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ORIGINAL PAPER

Food consumption patterns and dietary diversity in eastern India: evidence from village level studies (VLS)

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Abstract The level of diversity in household diets is an indirect measure of diet quality and the extent to which nutritional needs of households are being met. There is also a positive relationship between dietary diversity and the three pillars of food security, viz., availability, access and utilization. In the light of these statements, the paper reports on the patterns of food consumption and dietary diversity in 12 selected villages of eastern India with a view to understanding the heterogeneity in food habits, quality of diet intake and the socio-economic and demographic determinants of the dietary diversity in the region. There was significant disparity across the villages in terms of budgetary shares and intake levels of different food items. The level of heterogeneity in food intake was also reflected in the estimates of dietary diversity across villages. Multiple regression analysis on the determinants of dietary diversity showed that larger households with better-educated male heads and higher purchasing power fared well on dietary diversity scores. Access to the Public Distribution System (PDS) also contributed to enhancement of dietary diversity through an indirect route, as PDS beneficiaries are better able to afford diverse food items. In contrast, low social status in the form of affiliation to scheduled castes/scheduled tribes (SC/ST) diminished diversity scores. From a policy perspective, it is therefore important to focus interventions on improving dietary diversity and nutrition security with proper understanding of the socio-economic setting of the target area and its population.

Keywords Household food security · Food policy · Dietary diversity · Eastern India

Introduction

The dietary habits of people of a region have substantial implications for the quality of life of its population. 'Dietary habit' broadly indicates the types, variety and quality of food intake and is highly dependent on the demographics of the consumer population. With available household-level information on individual food items consumed, their shares in total consumption, frequency of intake and nutrient composition, it is possible to make general assessments of their dietary habits. One of the commonly used indicators for objective assessment of healthy dietary habits is 'dietary diversity', which measures the number of different types of food items included in a food basket. It may be defined as the variety of foods across and within food groups capable of ensuring adequate intake of essential nutrients that can promote good health (WHO/FAO 1996; Ruel 2002). The level of diversity in household diets is an indirect measure of diet quality or the extent to which nutritional needs of the households are being met. Diets with greater variety of foods or food groups are associated with greater energy and nutrient intake (Kant 2004; Rose et al. 2002; Tarini et al. 1999). Dietary diversity has also been positively linked with the three pillars of food security (availability, access and utilization) based on the

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results of empirical studies (Bernal and Lorenzana 2003; Styen et al. 2006; Hillbrunner and Egan 2008). Therefore, understanding household dietary diversity may be an alternative and easier pathway to assess household level food security (Taruvinga et al. 2013; Thorne-Lyman et al. 2010, Headey and Ecker 2013). The dietary diversity of people in a region is determined by a variety of factors including agricultural biodiversity in the region and diversity of its farming systems (Jones et al. 2014; Oyarzun et al. 2013; Herforth 2010), historical consumption habits of the population, local practices and level of technology associated with food production, processing and storage (Keding et al. 2013), income/expenditure levels of the inhabitants (Doan 2014; Taruvinga et al. 2013; Drescher et al. 2009) and demographic and socio-economic characteristics of households. Against this backdrop, the current study examines the food consumption patterns and dietary diversity in eastern India, based on household level data from 12 villages with a view to exploring the heterogeneity in food habits, quality of diet intake and the various household-specific socio-economic and demographic factors that determine the observed dietary patterns.

Eastern India represents a relatively under-developed region in India with low per capita income, unimpressive anthropometric parameters of inhabitants, and a reportedly high level of food insecurity. Data from the National Family Health Survey (IIPS and Macro International 2007) revealed high incidences of wasting and stunting in children and anemia and low BMI in adult men and women. Similarly, studies conducted across the states of India, based on composite indices of malnutrition, reported serious levels of food insecurity in eastern India, particularly concentrated in the states of Bihar, Jharkhand, Chhattisgarh and Odisha (Gulati et al. 2012; MSSRF 2008). The government sponsored Public Distribution System (PDS), which is one among the largest in the world for ensuring subsidized distribution of essential food grains to eligible beneficiary households, is also reported to be performing poorly in eastern Indian states. High prevalence of targeting errors (errors of exclusion and inclusion) and unauthorized diversion of PDS food grains have been recorded in recent studies in most of the above states[1] (Swaminathan 2009; Khera 2011a, b).This study is therefore intended to examine empirically the consumption habits of people in the region, based on cross-sectional data collected through primary surveys. The next section elaborates the data and methodology used in the study, followed by a detailed discussion on food consumption and expenditure patterns of the sample households. Analysis of dietary diversity and its determinants follows in the next section and the last section concludes with the key findings of the study and suggestions for action.

