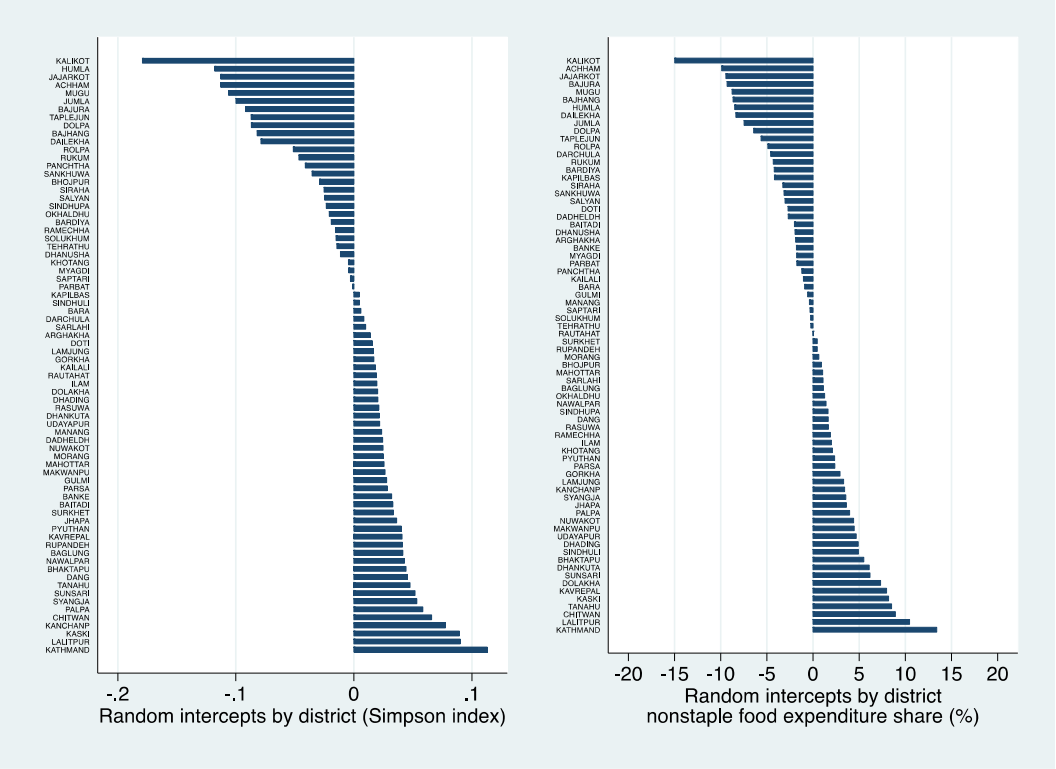
At the community level, a price index increase is positively associated with the expenditure share of fruits and vegetables. An increase in the average annual nonagricultural wage is correlated with an increase in the expenditure share of plant proteins, while an increase in the average agricultural wage is correlated with an increase in the expenditure share of fruits and vegetables. Quick access to paved roads is associated with higher expenditure shares of fruits and vegetables and animal proteins. An increase in the percentage of households with access to irrigation is negatively correlated with the expenditure shares of fruits and vegetables and plant proteins.

At the district level, we observe that the expenditure share of animal proteins is higher among households in the hilly and mountainous regions than those in the Terai region, while expenditure shares of fruits and vegetables and plant proteins are lower. An increase in average annual rainfall is negatively associated with the expenditure share of fruits and vegetables. An increase in road density is positively

correlated with the expenditure share of fruits and vegetables. Although urban population density is negatively correlated with the expenditure share of fruits and vegetables, it is positively correlated with the expenditure share of plant proteins.

We also estimated the random intercepts. Random intercepts at all levels are statistically significant at less than the 1 percent level. Finally, we predicted the random intercept at each level. These estimates are the mean of the SI for a given level. We plotted the SI and nonstaple food expenditure shares by district (Figure 4.1). Based on this graph, we can compare geographical districts in terms of average SI. Districts with the lowest SI and nonstaple food expenditure shares are from the far-western region and are remote hilly or mountainous districts. The districts with the highest SI and lowest nonstaple food expenditure shares are the capital/urban districts and Terai districts.

Figure 4.1 Average dietary quality across districts in Nepal



Source: NLSS (1995, 2004, 2011).

Table 4.3 Determinants of nonstaple food expenditure share of various food groups

Variables	Fruit/vegetable share	Animal protein share	Pulse share	Nonstaple foods
2004	1.0442***	3.9079***	-0.0400	4.9701***
	(0.4024)	(0.5277)	(0.2190)	(0.8783)
2011	-0.0400	6.2528***	0.4015	6.2225***
	(0.4440)	(0.6064)	(0.2500)	(0.9864)
Male headed	-0.2305	0.9857***	-0.1363	0.7537***
	(0.1637)	(0.2392)	(0.0992)	(0.2740)
Age	-0.0168***	-0.0054	0.0005	-0.0225**
	(0.0047)	(0.0069)	(0.0029)	(0.0089)
Family size	-0.3454***	-0.1417***	-0.0784***	-0.4850***
	(0.0295)	(0.0430)	(0.0178)	(0.0577)
Dependent ratio	-0.5946**	0.0969	0.1041	-0.5208
	(0.2818)	(0.4123)	(0.1710)	(0.4460)
Brahmin	1.0041***	-1.2290***	0.3312**	-0.2723
	(0.2297)	(0.3322)	(0.1379)	(0.3854)
Mongolian	-0.1287	-0.5868*	0.0529	-0.7672*
	(0.2107)	(0.3036)	(0.1259)	(0.3916)
Madhesi	0.5451*	-2.6106***	-0.1844	-2.0806***
	(0.2973)	(0.4265)	(0.1772)	(0.5341)
Unprivileged	-0.3278	-1.8792***	0.0510	-2.2188***
	(0.2264)	(0.3270)	(0.1358)	(0.4052)
Farmer	-1.5104***	-2.2589***	-0.2296*	-3.7153***
	(0.2124)	(0.3091)	(0.1283)	(0.3979)
Car	-0.8414	3.6080***	-1.1800***	2.7242***
	(0.6951)	(1.0124)	(0.4203)	(0.6842)
TV	0.2295	1.6260***	0.1878	1.8675***
	(0.1908)	(0.2774)	(0.1151)	(0.3332)
Telephone	0.4093*	1.9165***	0.0808	2.3664***
	(0.2125)	(0.3087)	(0.1281)	(0.4612)
Annual remittance (continuous)	-0.0025	0.0324*	0.0009	0.0294
	(0.0128)	(0.0187)	(0.0077)	(0.0189)
Remittance (dummy)	0.5905***	0.6339***	-0.1201	1.2552***
	(0.1680)	(0.2441)	(0.1013)	(0.2645)
Cash transfer	0.8690	1.7660**	0.4017	2.5929***
	(0.5561)	(0.8108)	(0.3365)	(0.8209)
Poor	-1.6039***	-3.1918***	-0.4578***	-4.7794***
	(0.1714)	(0.2494)	(0.1035)	(0.3386)
Nonfarm income	-0.0003	0.0031*	-0.0004	0.0029***
	(0.0011)	(0.0016)	(0.0007)	(0.0004)
Migrated household	-0.2781*	0.3969*	-0.3188***	0.1112
	(0.1515)	(0.2172)	(0.0903)	(0.2982)
Illiterate mother	-0.5710***	-0.4484**	-0.2259***	-1.0185***
	(0.1431)	(0.2091)	(0.0867)	(0.2731)
Illiterate father	-0.4606***	-0.3382	-0.0195	-0.8075***
	(0.1523)	(0.2228)	(0.0924)	(0.2684)
Urban	1.6275***	-0.0457	-0.3723	1.6207
	(0.5267)	(0.7229)	(0.3019)	(1.5400)
Crop diversity	0.1122***	-0.0163	-0.0041	0.0849*
	(0.0176)	(0.0253)	(0.0105)	(0.0476)
Net buyer	-3.0819***	-4.1603***	-1.0108***	-7.2341***
	(0.1816)	(0.2639)	(0.1095)	(0.3393)
Net buyer # Urban	-0.4570	1.1999*	0.7204***	0.7018
	(0.4554)	(0.6606)	(0.2744)	(1.4869)
Kitchen garden	0.7621***	0.1330	-0.2710***	0.8414***
	(0.1497)	(0.2169)	(0.0900)	(0.2494)
Agricultural land	0.2876***	0.1083	0.1011***	0.4049***

Table 4.3 continued

Variables	Fruit/vegetable share	Animal protein share	Pulse share	Nonstaple foods
	(0.0548)	(0.0799)	(0.0332)	(0.1132)
Mother employed in agriculture	-0.6339***	-0.9716***	-0.1750*	-1.6222***
	(0.1561)	(0.2273)	(0.0943)	(0.2522)
Hired labor	-0.2332	-0.8117***	-0.0533	-1.0601***
	(0.1678)	(0.2440)	(0.1011)	(0.3012)
Improved seed	0.0054	0.6573**	-0.1150	0.7308**
	(0.1790)	(0.2599)	(0.1078)	(0.3425)
Agricultural loan	-0.0030	0.3525	0.0615	0.3294
	(0.1848)	(0.2694)	(0.1118)	(0.2736)
Agricultural advice	0.0302	0.1207	0.2049	0.2207
	(0.2747)	(0.4009)	(0.1664)	(0.3691)
Own livestock	-0.7070**	1.5667***	-0.5186***	0.8664
	(0.2867)	(0.4125)	(0.1712)	(0.5450)
Marketed surplus	-0.0872	0.3807***	-0.0064	0.2978**
	(0.0844)	(0.1236)	(0.0513)	(0.1449)
Access to school	-0.1314*	-0.0329	-0.0366	-0.1732
	(0.0782)	(0.1141)	(0.0473)	(0.1448)
Access to bus stop	-0.0027	-0.0016	0.0000	-0.0040***
	(0.0017)	(0.0025)	(0.0010)	(0.0012)
Access to paved road	-0.0247	0.0062	0.0037	-0.0220
	(0.0215)	(0.0301)	(0.0125)	(0.0342)
Access to market center	0.0026	0.0611*	-0.0279*	0.0623
	(0.0261)	(0.0371)	(0.0154)	(0.0446)
Access to agricultural center	0.0038*	-0.0001	0.0005	0.0036
	(0.0020)	(0.0027)	(0.0011)	(0.0025)
Access to bank	-0.0048	0.0083	-0.0210**	0.0017
	(0.0159)	(0.0220)	(0.0092)	(0.0303)
Price index	1.6867**	-0.0898	-0.1898	1.4854
	(0.7599)	(0.9674)	(0.4053)	(1.3484)
Average annual non-agricultural wage	0.0372	0.0102	0.0399**	0.0473*
	(0.0321)	(0.0405)	(0.0171)	(0.0284)
Average annual agricultural wage	0.6177***	0.3645*	-0.1121	0.9269***
	(0.1756)	(0.2192)	(0.0924)	(0.2831)
Average time to reach a market center	-0.0158	0.0039	-0.0070	-0.0082
	(0.0120)	(0.0156)	(0.0065)	(0.0229)
Average time to reach a paved road	-0.0200**	-0.0185	-0.0076	-0.0348*
	(0.0088)	(0.0117)	(0.0049)	(0.0184)
Percentage of households with access to irrigation	-0.0199***	-0.0095*	-0.0041*	-0.0276***
	(0.0043)	(0.0055)	(0.0023)	(0.0085)
Hill	-2.5590***	6.0312***	-1.2914***	3.0728***
	(0.5305)	(0.9437)	(0.3323)	(0.9505)
Mountain	-3.3866***	3.4636***	-2.1076***	-0.6468
	(0.7697)	(1.3111)	(0.4713)	(2.0104)
All-season road	-0.0109	0.0223**	-0.0049	0.0048
	(0.0083)	(0.0113)	(0.0046)	(0.0196)
Annual rainfall	-0.0067**	0.0047	0.0002	-0.0054
	(0.0030)	(0.0047)	(0.0018)	(0.0082)
Road density	0.0379***	0.0014	-0.0117	0.0381

Table 4.3 continued

Variables	Fruit/vegetable share	Animal protein share	Pulse share	Nonstaple foods
	(0.0131)	(0.0194)	(0.0076)	(0.0285)
Urban population density	-0.0000**	-0.0000	0.0000**	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Constant	23.8305***	17.9038***	10.9291***	42.9334***
	(1.2896)	(1.8352)	(0.7281)	(3.1704)
Observations	12,019	12,019	12,019	12,019
Fit statistics (AIC)	80213.98	89189.19	68036.92	91798.55
Number of groups	74	74	74	74
Survey month fixed effects	Yes	Yes	Yes	Yes
Random intercept				
District (variance)	1.873	8.332	0.893	13.198
	(0.522)	(1.737)	(0.204)	(3.338)
Community (variance)	7.813	9.326	1.737	16.156
	(0.534)	(0.792)	(0.141)	(1.546)
Residual (variance)	41.095	89.170	15.320	108.747
	(0.558)	(1.207)	(0.207)	(2.253)

Source: Authors.

Note: Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5. IMPROVEMENTS IN DIETARY QUALITY BETWEEN 1995 AND 2011

We tested whether the difference in coefficients between 1995 and 2011 is systematic. For example, the Hausman test for the dietary diversity model indicates that the coefficients systematically differ between the two survey periods ($\chi^2(64) = 340.59$, Prob > $\chi^2 = 0$). Therefore, we used the Blinder-Oaxaca technique to decompose the dietary quality gap between 1995 and 2011 into two parts: one part that is explained by the differences in determinants of dietary quality such as household and agricultural characteristics, and one part that cannot be accounted for by such group differences. We use the twofold decomposition approach using coefficients from a pooled model over both the groups as the reference coefficients.

Table 5.1 shows average dietary quality in 1995 and 2011, and the change accounted for by differences in household, agricultural, and district characteristics. For nonstaple foods, differences in household characteristics account for about 43 percent of the dietary quality improvement, differences in agricultural characteristics account for about 31 percent of the improvement, and differences in district characteristics account for about 26 percent of the improvement. Similarly, for dietary diversity (SI), differences in household characteristics explain about 38 percent of the improvement, differences in agricultural characteristics explain about 16 percent of the improvement, and differences in district characteristics explain about 23 percent of the improvement.

Table 5.1 Explaining the observed improvement in dietary quality between 1995 and 2011 in Nepal

	Nonstaple Foods			Dietary Diversity		
	Household	**Agriculture**	**District**	**Household**	**Agriculture**	**District**
Year 1995	36.82	36.82	36.82	0.64	0.64	0.64
	(0.27)	(0.27)	(0.27)	(0.00)	(0.00)	(0.00)
Year 2011	50.74	50.74	50.74	0.77	0.77	0.77
	(0.19)	(0.19)	(0.19)	(0.00)	(0.00)	(0.00)
Difference	13.92	13.92	13.92	0.13	0.13	0.13
	(0.33)	(0.33)	(0.33)	(0.00)	(0.00)	(0.00)
Explained	5.99	4.34	3.56	0.05	0.02	0.03
	(0.38)	(0.41)	(0.16)	(0.003)	(0.003)	(0.003)
Explained (%)	**43.03**	**31.17**	**25.57**	**38.37**	**15.94**	**23.08**

Source: Authors.

Note: All coefficients are statistically significant at less than the 1% level. Negative values are expressed in the absolute term.

Table 5.2 illustrates the percentage of the dietary gap explained by changes among the significant factors at the different levels. Household trends accounting for a change in the expenditure share of nonstaple foods include a change in the proportion of households owning a telephone, which accounts for 14.30 percent of the change in expenditure share, followed by a change in the proportion of poor households (14.29 percent), then a change in the proportion of households with a TV (9.98 percent), and a change in family size (4.09 percent). Agricultural trends explaining the change in expenditure share include a change in the share of households using agri-machinery, which accounts for 37.71 percent of the expenditure share change, crop diversity (5.82 percent), and a change in the proportion of net-buyer households (3.59 percent). Changes in road density and urban population density are important district characteristics that also help explain the change in nonstaple food expenditure shares between 1995 and 2011.

Dietary quality improvement from 1995 to 2011 is mostly explained by the change in the proportion of households with a TV, which explains 24 percent of that improvement, followed by a change in the proportion of poor households (21.67 percent) and a change in the proportion of households with a telephone (14.62 percent). Agricultural characteristics explaining the change in dietary diversification include a change in the proportion of households using agri-machinery (23.2 percent) and a change in mothers' agricultural employment status (12.64 percent). Changes in road density and urban population density are also important district characteristics that help explain the change in dietary diversity between 1995 and 2011.

Table 5.2 Factors explaining the dietary quality gap between 1995 and 2011

	Nonstaple Foods	Explained (%) Change	**Dietary Diversification**	Explained (%) Change
Household sociodemographic characteristics				
Change in family size	0.57	4.09	0.38	7.60
	(0.08)		(0.07)	
Change in proportion of farm households	0.26	1.87	0.22	4.35
	(0.04)		(0.03)	
Change in proportion of households with TV	1.39	9.98	1.20	23.98
	(0.14)		(0.11)	
Change in proportion of households with telephone	1.99	14.30	0.73	14.62
	(0.25)		(0.20)	
Change in proportion of poor households	1.99	14.30	1.08	21.67
	(0.26)		(0.09)	
Change in proportion of households that have migrated				
Change in proportion of households with educated father	0.45	3.23	0.47	9.43
	(0.08)		(0.08)	
Agricultural characteristics				
Change in mothers' employment status from agriculture to non-agriculture sector	1.87	13.43	0.016	12.64
	(0.15)		(0.001)	
Change in proportion of households using agri-machinery	5.25	37.71	0.029	23.2
	(0.34)		(0.002)	
Change in crop diversity	0.81	5.82		
	(0.08)			
Change in proportion of net-buyer households	0.50	3.59		
	(0.06)			
District characteristics				
Change in road density	8.80	63.22	0.07	56.00
	(0.58)		(0.005)	
Change in urban population density	5.70	40.95	0.05	41.66
	(0.46)		(0.004)	

Source: Authors.