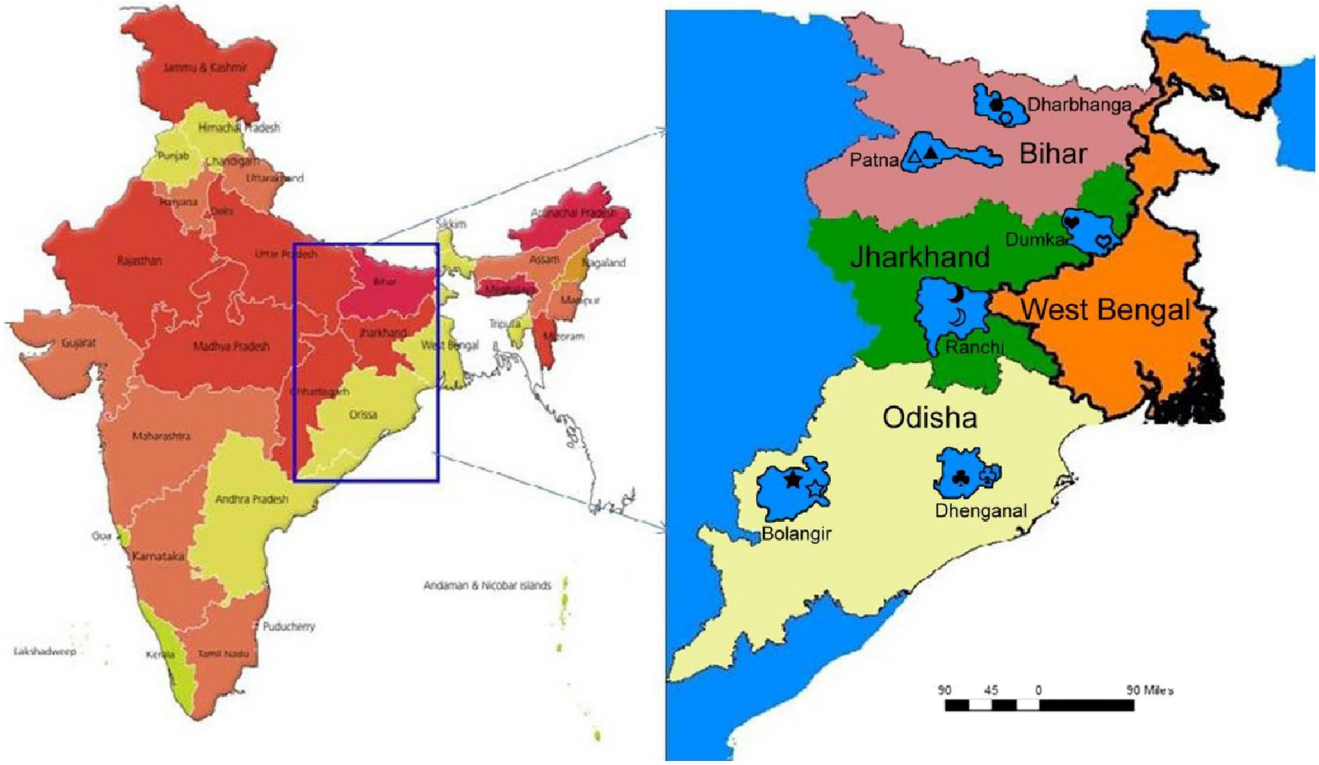
Methodology

Data

This study used an annual round (2011–12) of cross-section data, which forms part of the high-frequency panel data collected through the Village Level Studies (VLS)[2] of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).These data are comprehensive household, individual, and plot level records collected from selected villages on a continuous basis over several years. During data collection, the resident investigators re-interview the participating households several times per year so as to capture the dynamics of the households, including their expenditure, income, consumption, investment and farming practices. In the present context, the data pertains to 12 villages in eastern India (Arap and Bhagakole villages of Patna district; Susari and Inai villages of the Darbhanga district of Bihar state; Dubaliya and Hesapiri villages of Ranchi district; Dumariya and Durgapur villages of Dumka district of Jharkhand state; Sogar and Chandrasekhapur (CSpur here onwards) villages of Dhenganal district; and Ainlatunga and Bilaikani villages of Bolangir district of Odisha state). The geographical locations of the selected villages are illustrated in Fig. 1 and their socio-economic and demographic characteristics were abstracted from the forms depicted in Appendix 1. From each village, 40 households were selected (480 households from 12 villages) and were monitored on a sustained basis. The selected households were categorized into various farm-size classes based on the size of land they possessed. First, all households in a village possessing land area less than or equal to 0.5 acres were classified as ‘marginal’ households. All the remaining households were categorized into tercile groups, each containing a third of the population. The bottom, middle and top tercile groups were referred to as ‘small’, ‘medium’ and ‘large’ households, respectively.

[1] The state of Chhattisgarh is an exception, where the recent attempts to revitalize the PDS has brought about inspiring results. The state embraced a near universal PDS in the year 2005 and is highly successful in providing subsidized food grains with negligible levels of unauthorized leakages.

[2] The VLS are longitudinal surveys initiated by ICRISAT in 1975 in 10 semi-arid tropical Indian villages. The surveys continued for the next 10 years, before formally closing in 1985 in response to budgetary pressure. The surveys were re-opened in 2002 in the initial six villages, starting with low frequency rounds and with higher frequency interviews since 2005–06. Subsequently in 2010, the programme was redesigned under the title, ‘Village Dynamics in South Asia (VDSA), extending the activities to Eastern India and Bangladesh. This initiative was funded by the Bill and Melinda Gates Foundation (BMGF) and implemented in India in collaboration with Indian Council of Agricultural Research (ICAR), State Agricultural Universities (SAUs) and other local organizations. The VLS data however cannot be treated as representative data for districts, states or the agro-climatic region within which the villages are located due to the relatively small sample coverage.