Note: Robust standard errors in parentheses. Negative values are expressed in absolute terms.

6. ROBUSTNESS TEST

We used quantile regression to explore whether the associations between our variables and the expenditure share of nonstaple foods and dietary diversity differed at different points along the distribution (Table 6.1). This allowed us to examine variations at points of interest on the lower and higher ends of the distribution.

Regressions estimated at the 20th, 50th, and 90th quantiles led to results like those in Tables 4.2 and 4.3. For both nonstaple food expenditure share and dietary diversity, we also separately estimated the full model (Model 7) for urban versus rural households, poor versus nonpoor households, and farmers versus nonfarmers (Tables A.1 and A.2). For nearly all variables, the results are similar to those obtained from the main model.

Table 6.1 Robustness test using quantile regression

	Expenditure share of nonstaple foods			Dietary diversity (Simpson index)		
Variables	**90th**	**50th**	**20th**	**90th**	**50th**	**20th**
2004	6.4177***	6.6699***	7.1630***	0.0277***	0.0893***	0.0525***
	(1.1957)	(1.0464)	(0.9855)	(0.0046)	(0.0114)	(0.0070)
2011	8.4644***	8.1677***	8.3392***	0.0290***	0.1025***	0.0582***
	(1.4778)	(1.2624)	(1.0413)	(0.0051)	(0.0141)	(0.0077)
Male headed	0.1493	0.8511**	1.1957***	-0.0001	-0.0022	0.0012
	(0.4956)	(0.3807)	(0.4062)	(0.0016)	(0.0036)	(0.0022)
Age	0.0036	-0.0298**	-0.0371***	-0.0001***	-0.0004***	-0.0002***
	(0.0144)	(0.0124)	(0.0128)	(0.0000)	(0.0001)	(0.0001)
Family size	-0.3834***	-0.5180***	-0.3986***	-0.0028***	-0.0052***	-0.0049***
	(0.1010)	(0.0755)	(0.0851)	(0.0003)	(0.0009)	(0.0005)
Dependent ratio	-0.5349	-1.5699**	-0.7526	0.0027	0.0052	0.0002
	(1.0806)	(0.7054)	(0.7429)	(0.0026)	(0.0067)	(0.0037)
Brahmin	-0.4893	-0.7861	-0.3631	-0.0024	-0.0028	-0.0031
	(0.8321)	(0.5768)	(0.6084)	(0.0019)	(0.0044)	(0.0028)
Mongolian	-2.6176***	-1.3007**	-0.7702	-0.0014	-0.0133***	-0.0055**
	(0.6573)	(0.5460)	(0.6075)	(0.0018)	(0.0051)	(0.0027)
Madhesi	-3.6182***	-2.6684***	-1.8443***	-0.0068**	-0.0237***	-0.0166***
	(0.9376)	(0.7203)	(0.6638)	(0.0028)	(0.0073)	(0.0041)
Unprivileged	-3.8708***	-3.0932***	-2.1666***	-0.0061***	-0.0229***	-0.0205***
	(0.7866)	(0.5415)	(0.5895)	(0.0022)	(0.0056)	(0.0037)
Farmer	-2.7074***	-3.2121***	-3.1537***	-0.0106***	-0.0261***	-0.0188***
	(0.6953)	(0.6205)	(0.5552)	(0.0022)	(0.0060)	(0.0034)
Car	3.6871***	4.7415***	2.3591	0.0028	0.0036	0.0007
	(1.3941)	(1.3632)	(1.4639)	(0.0046)	(0.0104)	(0.0063)
TV	2.0853***	1.9388***	1.9284***	0.0097***	0.0221***	0.0175***
	(0.5614)	(0.4418)	(0.5234)	(0.0016)	(0.0046)	(0.0025)
Telephone	1.5413**	2.5994***	2.0487***	0.0038*	0.0080*	0.0065**
	(0.6502)	(0.4649)	(0.4910)	(0.0020)	(0.0045)	(0.0029)
Annual remittance (continuous)	0.0910**	0.0038	0.0243***	-0.0000	0.0002***	0.0001*
	(0.0358)	(0.0049)	(0.0049)	(0.0000)	(0.0000)	(0.0000)
Remittance (dummy)	1.2354**	1.3931***	1.3924***	0.0024	-0.0028	0.0025
	(0.5067)	(0.4048)	(0.4255)	(0.0015)	(0.0041)	(0.0022)
Cash transfer	2.6364***	4.5577***	2.6701	0.0286***	0.0236***	0.0267***
	(0.4729)	(0.5922)	(2.3843)	(0.0087)	(0.0054)	(0.0071)
Poor	-5.4669***	-4.9163***	-4.5284***	-0.0270***	-0.0728***	-0.0540***
	(0.5939)	(0.4431)	(0.4091)	(0.0025)	(0.0057)	(0.0040)
Nonfarm income	0.0007***	0.0025***	0.0038***	-0.0000***	0.0000	-0.0000*

Table 6.1 continued

	Expenditure share of nonstaple foods			Dietary diversity (Simpson index)		
Variables	**90th**	**50th**	**20th**	**90th**	**50th**	**20th**
	(0.0002)	(0.0004)	(0.0004)	(0.0000)	(0.0000)	(0.0000)
Migrated household	-0.2237	0.3536	-0.0307	-0.0002	0.0082**	0.0030
	(0.4738)	(0.3348)	(0.3956)	(0.0013)	(0.0032)	(0.0020)
Illiterate mother	-1.0988**	-1.0853***	-0.9433***	-0.0046***	-0.0113***	-0.0110***
	(0.4816)	(0.3497)	(0.3519)	(0.0015)	(0.0039)	(0.0023)
Illiterate father	-1.0399**	-0.6670*	-0.9956**	-0.0042***	-0.0060	-0.0041*
	(0.4539)	(0.3723)	(0.4058)	(0.0014)	(0.0038)	(0.0023)
Urban	2.0863	0.2048	0.0226	-0.0058*	-0.0324***	-0.0112*
	(1.5450)	(1.1918)	(1.3849)	(0.0035)	(0.0082)	(0.0062)
Crop diversity	0.0058	0.0951**	0.1402***	-0.0006***	0.0006	-0.0001
	(0.0702)	(0.0473)	(0.0518)	(0.0002)	(0.0005)	(0.0003)
Net buyer	-7.2733***	-7.6496***	-6.6235***	-0.0257***	-0.0745***	-0.0493***
	(0.7551)	(0.4808)	(0.4817)	(0.0024)	(0.0049)	(0.0032)
Net buyer # Urban	0.2296	2.2277*	2.0390	0.0151***	0.0639***	0.0291***
	(1.5440)	(1.1431)	(1.3932)	(0.0035)	(0.0080)	(0.0054)
Kitchen garden	0.4815	0.5552	0.8279**	0.0004	0.0065*	0.0011
	(0.4843)	(0.4003)	(0.3819)	(0.0017)	(0.0038)	(0.0022)
Agricultural land	0.8710**	0.3968***	0.3309***	0.0018***	0.0041***	0.0026**
	(0.3792)	(0.1098)	(0.1065)	(0.0006)	(0.0010)	(0.0012)
Mother employed in agriculture	-1.6593***	-1.8368***	-1.8958***	-0.0068***	-0.0223***	-0.0177***
	(0.5133)	(0.3912)	(0.4077)	(0.0018)	(0.0053)	(0.0029)
Hired labor	-0.4981	-0.6337	-0.8557*	0.0008	-0.0004	0.0016
	(0.6008)	(0.4089)	(0.4510)	(0.0021)	(0.0046)	(0.0029)
Improved seed	0.2111	1.3841***	1.1979**	0.0023	0.0129***	0.0092***
	(0.6229)	(0.4220)	(0.5088)	(0.0019)	(0.0048)	(0.0027)
Irrigation	-1.3749**	-0.2754	-0.2274	-0.0020	0.0028	-0.0001
	(0.5769)	(0.4232)	(0.4317)	(0.0019)	(0.0052)	(0.0029)
Fertilizer	-0.8423	-1.4547***	-0.8534*	-0.0001	-0.0061	-0.0095***
	(0.5532)	(0.4615)	(0.4642)	(0.0023)	(0.0057)	(0.0034)
Agricultural loan	0.6194	0.6132	0.2786	-0.0019	0.0002	0.0003
	(0.5435)	(0.4318)	(0.5090)	(0.0019)	(0.0041)	(0.0028)
Agricultural advice	-0.5327	0.5763	0.2017	0.0079**	-0.0094	0.0018
	(1.1237)	(0.6766)	(0.8448)	(0.0033)	(0.0060)	(0.0040)
Agri-machinery	-1.9181**	-2.0962***	-3.0839***	-0.0037	-0.0236***	-0.0118***
	(0.8468)	(0.5918)	(0.6935)	(0.0024)	(0.0071)	(0.0035)
Own livestock	0.8760	0.6901	0.3135	-0.0097***	-0.0192**	-0.0169***
	(1.0307)	(0.7479)	(0.6416)	(0.0032)	(0.0079)	(0.0045)
Marketed surplus	2.3012	0.2007	0.3371***	0.0142	0.0019***	0.0033
	(3.0298)	(0.4523)	(0.0467)	(0.0093)	(0.0004)	(0.0087)

Table 6.1 continued

	Expenditure share of nonstaple foods			Dietary diversity (Simpson index)		
Variables	**90th**	**50th**	**20th**	**90th**	**50th**	**20th**
Access to school	0.0807	0.0699	-0.2829*	-0.0004	-0.0050***	-0.0007
	(0.1282)	(0.1835)	(0.1486)	(0.0019)	(0.0012)	(0.0006)
Access to bus stop	-0.0034	-0.0025	-0.0014	-0.0000***	-0.0000	-0.0000
	(0.0028)	(0.0027)	(0.0030)	(0.0000)	(0.0001)	(0.0001)
Access to paved road	-0.0025	0.0118	-0.0004	0.0000	0.0002	-0.0000
	(0.0733)	(0.0563)	(0.0449)	(0.0002)	(0.0006)	(0.0004)
Access to market center	0.0719	0.0129	0.0588	-0.0000	-0.0000	-0.0001
	(0.0833)	(0.0595)	(0.0562)	(0.0003)	(0.0006)	(0.0004)
Access to agricultural center	0.0000	0.0055	0.0076	0.0000	0.0001***	0.0000
	(0.0042)	(0.0046)	(0.0064)	(0.0000)	(0.0000)	(0.0000)
Access to bank	-0.0429	-0.0476	-0.0533	-0.0003	-0.0008**	-0.0003
	(0.0477)	(0.0399)	(0.0337)	(0.0002)	(0.0004)	(0.0003)
Price index	-0.1629	0.0807	-0.5398	-0.0004	0.0121	0.0002
	(1.4020)	(1.2569)	(1.2774)	(0.0041)	(0.0189)	(0.0070)
Average annual nonagricultural wage	-0.0200	0.0758***	0.0235	0.0001	0.0002	0.0003
	(0.0234)	(0.0261)	(0.0254)	(0.0001)	(0.0002)	(0.0006)
Average annual agricultural wage	0.9596**	0.9125***	0.9827***	0.0016	0.0077***	0.0071***
	(0.4560)	(0.2745)	(0.2694)	(0.0013)	(0.0028)	(0.0019)
Average time to reach a market center	0.0137	0.0177	0.0208	0.0001	0.0001	0.0001
	(0.0316)	(0.0266)	(0.0241)	(0.0001)	(0.0004)	(0.0002)
Average time to reach a paved road	-0.0189	-0.0356*	-0.0402*	-0.0002***	-0.0006***	-0.0004**
	(0.0246)	(0.0202)	(0.0212)	(0.0001)	(0.0002)	(0.0002)
Percentage of households with access to irrigation	-0.0041	-0.0165*	-0.0164**	-0.0001*	-0.0003**	-0.0001*
	(0.0108)	(0.0094)	(0.0083)	(0.0000)	(0.0001)	(0.0001)
Hill	-11.9832***	-8.5856	-8.2279**	-0.0478	-0.1482***	-0.0976***
	(3.9441)	(8.7492)	(3.6273)	(0.0419)	(0.0471)	(0.0366)
Mountain	-2.7277	0.8135	1.1056	-0.0235	-0.0898**	-0.0503*
	(2.6791)	(3.2916)	(2.5311)	(0.0183)	(0.0360)	(0.0283)
All-season road	-0.0091	-0.0079	-0.0117	-0.0000	0.0002	0.0001
	(0.0249)	(0.0190)	(0.0175)	(0.0001)	(0.0003)	(0.0002)
Annual rainfall	-0.0163*	-0.0259**	-0.0161	-0.0001*	-0.0002	-0.0001
	(0.0095)	(0.0108)	(0.0101)	(0.0000)	(0.0001)	(0.0001)

Table 6.1 continued

	Expenditure share of nonstaple foods			Dietary diversity (Simpson index)		
Variables	**90th**	**50th**	**20th**	**90th**	**50th**	**20th**
Road density	-0.0071	0.0058	0.0375	-0.0000	-0.0001	-0.0001
	(0.0331)	(0.0392)	(0.0308)	(0.0002)	(0.0004)	(0.0002)
Urban population density	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Constant	61.4099***	49.9648***	39.5401***	0.8966***	0.7900***	0.8410***
	(3.3005)	(2.8554)	(2.7020)	(0.0136)	(0.0358)	(0.0220)
Observations	12,019	12,019	12,019	12,019	12,019	12,019
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Survey months fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Source: Authors.

Note: Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

7. CONCLUSION AND POLICY IMPLICATIONS

We studied the determinants of dietary quality using datasets derived from three rounds (1995, 2004, and 2011) of the NLSS. As indicators of dietary quality, we computed the expenditure shares of nonstaple foods (fruits and vegetables and animal and plant proteins) and an indicator of dietary diversity (the SI computed using the expenditure shares of 11 food items). We studied the factors influencing the improvement in dietary quality between 1995 and 2011 using multilevel models and the Blinder-Oaxaca decomposition method. We conducted robustness checks using quantile regression.

Dietary quality in Nepal improved significantly between 1995 and 2011. The average cereal expenditure share decreased by about 32 percent, while the expenditure shares of fruits and vegetables, animal proteins, and plant proteins increased by 26.61 percent, 55.54 percent, and 17.20 percent, respectively. Changes in household characteristics—such as poverty status, parents' education, the proportion of TV- and telephone-owning households, and the proportion of households receiving remittances—explain at least 37 percent of the observed improvement in dietary diversity and the expenditure shares of nonstaple foods. Changes in agricultural characteristics—such as the proportions of households using agri-machinery and improved seeds, and a change in crop diversity—explain at least 16 percent of the improvement in these indicators.

What explains the increased expenditure share of nonstaple foods in Nepal? The factors associated with a higher expenditure share of nonstaple foods include a male household head, family size, owning a TV, farming status, owning a telephone, receiving a remittance, receiving a social cash transfer, more educated parents, owning agricultural land, agricultural wages, and quick access to paved roads. Similarly, the factors positively and significantly correlated with dietary diversification include owning a TV, owning a telephone, receiving a remittance, receiving a social cash transfer, more educated parents, crop diversity, owning agricultural land, using improved seeds, and agricultural wages. We used quantile regression to test the robustness of the results. We also estimated our full model for rural versus urban

households, poor versus nonpoor households, and farmers versus nonfarmers. Overall, the results from our full model are highly robust across various quantile groups and sample sizes.

Our findings suggest a number of policy implications. Since dietary quality is generally better in the urban and Terai districts, we suggest that concerned agencies focus their efforts on improving the dietary quality of rural households, especially those in the far-western region of the country. We found household poverty to be one of the important factors negatively associated with household dietary quality. Therefore, any factors positively influencing household income levels, whether through social cash transfers or other means, will likely lead to improvements in household dietary quality. We found that crop diversity positively influenced dietary quality. Thus, any effort that leads farmers to diversify their crop portfolios will help in improving dietary quality. Parent illiteracy is linked to a low-quality diet. Thus, educating parents is critical to promoting household dietary diversification. Policies discouraging land fragmentation may also help improve dietary quality, as agricultural land ownership is linked to higher dietary quality, as are TV and telephone ownership and quick access to markets, paved roads, and agricultural centers. Any government effort to provide quick access to basic facilities and broader TV and telephone coverage to households in rural areas should lead to better dietary quality. Further, the lower level of dietary diversity among unprivileged ethnic groups suggests that the government or concerned organizations should initiate special programs to combat nutrition insecurity among these groups.

This study can be further improved by incorporating panel data. Rather than focusing on a single policy variable, we tried to examine the roles of as many factors as possible at various levels to broaden our understanding of the spatial and temporal determinants of dietary quality. We assess only the association between dietary quality and various explanatory variables. Future studies can be conducted to estimate the impact of specific policy variables on dietary quality.