Legend:

△	Arap	◗	Dubaliya	♣	Sogar
▲	Baghakole	☽	Hesapiri	♧	CSpur
⬡	Inai	❤	Dumariya	★	Ainlatunga
⬢	Susari	♡	Durgapur	☆	Bilaikani

Fig. 1 Map showing geographic locations of the selected villages in Bihar, Jharkhand and Odisha (Orissa) states of India

Empirical framework

The paper specifically examines the food consumption pattern, dietary diversity and its determinants of the sample households in the selected villages using the VLS data collected during the agricultural year 2011–12 (July, 2011 to June 2012). Quantity of food items consumed by respondent households was recorded based on a 30-day recall period.[3] The recall was administered to the heads of households at monthly intervals during the above period. Questionnaires were quite exhaustive with almost all types of food items generally consumed by rural inhabitants in India represented (See supplementary electronic material). They not only included foods prepared and consumed within the household, but also those that were consumed outside (e.g. at restaurants, social functions and children's mid-day meal programmes) including processed food items, beverages and intoxicants. Various aspects related to food intake such as the shares of various food items in total expenditure, per capita intake and share of home produce in total consumption of each food group and the contribution of the Public Distribution System (PDS) to household supply of cereals were probed. Further, diversity in the consumption basket of sample households was analyzed in detail using the Simpson Index of Dietary Diversity (SIDD) estimated according to the following formula:

$$SIDD = 1 - \sum_{i=1}^{n} P_i^2,$$

[3] A recall period of 30 days is generally considered too long, particularly for studies related to dietary diversity. However, under VLS programme, the sample households are sensitized to keep a record of their day-today consumption on a regular basis with help of their female members. Unless migrated, these households remain in the VLS records as regular data suppliers as long as the programme continues in the region. The resident nature of investigators also helps in checking discrepancies in the data, so minimizing sampling bias.

where, P_i is the proportion of i^{th} food item in total monthly consumption of all food by the members of the household. The monthly estimates were subsequently averaged to get the final SIDD estimate for the year under consideration. The index ranges between 0 and 1, where its value moves towards 0 in case of complete specialization. Separate scores of SIDD were obtained for households belonging to each village across farm size classes for comparison. To further understand the variation in diversity scores across different groups of households and to attribute this variation to different household-specific socio-economic and demographic determinants, a multiple linear regression model, as shown below, was fitted;

$$SIDD_i = \alpha + \beta Z_i + \gamma E_i + \delta O_i + \theta S_i + u_i \quad (1)$$

In the above equation, $SIDD_i$denotes the dependent variable representing dietary score of the households. Among the set of explanatory variables, Z_i represents a vector containing variables on sociological and demographic characteristics of the household such as age, sex and education of the family head, household size, caste affiliation and their food consuming habit (vegetarian versus non-vegetarian). $E_i$is a vector that represents the economic status and access of the household and includes variables such as per capita expenditure of the household, a dummy that determines the access of households to PDS, and another one to specify whether the household has any non-farm source of income or not. Ownership by the household of productive assets such as land and livestock was represented by the vector O_i.It includes three dummy variables that capture the farm-size class of the households, and another dummy that designates ownership of livestock. The vector S_i represents two dummy variables that identify the households by the state which they belong to. u_i is the error term and is assumed to be normally distributed. All the variables except the binary dummy variables were converted to log form before estimating the model.

Results and discussion

Food consumption and expenditure patterns

The expenditure patterns of the sample households across farm-size groups are presented in Table 1. Significant variation was observed in the level of expenditure made by households across villages as well as farm-size class. In Bihar state, monthly per capita expenditure on all goods averaged for all households in Baghakole and Inai villages was greater than the other two villages. Similarly, households in Dumariya and Bilaikani were ahead of their counterparts in their respective states in such expenditure. Among all 12 villages, Bilaikani stood out with the highest average expenditure of Rs. 1825/capita/month. On the other hand, villages such as Arap, Susari, Hesapiri and Durgapur were notable for their relatively low per capita monthly expenditure which fell in the range of Rs. 540 to 995. Though the expenditure pattern of households did not entirely match their farm size, the general trend was for households with larger sized farms to spend more. Exceptions to this rule were Dubaliya, Hesapiri and Durgapur in Jharkhand and Sogar, Ainlatunga and Bilaikani in Odisha. This could be due to higher non-farm income accrued by the smaller farm-size households in these villages. The share of food in total expenditure was above 50 % in most of the villages irrespective of the farm-size groups. However, a few villages such as Inai in Bihar, Dubaliya in Jharkhand and Sogar in Odisha, allocated less than 50 % of their total expenditure to purchase of food. As expected, the average expenditure of these villages was higher than the others. Also, the share was found to decrease with increase in farm-size (and with increase in magnitude of total expenditure in general), thereby upholding Engel's Law.

Table 2 shows the average consumption of various food items in the sample households in the selected villages. Cereals were the main source of dietary nutrients in all villages, with rice and wheat being the main staples. The share of cereals in total food expenditure varied between 24.3 % in CSpur to as high as 79.5 % in Hesapiri. Significant disparity in cereal consumption was noticed across the villages, with CSpur consuming the lowest at 11.92 kg/capita/month, whereas villages such as Ainlatunga and Bilaikani consumed almost double that amount. However, cereal consumption in all the sample villages was higher than the all India rural average of 11.35 kg/capita/month for the year 2009–10. Consumption of pulses and oils, on the other hand, were relatively lower (less than 1 kg/capita/month) in most of the villages except Ainlatunga and Bilaikani, both belonging to the Bolangir district of Odisha. As with pulses and oils, limited consumption of fresh fruits was reported by households belonging to villages in Bihar and Jharkhand, whereas those from Odisha consumed higher quantities. On the contrary, vegetable consumption was quite high in most of the villages, with Dumariya (16.20 kg/capita/month), Bilaikani (13.81 kg/capita/month) and Ainlatunga (9.49 kg/capita/month) topping the list. The villages of Bihar, particularly Arap and Baghakole, were far ahead of their counterparts from Jharkhand and Odisha in terms of milk consumption. Average consumption of non-vegetarian food was quite low in the majority of the villages, with the exception of Ainlatunga and Bilaikani, where the consumption of meat, and fish and egg

Table 1 Average monthly per capita expenditure across farm-size classes in sample households in eastern-India, 2011

					(Rupees/capita/month)	
State	Village	Marginal	Small	Medium	Large	All
Bihar	Arap	520	849	1146	1425	995
		(65.8)	(74.2)	(64.9)	(74.1)	(70.3)
	Baghakole	615	1044	1548	1892	1226
		(67.1)	(63.3)	(51.8)	(58.4)	(58.9)
	Inai	922	1055	1301	1485	1210
		(45.8)	(42.2)	(38.4)	(39.3)	(40.9)
	Susari	661	733	889	1046	848
		(56.8)	(61.1)	(54.8)	(44.6)	(52.7)
Jharkhand	Dubaliya	1655	964	958	1172	1156
		(29.3)	(46.6)	(55.3)	(55.3)	(46.3)
	Hesapiri	506	442	546	652	540
		(65.4)	(72.5)	(67.4)	(58.7)	(65.2)
	Dumariya	1607	1825	1852	1916	1800
		(65.2)	(58.8)	(55.7)	(65.6)	(60.9)
	Durgapur	676	518	570	826	639
		(56.0)	(63.9)	(67.9)	(56.8)	(60.8)
Odisha	Sogar	924	1408	965	1428	1192
		(51.1)	(44.1)	(56.2)	(47.5)	(49.2)
	CSpur	698	729	1330	1403	1063
		(74.6)	(68.2)	(43.7)	(39.5)	(50.7)
	Ainlatunga	1123	1736	1288	1661	1482
		(57.3)	(42.6)	(61.7)	(48.4)	(50.9)
	Bilaikani	1848	1560	1390	2474	1825
		(47.2)	(58.7)	(60.4)	(47.1)	(52.4)

Note: Figures in parentheses indicate share (%) of food in total expenditure

combined were relatively higher at 0.87 kg/capita/month and 1.70 kg/capita/month, respectively. To throw more light on this aspect, the percentage of sample households which consumed non-vegetarian diets (where at least one member of the household consumed non-vegetarian food at any time during the year) in each village was estimated (Fig. 2). In three villages of Bihar state, Arap, Baghakole and Susari, 62, 60 and 45 % of the households were pure vegetarian, not consuming non-vegetarian food at any time during the year. Inai was a clear exception, with 95 % of the households being non-vegetarian. Similarly, except Dumariya where 15 % of the households were pure vegetarians, all other sample households in Jharkhand state were non-vegetarian. In Odisha state, all Sogar and CSpur households and more than 90 % of households in Ainlatunga and Bilaikani consumed non-vegetarian food. Thus, the diversity of food consumption was very low in most villages, with a predominant dependence of household members on cereals and vegetables (and milk in the villages of Bihar) for meeting their energy and nutrient requirements. Evidently, the consumption of fruits, milk (with the exception of Bihar), and non-vegetarian food items were much lower than the All-India average[4] in the majority of the villages. All villages of Bihar and Jharkhand as well as two villages of Odisha (Sogar and CSpur) belonged to this category, while Dumariya, Ainlatunga and Bilaikani were clear exceptions. The latter three villages were conspicuous by their exceptionally high consumption of almost all food items, which is even higher than the average for the rest of India. Cereal and vegetable consumption in these villages was 2–3 times higher than the All-India average and speaks of their deviance from rest of the country. This variation in eating habits in certain pockets of eastern India, particularly in Odisha, may be attributable to the nature of their work, caste and religious affiliations.[5] A detailed investigation showed that residents of these villages resorted to cheaper

[4] The all-India average monthly consumption of various food items in rural areas as per the 66th round (2009–10) of National Sample Surveydata are; Cereals: 11.35 kg/capita; pulses: 0.65 kg/capita; oils: 0.65 kg/capita; vegetables: 4.04 kg/capita; fresh fruits: 0.91 kg/capita; milk: 4.12 kg/capita and meat, fish and egg: 0.59 kg/capita.

[5] People belonging to upper-castes, particularly Brahmins are known to eat heavily in relation to others, irrespective of their economic status.