APPENDIX TABLES

Table A.1 Robustness test: Determinants of expenditure share of nonstaple foods

Variables	Urban	Rural	Poor	Nonpoor	Farmers	Nonfarmers
2004	2.7671	5.3072***	2.7702**	5.0612***	4.4699***	4.1142***
	(1.8810)	(0.7856)	(1.2915)	(0.7409)	(0.8074)	(1.0630)
2011	5.3454***	7.1683***	4.4439***	6.4442***	5.6579***	6.9025***
	(1.3347)	(0.9892)	(1.4468)	(0.8350)	(0.9566)	(1.0650)
Male headed	0.8945*	0.1591	0.9568	0.3651	-0.0702	1.5046***
	(0.5360)	(0.3377)	(0.6038)	(0.3273)	(0.3352)	(0.5410)
Age	-0.0613***	-0.0356***	-0.0292**	-0.0436***	-0.0195**	-0.1063***
	(0.0166)	(0.0085)	(0.0144)	(0.0090)	(0.0086)	(0.0165)
Family size	-0.4792***	-0.5078***	-0.2833***	-0.6146***	-0.5398***	-0.3629***
	(0.1069)	(0.0502)	(0.0790)	(0.0558)	(0.0499)	(0.1083)
Dependent ratio	-0.0835	-0.8520*	-0.2713	-0.5502	-0.6607	-0.6475
	(0.9065)	(0.5091)	(1.0063)	(0.5043)	(0.5100)	(0.9019)
Brahmin	-1.9174***	-3.6066***	-2.7526***	-3.0630***	-3.5224***	-1.5882**
	(0.6851)	(0.4173)	(0.9199)	(0.3907)	(0.3997)	(0.7754)
Mongolian	1.9487***	2.2323***	2.2283***	2.2599***	2.1644***	2.3541***
	(0.6358)	(0.3798)	(0.6823)	(0.3660)	(0.3734)	(0.6668)
Madhesi	0.9322	1.0154**	1.1076	1.2327**	1.5607***	-1.0565
	(1.0598)	(0.5049)	(0.8568)	(0.5307)	(0.5182)	(0.9422)
Unprivileged	1.5443*	0.3698	0.6957	0.5981	0.7266*	-0.3225
	(0.7920)	(0.3897)	(0.6535)	(0.4150)	(0.3907)	(0.7641)
Farmer	-2.0065***	-2.3444***	-2.6794***	-2.2296***		
	(0.6598)	(0.4301)	(0.6910)	(0.4092)		
Car	-0.0961	0.7853	2.9588	0.3918	1.9485	-0.3688
	(1.2131)	(2.1485)	(9.5308)	(1.0735)	(1.6349)	(1.3445)
TV	1.1947**	1.3059***	0.9697	1.3429***	1.7080***	0.3866
	(0.5766)	(0.3471)	(0.8034)	(0.3260)	(0.3459)	(0.5690)
Telephone	1.1915*	1.3153***	1.4594**	1.2081***	1.3953***	0.8211
	(0.7019)	(0.3675)	(0.6998)	(0.3750)	(0.3716)	(0.6530)
Annual remittance (continuous)	-0.0531	0.0140	-0.3912	0.0130	0.0126	-0.0115
	(0.1192)	(0.0190)	(0.5431)	(0.0196)	(0.0189)	(0.1536)
Remittance (dummy)	1.4308***	0.6739**	0.5083	1.0288***	0.7780***	0.9403*
	(0.5176)	(0.2958)	(0.5900)	(0.2881)	(0.2971)	(0.4988)
Cash transfer	1.2945	1.5925	-3.0682	1.7238*	2.3153*	0.7596
	(1.2752)	(1.2394)	(4.0647)	(0.9237)	(1.2006)	(1.2978)
Poor	-2.7058***	-2.2182***			-1.9889***	-3.5498***
	(0.7219)	(0.2823)			(0.2912)	(0.5960)
Nonfarm income	0.0297*	-0.0002	0.0076	0.0002	0.0433**	-0.0004
	(0.0176)	(0.0017)	(0.0726)	(0.0017)	(0.0182)	(0.0016)
Migrated household	0.1925	0.2135	0.5660	0.0516	0.1197	0.2132
	(0.4799)	(0.2743)	(0.4966)	(0.2691)	(0.2764)	(0.4468)
Illiterate mother	-1.6763***	-0.5274**	0.1227	-1.0984***	-0.8085***	-0.7797
	(0.5254)	(0.2460)	(0.4202)	(0.2653)	(0.2474)	(0.5065)
Illiterate father	-1.1264**	-0.4271	-0.2096	-0.6290**	-0.3684	-1.3276***
	(0.5100)	(0.2597)	(0.4712)	(0.2694)	(0.2605)	(0.4972)
Urban			-0.0302	1.2039	0.4342	4.9108**
			(2.0858)	(0.8462)	(0.8768)	(2.1985)
Crop diversity	-0.1081	0.1084***	0.2332***	0.0014	0.1283***	-0.4132***
	(0.0738)	(0.0306)	(0.0553)	(0.0321)	(0.0297)	(0.1095)
Net buyer	-5.6553***	-5.4616***	-5.2871***	-5.5685***	-5.3168***	-8.2756***
	(0.7622)	(0.2860)	(0.5287)	(0.3337)	(0.2911)	(1.2608)
Net buyer # Urban			2.9127	0.1405	1.7756**	-3.2568
			(2.0214)	(0.7727)	(0.7952)	(2.1273)
Kitchen garden	0.9059*	0.3047	-0.1887	0.6423**	0.1586	1.1111**

Table A.1 continued

Variables	Urban	Rural	Poor	Nonpoor	Farmers	Nonfarmers
	(0.4898)	(0.2597)	(0.4174)	(0.2718)	(0.2666)	(0.4441)
Agricultural land	0.1489	0.2884***	-0.0245	0.4198***	0.2649***	
	(0.2133)	(0.0911)	(0.1360)	(0.1050)	(0.0847)	
Mother employed in agriculture	0.1382	-0.7301***	-0.6737*	-0.5807*	-0.4380*	-1.6032***
	(0.6791)	(0.2590)	(0.4080)	(0.3001)	(0.2660)	(0.6062)
Hired labor	-0.0860	-0.6938**	-0.4881	-0.7032**	-0.2411	-4.5835***
	(0.7690)	(0.2823)	(0.4592)	(0.3221)	(0.2761)	(1.0107)
Improved seed	1.1790	0.3965	0.3494	0.7547**	0.5358*	1.4547
	(0.7787)	(0.2932)	(0.5762)	(0.3150)	(0.2849)	(1.1470)
Irrigation	0.4008	-0.7869***	-0.5469	-0.5557*	-0.6289**	
	(0.6862)	(0.2841)	(0.4764)	(0.3182)	(0.2682)	
Fertilizer	-3.1858***	-0.3539	-0.4431	-0.8189**	-0.1996	-1.7358*
	(0.8339)	(0.3022)	(0.4750)	(0.3450)	(0.2991)	(1.0349)
Agricultural loan	1.2947*	-0.0932	0.6079	-0.0500	0.0778	0.6341
	(0.6688)	(0.3165)	(0.6128)	(0.3251)	(0.3181)	(0.6347)
Agricultural advice	0.0771	-0.3978	0.7751	-0.7163	-0.3836	-2.9657
	(1.1851)	(0.4414)	(1.0348)	(0.4611)	(0.4219)	(2.1899)
Agri-machinery	-1.2640*	-2.2014***	-1.6789*	-1.8850***	-1.8415***	-0.2733
	(0.7302)	(0.5136)	(0.9333)	(0.4579)	(0.5436)	(0.6718)
Own livestock	1.3002	-0.9090*	-0.8812	-1.0849**	-1.0221*	0.4279
	(1.0009)	(0.5143)	(0.8529)	(0.5174)	(0.5743)	(0.7713)
Marketed surplus	1.8886	0.2209*	0.9456	0.2348*	0.2156*	9.4652***
	(1.4064)	(0.1244)	(0.9379)	(0.1291)	(0.1239)	(3.4454)
Access to school	0.2343	-0.3288**	-0.3058	-0.2536*	-0.2713**	-0.4340
	(0.4233)	(0.1322)	(0.3402)	(0.1384)	(0.1373)	(0.3164)
Access to bus stop	-0.1060	-0.0040	0.0007	-0.0054*	-0.0043	0.0338
	(0.1269)	(0.0026)	(0.0077)	(0.0028)	(0.0026)	(0.0495)
Access to paved road	0.0056	0.0046	0.0726	-0.0083	0.0079	0.0014
	(0.1401)	(0.0335)	(0.0535)	(0.0385)	(0.0347)	(0.0838)
Access to market center	-0.0875	0.0058	0.0647	-0.0110	-0.0164	-0.0231
	(0.1088)	(0.0428)	(0.0744)	(0.0455)	(0.0437)	(0.0885)
Access to agricultural center	0.0078	0.0059**	0.0060	0.0071**	0.0084***	-0.0165*
	(0.0419)	(0.0029)	(0.0062)	(0.0032)	(0.0030)	(0.0099)
Access to bank	0.3793***	-0.0271	-0.0591	0.0117	-0.0142	0.0812
	(0.1247)	(0.0245)	(0.0402)	(0.0277)	(0.0253)	(0.0608)
Price index	-2.6945	4.6501**	2.0838	-0.5978	-0.2533	-1.9811
	(2.3791)	(2.3429)	(2.5360)	(1.1410)	(1.4147)	(1.3440)
Average annual nonagricultural wage	-0.0418	0.0537	-0.1156	0.0589	-0.0201	0.0617
	(0.1148)	(0.0512)	(0.1492)	(0.0469)	(0.0963)	(0.0451)
Average annual agricultural wage	0.1443	0.9436***	1.7806***	0.8003***	0.8729***	1.7452***
	(1.1087)	(0.2676)	(0.4289)	(0.2645)	(0.2737)	(0.4239)
Average time to reach a market center	-0.0519	-0.0010	0.0074	-0.0051	0.0037	0.0280
	(0.0759)	(0.0187)	(0.0249)	(0.0204)	(0.0188)	(0.0461)
Average time to reach a paved road	-0.0189	-0.0390***	-0.0352*	-0.0460***	-0.0399***	-0.0522
	(0.0747)	(0.0138)	(0.0192)	(0.0151)	(0.0139)	(0.0365)
Percentage of households with access to irrigation	-0.0350*	-0.0081	-0.0020	-0.0085	-0.0109	-0.0198
	(0.0182)	(0.0072)	(0.0105)	(0.0073)	(0.0072)	(0.0129)
Hill	2.7952*	0.4346	2.9453**	1.1159	1.3523	3.0873***
	(1.5892)	(1.1443)	(1.3256)	(1.0811)	(1.0984)	(1.1286)
Mountain	4.1370	-2.6699*	0.7514	-1.7660	-1.3813	3.2314
	(3.7158)	(1.5970)	(1.8393)	(1.5384)	(1.5381)	(2.2153)
All-season road	-0.0159	-0.0081	0.0154	-0.0141	-0.0081	0.0115