Table 2 Consumption of various food items in sample households of eastern-India, 2011

State	Village	Cereals	Pulses	Oils	Fresh fruits	Vegetables	Milk	(kg/person/month) Meat, fish & egg	Others
Bihar	Arap	18.72	0.68	0.74	0.71	8.35	13.01	0.05	–
		(27.4)	(4.0)	(8.7)	(1.9)	(13.0)	(33.0)	(0.7)	(11.2)
	Baghakole	17.70	0.78	0.66	0.60	10.79	8.68	0.12	–
		(31.5)	(5.0)	(7.6)	(2.9)	(13.2)	(24.4)	(1.3)	(14.1)
	Inai	13.40	0.60	0.41	0.87	6.54	4.36	0.34	–
		(36.7)	(5.2)	(7.4)	(4.9)	(12.4)	(17.3)	(8.3)	(7.8)
	Susari	12.51	0.62	0.38	0.35	4.21	6.04	0.11	–
		(37.1)	(6.6)	(7.7)	(2.1)	(9.1)	(27.2)	(2.9)	(7.3)
Jharkhand	Dubaliya	16.33	0.32	0.53	0.29	6.81	0.79	0.62	–
		(39.3)	(3.2)	(8.8)	(2.1)	(14.6)	(4.2)	(13.5)	(14.2)
	Hesapiri	14.02	0.51	0.33	0.08	6.77	0.31	0.20	–
		(79.5)	(2.9)	(4.4)	(0.1)	(6.2)	(0.5)	(0.4)	(6.0)
	Dumariya	21.57	1.46	1.15	0.72	16.20	4.93	0.79	–
		(24.4)	(6.8)	(9.0)	(2.0)	(16.8)	(14.0)	(8.6)	(18.4)
	Durgapur	15.11	0.49	0.51	0.10	5.85	0.32	0.42	–
		(46.4)	(7.5)	(11.6)	(0.7)	(14.1)	(1.8)	(8.7)	(9.2)
Odisha	Sogar	13.29	0.93	0.54	1.41	6.92	2.49	0.47	–
		(35.4)	(7.4)	(6.8)	(3.4)	(15.3)	(10.7)	(9.5)	(11.6)
	CSpur	11.92	0.71	0.51	1.06	6.76	2.01	0.66	–
		(24.3)	(8.6)	(9.9)	(4.4)	(15.7)	(12.2)	(12.7)	(12.2)
	Ainlatunga	20.16	1.60	0.83	1.67	9.49	0.47	0.87	–
		(24.8)	(11.0)	(9.0)	(4.8)	(17.0)	(1.4)	(13.7)	(18.3)
	Bilaikani	25.87	2.12	1.09	1.47	13.81	2.12	1.70	–
		(25.7)	(6.5)	(8.0)	(3.6)	(16.9)	(2.7)	(18.1)	(18.4)

Note: Figures in parentheses indicate share (per cent) of each food item in total food expenditure

quality cereals and low-priced seasonal vegetables thereby minimizing the impact on their household budget. Thus, the sample villages were diverse in their dietary habits with high disparity in absolute as well as relative levels of consumption of various food items.

The level of self-sufficiency of the sample households in the food items consumed by them is depicted in Table 3. In general, the sample villages of Bihar were highly self-sufficient in most of the food they consumed, except the non-vegetarian items. The share of home produce in total cereals consumed was above 60 %, while the share ranged between 15 and 72 % in pulses across the four villages in Bihar state. In the case of edible oils, while Arap was the most self-sufficient (62.4 % home-produced), Susari stood at the opposite extreme with 100 % dependence on outside sources. Bihar villages were particularly self-reliant for milk with 42–86 % their consumption being produced at home, explaining their higher milk consumption in relation to the rest of the villages. In Jharkhand, the share of home-produce in total consumption was relatively higher in the case of cereals, vegetables and milk, though disparate trends were observed across the villages for individual items. Unlike most other villages, Hesapiri and Durgapur produced nearly one-fifth of their requirements for meat, fish and eggs as a group. In Odisha, households, apart from those in Ainlatunga, were self-reliant for about half their cereals and milk, but relied on outside sources for most of their pulses, fresh fruit and vegetables, particularly oils and non-vegetarian food items.

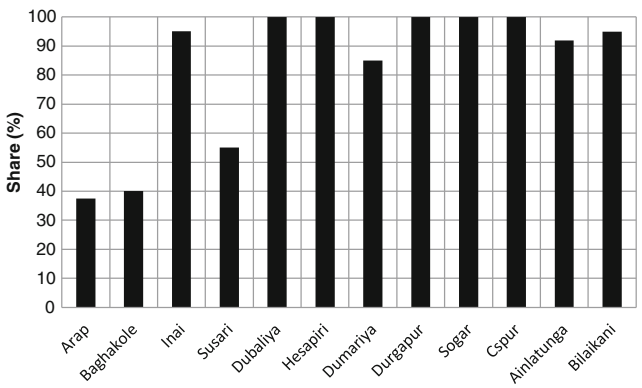


Fig. 2 Share of non-vegetarian households in the sample villages in eastern India, 2011

Table 3 Percent of home produced food items consumed by sampled households in eastern-India, 2011

State	Village	Cereals	Pulses	Oils	Fresh fruit	Vegetables	Milk	Meat, fish & egg
Bihar	Arap	64.7	71.7	62.4	55.8	29.2	86.4	1.4
	Baghakole	66.5	14.6	13.5	4.6	23.0	86.4	0.0
	Inai	63.0	40.7	21.2	15.6	25.1	41.8	0.0
	Susari	66.8	30.2	0.0	46.1	15.2	59.7	0.0
Jharkhand	Dubaliya	39.8	6.2	2.2	40.4	25.6	57.0	2.5
	Hesapiri	46.6	32.3	0.8	2.8	27.9	61.5	21.0
	Dumariya	20.6	13.0	0.0	3.1	24.1	66.6	8.3
	Durgapur	38.5	0.8	0.0	53.6	6.4	92.8	21.9
Odisha	Sogar	58.6	21.6	0.5	19.4	15.1	64.1	4.5
	CSpur	56.7	8.2	0.2	23.7	25.8	45.5	0.1
	Ainlatunga	9.3	4.2	1.9	16.0	7.0	38.2	1.4
	Bilaikani	42.4	43.3	0.0	18.0	11.1	60.5	27.6