Table A.1 continued

Variables	Urban	Rural	Poor	Nonpoor	Farmers	Nonfarmers
	(0.0325)	(0.0142)	(0.0175)	(0.0144)	(0.0138)	(0.0242)
Annual rainfall	-0.0015	-0.0038	-0.0027	-0.0021	-0.0031	-0.0048
	(0.0117)	(0.0056)	(0.0070)	(0.0056)	(0.0056)	(0.0073)
Road density	0.0076	0.0229	0.1021***	0.0062	0.0222	0.0025
	(0.0388)	(0.0261)	(0.0362)	(0.0229)	(0.0251)	(0.0261)
Urban population density	0.0000	-0.0000	-0.0001***	-0.0000	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Constant	45.4415***	32.4531***	24.6787***	39.7859***	33.7686***	44.1174***
	(4.1081)	(2.9901)	(3.5841)	(2.2045)	(2.3883)	(3.0379)
Observations	2,509	8,553	2,717	8,345	8,504	2,558
Number of groups	44	74	72	74	74	62

Source: Authors.

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Random effects not included.

Table A.2 Robustness test: Determinants of dietary diversity (Simpson index)

Variables	Urban	Rural	Poor	Nonpoor	Farmer	Non-farmer	Overall
2004	0.0275**	0.0710***	0.0719***	0.0560***	0.0623***	0.0523***	0.0618***
	(0.0116)	(0.0080)	(0.0161)	(0.0062)	(0.0079)	(0.0096)	(0.0097)
2011	0.0547***	0.0966***	0.1053***	0.0641***	0.0746***	0.0837***	0.0764***
	(0.0080)	(0.0099)	(0.0178)	(0.0069)	(0.0092)	(0.0096)	(0.0112)
Male headed	0.0025	-0.0008	0.0020	-0.0008	-0.0013	0.0013	0.0001
	(0.0035)	(0.0028)	(0.0064)	(0.0023)	(0.0027)	(0.0039)	(0.0020)
Age	-0.0003***	-0.0003***	-0.0004**	-0.0003***	-0.0003***	-0.0004***	-0.0003***
	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Family size	-0.0038***	-0.0047***	-0.0023**	-0.0056***	-0.0050***	-0.0032***	-0.0045***
	(0.0007)	(0.0005)	(0.0010)	(0.0005)	(0.0005)	(0.0009)	(0.0005)
Dependent ratio	0.0145**	-0.0031	-0.0010	0.0010	-0.0043	0.0156**	0.0014
	(0.0061)	(0.0048)	(0.0121)	(0.0040)	(0.0047)	(0.0070)	(0.0039)
Brahmin	0.0030	-0.0018	0.0069	-0.0003	-0.0035	0.0077	-0.0005
	(0.0046)	(0.0040)	(0.0112)	(0.0032)	(0.0038)	(0.0060)	(0.0029)
Mongolian	-0.0020	-0.0036	0.0055	-0.0045	-0.0037	0.0015	-0.0029
	(0.0043)	(0.0037)	(0.0083)	(0.0030)	(0.0035)	(0.0053)	(0.0031)
Madhesi	-0.0053	-0.0197***	-0.0038	-0.0190***	-0.0222***	-0.0050	-0.0159***
	(0.0071)	(0.0050)	(0.0105)	(0.0043)	(0.0049)	(0.0075)	(0.0049)
Unprivileged	-0.0105**	-0.0177***	-0.0056	-0.0164***	-0.0167***	-0.0152**	-0.0158***
	(0.0053)	(0.0038)	(0.0080)	(0.0034)	(0.0037)	(0.0061)	(0.0031)
Farmer	-0.0203***	-0.0264***	-0.0315***	-0.0230***			-0.0254***
	(0.0045)	(0.0042)	(0.0085)	(0.0033)			(0.0042)
Car	0.0017	-0.0021	-0.0210	0.0008	0.0019	0.0029	-0.0005
	(0.0086)	(0.0212)	(0.1211)	(0.0089)	(0.0157)	(0.0111)	(0.0072)
TV	0.0183***	0.0124***	0.0108	0.0167***	0.0145***	0.0141***	0.0151***
	(0.0038)	(0.0034)	(0.0099)	(0.0026)	(0.0033)	(0.0044)	(0.0025)
Telephone	0.0014	0.0099***	0.0102	0.0093***	0.0093***	0.0044	0.0074**
	(0.0048)	(0.0036)	(0.0087)	(0.0031)	(0.0035)	(0.0052)	(0.0034)
Annual remittance (continuous)	0.0005	0.0002	-0.0004	0.0002	0.0003	-0.0014	0.0002***
	(0.0008)	(0.0002)	(0.0068)	(0.0002)	(0.0002)	(0.0012)	(0.0000)
Remittance (dummy)	-0.0035	0.0042	0.0066	0.0007	0.0044	0.0001	0.0034
	(0.0035)	(0.0029)	(0.0073)	(0.0023)	(0.0028)	(0.0040)	(0.0021)
Cash transfer	0.0043	0.0296***	-0.0763	0.0216***	0.0325***	-0.0015	0.0180**
	(0.0090)	(0.0110)	(0.0512)	(0.0072)	(0.0104)	(0.0107)	(0.0071)
Poor	-0.0503***	-0.0497***			-0.0471***	-0.0588***	-0.0502***
	(0.0050)	(0.0027)			(0.0027)	(0.0049)	(0.0032)
Nonfarm income	0.0002	-0.0000	0.0002	-0.0000	0.0002	-0.0000	0.0000
	(0.0001)	(0.0000)	(0.0009)	(0.0000)	(0.0002)	(0.0000)	(0.0000)
Migrated household	0.0072**	0.0022	0.0024	0.0027	0.0009	0.0135***	0.0033
	(0.0033)	(0.0026)	(0.0059)	(0.0022)	(0.0025)	(0.0036)	(0.0021)
Illiterate mother	-0.0114***	-0.0093***	-0.0033	-0.0113***	-0.0084***	-0.0178***	-0.0102***
	(0.0037)	(0.0023)	(0.0050)	(0.0021)	(0.0023)	(0.0041)	(0.0023)
Illiterate father	-0.0060*	-0.0068***	-0.0045	-0.0066***	-0.0077***	-0.0063	-0.0065***
	(0.0036)	(0.0025)	(0.0058)	(0.0022)	(0.0025)	(0.0040)	(0.0019)
Urban	-		0.0110	-0.0193***	-0.0094	-0.0487***	-0.0190**
			(0.0259)	(0.0070)	(0.0086)	(0.0164)	(0.0082)
Crop diversity	0.0006	0.0013***	0.0036***	0.0000	0.0014***	-0.0014	0.0010***
	(0.0005)	(0.0003)	(0.0007)	(0.0003)	(0.0003)	(0.0009)	(0.0004)
Net buyer	-0.0274***	-0.0635***	-0.0704***	-0.0610***	-0.0647***	-0.0525***	-0.0639***
	(0.0051)	(0.0028)	(0.0065)	(0.0027)	(0.0027)	(0.0101)	(0.0039)
Net buyer # Urban	-		0.0204	0.0419***	0.0361***	0.0703***	0.0438***
			(0.0250)	(0.0062)	(0.0076)	(0.0156)	(0.0069)