In the sample villages, household food requirements beyond those produced at home were obtained either from the open market or the PDS.[6] PDS was the major source of cereals and was highest in Odisha followed by Jharkhand and least in Bihar (Table 4). Inter-village and inter-state disparities in PDS dependence could be attributed to a number of determinants such as differences in performance of PDS delivery services in the states, socio-economic profile of households and people's consumption habits. Among the four Bihar villages, Arap sourced 18.7 % of their cereals from PDS, followed by Baghakole (11.8 %), Inai (3.3 %) and the least being Susari (0.40 %). In Jharkhand, PDS accounted for 25–36 % of the cereals consumed by households, whereas in Odisha, PDS dependence ranged from16 to 50 %. Among all villages, Ainlatunga was the most PDS oriented with almost half its cereal requirement being met from this subsidized grain delivery system. Households belonging to smaller land categories relied more on PDS for grains than those belonging to larger land categories, indicating successful beneficiary targeting. A few exceptions to this rule included CSpur, Ainlatunga and Bilakani in Odisha state, where the smaller land classes were economically stronger owing to their higher non-farm income.

Dietary diversity

Dietary diversity can serve as a proxy measure for nutritional adequacy (Jones et al. 2014). In the present study, there was an almost perfect positive linear relationship between dietary diversity and household per capita expenditure (Fig. 3). Higher levels of household expenditure allowed access to more food groups, increasing dietary diversity. This relationship held good even when the sample was disaggregated at village level. Villages with higher per capita expenditure fared well on dietary diversity scores. For instance, villages such as Arap, Baghakole, Inai, Dumariya, CSpur, Ainlatunga and Bilaikani, which scored 0.80 and above on SIDD (Table 5), were also on the higher side of the household per capita expenditure scale. On the other hand, two villages of Jharkhand (Hesapiri and Durgapur) which were lowest in terms of per capita expenditure were also low on their dietary diversity score. Dubaliya was a clear exception with a low SIDD score of 0.69 in spite of the higher average per capita expenditure of its households (Rs. 1156/month). However, there was minimal variation in dietary scores among the different categories of farm-size.

Determinants of dietary diversity

This section explores the determinants of dietary diversity among sampled households using a regression framework. As elaborated in the methodology section, determinants of dietary diversity could include a variety of socio-economic

Table 4 Percent of cereals purchased from PDS by sampled households in eastern-India, 2011

	Village	Marginal	Small	Medium	Large	All
Bihar	Arap	43.5	25.1	12.8	0.0	18.7
	Baghakole	30.7	12.0	3.8	0.0	11.8
	Inai	8.6	1.7	3.5	0.2	3.3
	Susari	1.0	0.4	0.2	0.0	0.4
Jharkhand	Dubaliya	25.2	23.9	22.4	33.7	26.9
	Hesapiri	46.1	38.3	31.8	31.1	36.4
	Dumariya	34.3	33.4	25.1	18.6	27.3
	Durgapur	21.0	34.4	21.2	24.6	25.3
Odisha	Sogar	38.5	14.5	9.9	6.3	16.2
	CSpur	41.4	47.4	48.1	23.4	39.0
	Ainlatunga	46.6	52.8	48.8	49.9	49.9
	Bilaikani	30.1	37.5	32.2	19.6	29.5

[6] Cereals (mainly rice and wheat) constitute the major share of PDS supplies in India.

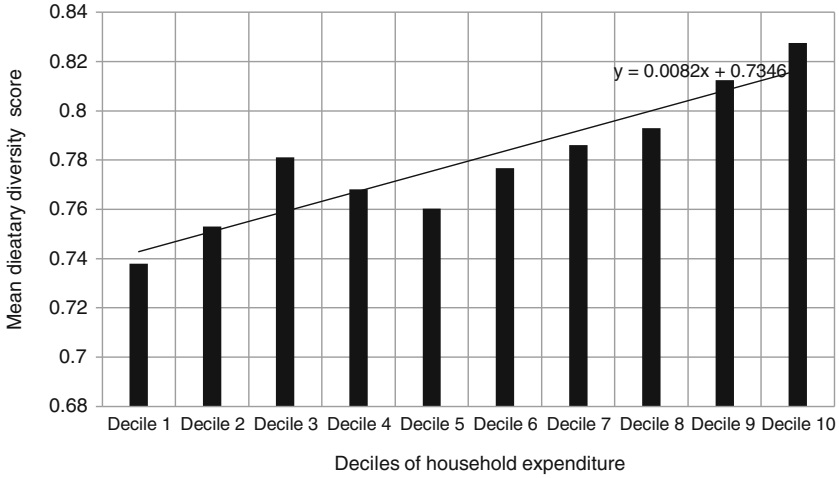


Fig. 3 Mean dietary diversity score by deciles of per capita expenditure in sample households of eastern India, 2011