Table A.2 continued

Variables	Urban	Rural	Poor	Nonpoor	Farmer	Non-farmer	Overall
Kitchen garden	0.0064*	0.0036	0.0011	0.0043*	0.0031	0.0040	0.0038
	(0.0033)	(0.0025)	(0.0052)	(0.0022)	(0.0025)	(0.0036)	(0.0025)
Agricultural land	0.0036***	0.0032***	-0.0004	0.0045***	0.0030***		0.0033***
	(0.0014)	(0.0009)	(0.0017)	(0.0008)	(0.0008)		(0.0011)
Mother employed in agriculture	-0.0114**	-0.0114***	-0.0178***	-0.0117***	-0.0102***	-0.0161***	-0.0121***
	(0.0047)	(0.0025)	(0.0050)	(0.0024)	(0.0025)	(0.0049)	(0.0024)
Hired labor	-0.0133**	0.0020	0.0120**	-0.0019	0.0042	-0.0298***	-0.0001
	(0.0053)	(0.0028)	(0.0056)	(0.0026)	(0.0026)	(0.0083)	(0.0028)
Improved seed	0.0060	0.0085***	0.0140**	0.0106***	0.0079***	0.0195**	0.0084***
	(0.0053)	(0.0029)	(0.0071)	(0.0026)	(0.0027)	(0.0095)	(0.0027)
Irrigation	0.0073	-0.0007	0.0066	-0.0010	-0.0000		0.0015
	(0.0048)	(0.0027)	(0.0058)	(0.0026)	(0.0025)		(0.0033)
Fertilizer	-0.0275***	-0.0038	-0.0148**	-0.0040	-0.0004	-0.0322***	-0.0069**
	(0.0058)	(0.0029)	(0.0058)	(0.0028)	(0.0028)	(0.0086)	(0.0032)
Agricultural loan	0.0088*	0.0028	0.0027	0.0027	0.0020	0.0127**	0.0033
	(0.0046)	(0.0030)	(0.0075)	(0.0026)	(0.0030)	(0.0051)	(0.0023)
Agricultural advice	0.0078	0.0040	0.0166	0.0035	0.0027	0.0012	0.0046
	(0.0082)	(0.0044)	(0.0126)	(0.0038)	(0.0040)	(0.0183)	(0.0035)
Agri-machinery	-0.0103**	-0.0160***	-0.0304***	-0.0102***	-0.0109**	-0.0072	-0.0140***
	(0.0049)	(0.0049)	(0.0117)	(0.0037)	(0.0051)	(0.0055)	(0.0049)
Own livestock	-0.0051	-0.0041	-0.0022	-0.0135***	-0.0062	-0.0143**	-0.0085
	(0.0067)	(0.0049)	(0.0105)	(0.0042)	(0.0054)	(0.0063)	(0.0055)
Marketed surplus	0.0230**	0.0017	0.0182	0.0016	0.0015	0.1270***	0.0019*
	(0.0099)	(0.0013)	(0.0118)	(0.0011)	(0.0012)	(0.0288)	(0.0010)
Access to school	0.0013	-0.0026**	-0.0011	-0.0025**	-0.0024*	-0.0033	-0.0022
	(0.0030)	(0.0012)	(0.0042)	(0.0011)	(0.0013)	(0.0021)	(0.0016)
Access to bus stop	-0.0005	-0.0000*	0.0000	-0.0001***	-0.0000*	0.0000	-0.0000**
	(0.0007)	(0.0000)	(0.0001)	(0.0000)	(0.0000)	(0.0004)	(0.0000)
Access to paved road	-0.0006	-0.0004	0.0004	-0.0002	-0.0001	-0.0013*	-0.0003
	(0.0009)	(0.0003)	(0.0007)	(0.0003)	(0.0003)	(0.0007)	(0.0004)
Access to market center	-0.0007	0.0008**	0.0016*	0.0001	0.0003	0.0003	0.0005
	(0.0007)	(0.0004)	(0.0009)	(0.0004)	(0.0004)	(0.0007)	(0.0004)
Access to agricultural center	0.0004	0.0000	-0.0001	0.0000	0.0000	-0.0000	0.0000
	(0.0003)	(0.0000)	(0.0001)	(0.0000)	(0.0000)	(0.0001)	(0.0000)
Access to bank	-0.0003	-0.0003	-0.0006	-0.0003	-0.0003	-0.0001	-0.0003
	(0.0008)	(0.0002)	(0.0005)	(0.0002)	(0.0002)	(0.0005)	(0.0003)
Price index	-0.0003	0.0930***	0.0721**	0.0018	0.0104	-0.0076	0.0132
	(0.0132)	(0.0245)	(0.0316)	(0.0099)	(0.0142)	(0.0126)	(0.0141)
Average annual nonagricultural wage	0.0008	0.0001	0.0011	0.0003	0.0009	0.0003	0.0005
	(0.0007)	(0.0005)	(0.0019)	(0.0004)	(0.0010)	(0.0004)	(0.0003)
Average annual agricultural wage	0.0015	0.0071**	0.0194***	0.0063***	0.0076***	0.0086**	0.0082***
	(0.0069)	(0.0029)	(0.0054)	(0.0023)	(0.0028)	(0.0038)	(0.0023)
Average time to reach a market center	-0.0002	-0.0001	-0.0002	-0.0001	-0.0000	-0.0003	-0.0001

Table A.2 continued

Variables	Urban	Rural	Poor	Nonpoor	Farmer	Non-farmer	Overall
	(0.0005)	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0004)	(0.0003)
Average time to reach a paved road	0.0005	-0.0005***	-0.0006***	-0.0005***	-0.0005***	-0.0000	-0.0005**
	(0.0004)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0003)	(0.0002)
Percentage of households with access to irrigation	-0.0002*	-0.0003***	-0.0003**	-0.0002***	-0.0003***	-0.0002**	-0.0003***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Hill	0.0077	-0.0020	0.0143	0.0067	0.0066	0.0275**	0.0090
	(0.0069)	(0.0116)	(0.0153)	(0.0093)	(0.0110)	(0.0136)	(0.0085)
Mountain	-0.0224	-0.048***	-0.0281	-0.0326**	-0.0354**	0.0468**	-0.0345
	(0.0165)	(0.0163)	(0.0214)	(0.0132)	(0.0155)	(0.0236)	(0.0215)
All-season road	0.0001	0.0001	0.0000	0.0001	0.0001	0.0008***	0.0001
	(0.0002)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Annual rainfall	-0.0000	-0.0000	0.0001	-0.0001	-0.0000	-0.0002**	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0000)	(0.0001)	(0.0001)	(0.0001)
Road density	-0.0001	0.0001	0.0009**	-0.0000	0.0002	-0.0002	0.0001
	(0.0002)	(0.0003)	(0.0004)	(0.0002)	(0.0003)	(0.0003)	(0.0003)
Urban population density	0.0000	-0.0000	-0.0000**	-0.0000	-0.0000	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Constant	0.8204***	0.7031***	0.5980***	0.8251***	0.7606***	0.7851***	0.7887***
	(0.0224)	(0.0308)	(0.0437)	(0.0189)	(0.0239)	(0.0294)	(0.0325)
Survey month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,731	9,288	2,898	9,121	9,201	2,818	12,019
Number of groups	45	74	72	74	74	64	74

Source: Authors.

Note: Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Random effects not included.

REFERENCES

Arimond, M., and M. T. Ruel. 2004. "dietary diversity Is Associated with Child Nutritional Status: Evidence from 11 Demographic and Health Surveys." *Journal of Nutrition* 134: 2579–2585.

Arimond, M., Wiesmann, D., Becquey, E., Carriquiry, A., Daniels, M.C., Deitchler, M., Fanou-Fogny, N., Joseph, M.L., Kennedy, G., Martin-Prevel, Y. and Torheim, L.E., 2010. Simple food group diversity indicators predict micronutrient adequacy of women's diets in 5 diverse, resource-poor settings. *The Journal of Nutrition*, 140(11), pp.2059S-2069S.

Behrman, J. R., and A. B. Deolalikar. 1990. "The Intrahousehold Demand for Nutrients in Rural South India: Individual Estimates, Fixed Effects, and Permanent Income." *Journal of Human Resources* 25 (4): 665–696.