as well as demographic variables such as age, gender and education of the household head, household size, its caste affiliation, consumption habits, expenditures made on consumables, access to PDS, non-farm sources of income, ownership of productive assets such as land and livestock and state of residence. The choice of the explanatory variables included in the analysis was guided by previous empirical literature on this subject (Liu et al. 2014; Jones et al. 2014; Thorne-Lyman et al. 2010; Thiele and Weiss 2003). Accordingly, a multiple linear regression model with double-log transformation was fitted, taking SIDD as the dependent variable. The model was estimated using weighted least squares (WLS) procedure to tackle the underlying heteroscedasticity problem. Overall fit of the model was significant at the 1 % level with an adjusted R^2 value of 0.64 (Table 6). The coefficient of the variable 'age of the household head' was insignificant, suggesting no apparent causality of this variable on the level of dietary diversity. However, education of the household head was significant and positive in determining the dietary basket. Ample literature is in line with this result as education not only improves knowledge of health and nutrition but also lowers the cognitive cost associated with consuming variety (Liu et al. 2014; Gronau and Hamermesh 2008). Similarly, male-headed households showed higher inclination to consume diverse types of food items. On further probing the data for underlying reasons, it was noticed that female-headed households commanded relatively lower purchasing power (average annual expenditure per capita Rs.11,728) compared to that of male-headed households (average annual expenditure per capita Rs.14,034). As dietary diversity increases linearly with household expenditure, the lower income of female-headed households may explain this result rather than gender per se. The positive and significant coefficient with respect to the variable 'household size' signifies higher dietary diversity in households with more members. On the other hand, households affiliated to scheduled castes/scheduled tribes (SC/ST)[7] had lower

Table 5 Estimated scores of SIDD for sample households across farm-size classes in eastern-India, 2011

State	Village	Marginal	Small	Medium	Large	All
Bihar	Arap	0.86	0.85	0.84	0.83	0.84
		(0.01)	(0.02)	(0.03)	(0.01)	(0.02)
	Baghakole	0.86	0.85	0.84	0.83	0.85
		(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
	Inai	0.81	0.81	0.83	0.82	0.82
		(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
	Susari	0.79	0.79	0.79	0.77	0.78
		(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
Jharkhand	Dubaliya	0.67	0.69	0.67	0.75	0.69
		(0.10)	(0.05)	(0.06)	(0.05)	(0.07)
	Hesapiri	0.74	0.72	0.70	0.73	0.72
		(0.03)	(0.07)	(0.08)	(0.07)	(0.06)
	Dumariya	0.83	0.84	0.82	0.84	0.83
		(0.04)	(0.03)	(0.03)	(0.01)	(0.01)
	Durgapur	0.63	0.62	0.62	0.67	0.64
		(0.11)	(0.11)	(0.12)	(0.10)	(0.11)
Odisha	Sogar	0.77	0.78	0.74	0.77	0.77
		(0.05)	(0.04)	(0.06)	(0.06)	(0.05)
	CSpur	0.79	0.78	0.82	0.80	0.80
		(0.04)	(0.03)	(0.03)	(0.04)	(0.05)
	Ainlatunga	0.78	0.80	0.84	0.79	0.80
		(0.07)	(0.06)	(0.04)	(0.04)	(0.05)
	Bilaikani	0.77	0.82	0.79	0.80	0.80
		(0.05)	(0.03)	(0.04)	(0.06)	(0.05)

Note: Figures in parentheses indicate standard deviation in SIDD

[7] The Scheduled Castes (SCs) and Scheduled Tribes (STs) are official designations given to various groups of historically disadvantaged people in India.

Table 6 Multiple regression results of determinants of household dietary diversity in eastern India, 2011

Dependent variable – Log (SIDD)		
Variable	Coefficient	Standard error
Constant	−1.335	0.095
Socio-Demographic variables (Z_i)		
Log (Age of the household head (years))	0.000	0.012
Education of the household head (secondary & above =1, otherwise =0)	0.018**	0.008
Gender of the household head (male =1, female =0)	0.067***	0.012
Log (Household size (no.))	0.065***	0.008
Caste affiliation (SC/ST = 1, others =0)	−0.034***	0.009
Vegetarian dummy (did not consume any non-vegetarian food in last one year =1, otherwise =0)	0.017	0.015
Economic variables (E_i)		
Log (Annual per capita expenditure (Rs.))	0.051***	0.009
Log (Annual per capita expenditure on food (Rs.))	0.037***	0.012
Access to PDS (PDS consumer =1, otherwise =0)	0.065***	0.008
Nonfarm source of income (at least one member employed in nonfarm sector =1, otherwise =0)	−0.005	0.007
Variables of ownership of productive assets (O_i).		
Land class 1 (marginal =1 otherwise =0)	0.014	0.011
Land class 2 (small =1 otherwise =0)	−0.003	0.011
Land class 3 (medium =1 otherwise =0)	0.017	0.013
Livestock dummy (own livestock =1, otherwise =0)	0.013	0.008
State dummy variables (S_i)		
State dummy (Bihar)	0.127***	0.013
State dummy (Odisha)	0.035***	0.009
No. of observations	480	
F value	53.83	
Adjusted R^2	0.64	

Note: ***, ** and * denote significance at 1 %, 5 % and 10 % respectively

dietary diversity as is clear from a negative and significant coefficient associated with this variable. Among the economic variables, the level of annual per capita total expenditure as well as food expenditure of the household had strong influences on the level of dietary diversity, a finding in agreement with much previous literature (Liu et al. 2014; Jones et al. 2014; Hoddinott and Yohannes 2002). Access to PDS was another major determinant of dietary diversity. Rather than directly augmenting diversity in consumption, access to highly subsidized food under PDS acts by allowing the household budgetary savings thus accrued to be spent on additional food items. The dummy variables that denoted access to non-farm income did not return any significant coefficient. Similarly, farm-size as well as livestock dummies were insignificant, ruling out any direct causality between asset ownership and household dietary diversity. The coefficients with respect to state dummies indicate that dietary diversity in Bihar and Odisha were significantly higher than that of the reference state, Jharkhand.