Bernstein, M. A., K. L. Tucker, N. D. Ryan, E. F. O'Neill, K. M. Clements, M. E. Nelson, W. J. Evans, and M. A. F. Singh. 2002. "Higher Dietary Variety Is Associated with Better Nutritional Status in Frail Elderly People." *Journal of the American Dietetic Association* 102: 1096–1104.

Beyene, M., A. G. Worku, and M. M. Wassie. 2015. "dietary diversity, Meal Frequency and Associated Factors among Infant and Young Children in Northwest Ethiopia: A Cross-Sectional Study." *BMC Public Health* 15: 1.

Bhagowalia, P., D. Headey, and S. Kadiyala. 2012. *Agriculture, Income, and Nutrition Linkages in India*. IFPRI Discussion Paper 01195. Washington, DC: International Food Policy Research Institute.

Bhargava, A., H. E. Bouis, and N. S. Scrimshaw. 2001. "Dietary Intakes and Socioeconomic Factors Are Associated with the Hemoglobin Concentration of Bangladeshi Women." *Journal of Nutrition* 131: 758–764.

Blinder, A. S. 1973. "Wage Discrimination: Reduced Form and Structural Estimates." *Journal of Human Resources* 8: 436–455.

CBS (Central Bureau of Statistics). 2011. Nepal Living Standards Survey. Kathmandu, Nepal: CBS.

Cunningham, Kenda, Derek Headey, Akriti Singh, Chandni Karmacharya, PoojaPandey Rana. Maternal and Child Nutrition in Nepal: Examining drivers of progress from the mid-1990s to 2010s. *Global Food Security* 13 (2017) 30–37.

Disha, A. D., R. Rawat, A. Subandoro, and P. Menon. 2012. "Infant and Young Child Feeding (IYCF) Practices in Ethiopia and Zambia and Their Association with Child Nutrition: Analysis of Demographic and Health Survey Data." *African Journal of Food, Agriculture, Nutrition and Development* 12: 5895–5914.

Gebremedhin, S., K. Baye, T. Bekele, M. Tharaney, Y. Asrat, Y. Abebe, and N. Reta. 2017. "Predictors of dietary diversity in Children Ages 6 to 23 Months in Largely Food-Insecure Area of South Wollo, Ethiopia." *Nutrition* 33: 163–168.

Hatløy, A., L. Torheim, and A. Oshaug. 1998. "Food Variety a Good Indicator of Nutritional Adequacy of the Diet? A Case Study from an Urban Area in Mali, West Africa." *European Journal of Clinical Nutrition* 52: 891–898.

Hillbruner, C., and R. Egan. 2008. "Seasonality, Household Food Security, and Nutritional Status in Dinajpur, Bangladesh." *Food and Nutrition Bulletin* 29: 221–231.

Hoddinott, J., and Y. Yohannes. 2002. *dietary diversity as a Food Security Indicator*. Food Consumption and Nutrition Division Discussion Paper 136. Washington, DC: International Food Policy Research Institute.

Jann, B. 2008. "The Blinder-Oaxaca Decomposition for Linear Regression Models." *Stata Journal* 8: 453–479.

Jones, A. D., A. Shrinivas, and R. Bezner-Kerr. 2014. "Farm Production Diversity Is Associated with Greater Household dietary diversity in Malawi: Findings from Nationally Representative Data." *Food Policy* 46: 1–12.

Kant, A. K. 2004. "Dietary Patterns and Health Outcomes." *Journal of the American Dietetic Association* 104: 615–635.

Karamba, W. R., E. J. Quiñones, and P. Winters. 2011. “Migration and Food Consumption Patterns in Ghana.” *Food Policy* 36: 41–53.

Kennedy, G. L., M. R. Pedro, C. Seghieri, G. Nantel, and I. Brouwer. 2007. “dietary diversity Score Is a Useful Indicator of Micronutrient Intake in Non-breast-feeding Filipino Children.” *Journal of Nutrition* 137: 472–477.

Kumar, N., J. Harris, and R. Rawat. 2015. “If They Grow It, Will They Eat and Grow? Evidence from Zambia on Agricultural Diversity and Child Undernutrition.” *Journal of Development Studies* 51: 1060–1077.

Kumar, Anjani, Praduman Kumar and P K Joshi (2017). Food Consumption Pattern and Dietary Diversity in Nepal: Implications for Nutrition Security. Indian Journal of Human Development. 10 (3): 1-17.

Kumar, Anjani, Sunil Saroj, R K P Singh and Shiv Jee (2016). Agricultural Diversity, Dietary Diversity and Nutritional Intake: An Evidence on Inter-linkages from Village Level Studies (VLS) in Eastern India. Agricultural Economics Research Review. 29(Conf.): 15-31.

Lee, M. S., Y. C. Huang, and M. L. Wahlqvist. 2011. “Chewing Ability in Conjunction with Food Intake and Energy Status in Later Life Affects Survival in Taiwanese with the Metabolic Syndrome.” *Journal of the American Geriatrics Society* 58 (6): 1072–1080.

Marshall, T. A., P. J. Stumbo, J. J. Warren, and X.-J. Xie. 2001. “Inadequate Nutrient Intakes Are Common and Are Associated with Low Diet Variety in Rural, Community-Dwelling Elderly.” *Journal of Nutrition* 131: 2192–2196.

Miller, W. L., B. F. Crabtree, and D. K. Evans. 1992. “Exploratory Study of the Relationship between Hypertension and Diet Diversity among Saba Islanders.” *Public Health Reports* 107: 426.

Nepal, MOHP (Ministry of Health and Population). 2011. Nepal Demographic and Health Survey. Kathmandu, Nepal: MOHP.

NLSS, 2011. Central Bureau of Statistics. Nepal Living Standard Survey Kathmandu, Nepal.

NLSS, 2004. Central Bureau of Statistics. Nepal Living Standard Survey Kathmandu, Nepal.

NLSS, 1995. Central Bureau of Statistics. Nepal Living Standard Survey Kathmandu, Nepal.

Nguyen, M. C., and P. Winters. 2011. “The Impact of Migration on Food Consumption Patterns: The Case of Vietnam.” *Food Policy* 36: 71–87.

Oaxaca, R. 1973. “Male-Female Wage Differentials in Urban Labor Markets.” *International Economic Review* 14: 693–709.

Oyarzun, P. J., R. M. Borja, S. Sherwood, and V. Parra. 2013. “Making Sense of Agrobiodiversity, Diet, and Intensification of Smallholder Family Farming in the Highland Andes of Ecuador.” *Ecology of Food and Nutrition* 52: 515–541.

Rah, J. H., N. Akhter, R. D. Semba, S. De Pee, M. W. Bloem, A. A. Campbell, R. Moench-Pfanner, K. Sun, J. Badham, and K. Kraemer. 2010. “Low dietary diversity Is a Predictor of Child Stunting in Rural Bangladesh.” *European Journal of Clinical Nutrition* 64: 1393–1398.

Rao, S., Yajnik, C.S., Kanade, A., Fall, C.H., Margetts, B.M., Jackson, A.A., Shier, R., Joshi, S., Rege, S., Lubree, H. and Desai, B., 2001. Intake of micronutrient-rich foods in rural Indian mothers is associated with the size of their babies at birth: Pune Maternal Nutrition Study. *The Journal of nutrition*, 131(4), pp.1217-1224.

Rashid, D. A., L. C. Smith, and T. Rahman. 2011. “Determinants of Dietary Quality: Evidence from Bangladesh.” *World Development* 39: 2221–2231.

Rogers, B. L. 1996. “The Implications of Female Household Headship for Food Consumption and Nutritional Status in the Dominican Republic.” *World Development* 24: 113–128.

Ruel, M. T. 2003. “Is dietary diversity an Indicator of Food Security or Dietary Quality? A Review of Measurement Issues and Research Needs.” *Food Nutrition Bulletin* 24: 231–232.

Ruel, M. T., and P. Menon. 2002. “Child Feeding Practices Are Associated with Child Nutritional Status in Latin America: Innovative Uses of the Demographic and Health Surveys.” *Journal of Nutrition* 132: 1180–1187.

Sharma, A., and S. Chandrasekhar. 2016. “Impact of Commuting by Workers on Household dietary diversity in Rural India.” *Food Policy* 59: 34–43.

Smith, L. C., and L. J. Haddad. 2000. *Explaining Child Malnutrition in Developing Countries: A Cross-Country Analysis*. Washington, DC: International Food Policy Research Institute.

Steyn, N. P., J. H. Nel, G. Nantel, G. Kennedy, and D. Labadarios. 2006. “Food Variety and dietary diversity Scores in Children: Are They Good Indicators of Dietary Adequacy?” *Public Health Nutrition* 9: 644–650.

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