Conclusions

This paper examined the pattern of food consumption as well as dietary diversity in 12 selected villages of eastern India with a view to understanding the heterogeneity of food habits and its drivers in the region. Significant disparity was observed across the sample villages in terms of budgetary shares on different food items and their intake levels. Cereals were the main staples, though their shares in total food expenditure varied considerably across the villages. Households predominantly depended on cereals and vegetables to meet their energy and nutrient requirements, with relatively low consumption of other food items such as pulses, fruits, edible oils, milk (with the exception of villages in Bihar state).Consumption of non-vegetarian foods was particularly low in the study area. Close to half of the households in three Bihar villages were purely vegetarian. In general, the sample households from the four villages in Bihar were high in terms of self-sufficiency in staples, being above 60 % for cereals but ranging between 15 and 72 % for pulses and 42 and 86 % for milk. In

Jharkhand, the share of home-produce was high in the case of cereals, vegetables and milk, though disparate trends were observed across the villages on individual items. In Odisha too, households were fairly self-reliant on cereals and milk, but less so on pulses, fresh fruits and vegetables and least on oils and non-vegetarian food items. PDS was the main source of cereals, beyond that produced at home, in most of the sample villages. The dependence of households on PDS for cereals was highest in Odisha followed by Jharkhand and least in Bihar. Irrespective of location, households belonging to smaller land categories relied more on PDS for grains in relation to their counterparts in general. The level of heterogeneity in food intake in the study area was apparent from the estimates of dietary diversity compared across villages. In general, households and villages with higher per capita expenditure also had higher dietary diversity scores. However, no apparent patterns in dietary diversity were observed across farm-size classes. A variety of household-specific socio-economic and demographic variables had significant effects on dietary diversity, as shown by the multiple regression analysis. Households with better-educated male heads fared well in terms of dietary diversity in relation to their counterparts. Similarly, larger households with greater purchasing power and access to PDS scored higher in dietary diversity. In contrast, low social status in the form of affiliation to SC/ST reduced diversity scores of households. From a policy perspective, it is therefore important to focus interventions on improving dietary diversity and nutrition security with proper understanding of the socio-economic setting of the target area and its population.

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Appendix 1

Table 7 Socio-economic and demographic profile of sample households in Eastern India, 2011

Particulars/ Village	Unit	Bihar				Jharkhand				Odisha			
		Arap	Baghakole	Inai	Susari	Dubaliya	Hesapiri	Dumariya	Durgapur	Sogar	CSpur	Ainlatunga	Bilaikani
Number of households in village	No.	722.0	503.0	590.0	644.0	211.0	355.0	293.0	298.0	428.0	302.0	307.0	171.0
Average age	Years	55.0	49.0	51.0	55.0	49.0	42.0	53.0	45.0	53.0	53.0	44.0	46.0
Family size	No.	6.9	7.4	7.3	8.1	5.6	6.2	5.6	4.9	6.7	5.0	4.7	5.0
Male-headed household	Per cent	95.0	95.0	87.5	95.0	87.5	100.0	97.5	82.5	100.0	95.0	100.0	100.0
Sex-ratio	Per 1000 male	895.1	846.2	847.1	975.5	811.5	959.3	833.3	927.8	800.0	949.5	936.2	982.5
Education	Year	8.8	9.7	5.6	6.4	4.5	3.7	4.0	4.1	5.4	4.1	4.2	5.6
Literacy	Per cent	78.3	83.1	72.3	73.0	76.7	54.2	70.2	54.6	84.1	70.3	72.4	80.5
Average size of operational holding	Hectare	1.2	1.6	1.2	0.8	0.9	0.9	0.6	0.7	0.8	1.7	1.0	1.2
Irrigated area	Per cent	96.1	95.3	51.7	96.2	22.2	15.5	19.5	0.0	54.0	4.7	26.6	42.9
Average annual income	1000 Rupees	238.7	387.2	156.7	105.1	167.6	92.6	90.4	40.0	125.9	76.6	47.4	114.4
Share of income from farm	Per cent	12.3	27.8	5.9	1.8	19.8	16.2	18.1	11.8	8.3	45.7	32.5	39.8

Source: Farm survey 2011, VLS

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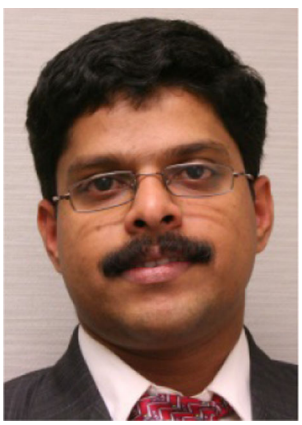

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