

## Original Research Article

# Dietary Diversity of Households in Villupuram district of TamilNadu

### ABSTRACT

**Aims:** To assess the factors influencing dietary diversity of Public Distribution System Beneficiary Households in rural and urban areas.

**Study design:** Purposive Random Sampling was used.

**Place and Duration of Study:** In Tamil Nadu, the Villupuram district was purposively selected for the study. The survey was conducted for the collection of primary data about the period April to May 2022.

**Methodology:** Based on the food security index of Tamil Nadu State Human Development Report 2017, the Villupuram district was selected for the study which falls under the low food security index. In this district, rural and urban households were randomly selected. The Simpson Dietary Diversity Index was used for the analysis. The Multiple Linear Regression method was used to understand the difference in food habits, quality of diet intake, and the socioeconomic and demographic determinants of the dietary diversity of public distribution system beneficiary households in the study area.

**Results:** The overall result of the Simpson Index of Dietary Diversity (SIDDD) score of rural and urban households are 0.78 and 0.85 respectively. The results clearly showed that urban PDS beneficiary households had higher dietary diversity than rural PDS beneficiaries' households. Monthly income, age, household size, and distance of PDS shops may enhance dietary diversity, thereby improving the nutritional status of households.

**Conclusion:** The dietary diversity of rural PDS beneficiary households differs significantly from urban PDS beneficiary households, owing to a higher intake of nutritious foods in urban PDS beneficiary households for dietary diversity. Price subsidy on the staple food commodities has different effects on the consumption pattern and dietary diversity for low, middle, and higher-income people in Public Distribution System. This study suggests that PDS beneficiary poor people to buy cheaper items rather than high-value commodities such as fruits, milk, meats, and fish compared to high-income groups for dietary diversity.

**Keywords:** [Dietary Diversity, Rural-Urban households, Multiple linear regression, Tamil Nadu]

### 1. INTRODUCTION

Food security is a major concern for Asian countries, including India. India accounts for nearly 17.53 percent of the world's population and will surpass China by 2030, with a population growth rate of 1.58 percent. By the end of 2030, India is expected to have a population of more than 1.53 billion people [1]. Undernourishment and malnutrition have been major issues affecting the growth and development of many developing countries Over time. In fact, solving these problems is one of the United Nations' Sustainable Development Goals (SDGs) [2]. Diet plays an important role in human life. Adequate diet and nutrition are important for good mental and physical health. Diet diversification is essential in overcoming malnutrition's triple burden: malnutrition (a lack of calories and

Comment [H1]: Lower case

proteins), micronutrient deficiencies, and excessive energy intake [3,4]. Inadequately diversified diets in terms of quantity and pattern in the food basket were always associated with less optimal growth, development, and long-term health outcomes [5]. Undernutrition has decreased among adolescents, whereas overweight has increased significantly from 1.8% in 1999 to 7.5% in 2015 for boys and from 1.9% to 6.1% for girls during the same period. Accordingly, the prevalence of overweight and obesity, diabetes, and excess consumption has become more prevalent across all demographic people [6].

**Comment [H2]:** Check spelling

Tamil Nadu is a creative state in India for all types of food security programs. It has implemented a wide range of programs, from mid-day meal schemes to free or subsidized rice for all. The primary goal of these programs is to reduce food and nutritional security among households, regardless of income level [7]. In India, the Public Distribution System (PDS) is one of the most powerful and subsidized policies for alleviating hunger. Specifically, Tamil Nadu is a pioneer in implementing universal PDS (supplying free rice in notified quantities to diverse categories of people) as well as in all food security programs ranging from mid-day meal schemes to free rice distribution through PDS. In 2004, the state of Tamil Nadu started offering rice at a cost of Rs.2.00 per kg to people living in poverty, and the rice supply was extended free of charge in 2011.

**Comment [H3]:** Reduce or enhance ?

Dietary habits have a significant impact on the population's quality of life. Dietary diversity, represented as the variety of foods across and within food groups capable of providing adequate intake of essential nutrients that can promote good health, can be defined as the variety of different types of food items included in a food basket [8,9]. The degree of diversity in household dietary habits is an indirect measure of diet quality or the amount to which households' nutritional needs are met. Diets with a higher range of foods or foods containing have higher energy and nutrient intake [10]. Understanding household dietary diversity might therefore be an alternative and convenient path to evaluate household-level food security. Dietary diversity scores (DDSs), which allow us to quantify diet diversity, have grown in popularity due to their relationship to a variety of well-being outcomes, including nutritional and health outcomes [11,12].

This study [13] stated that PDS has helped to alleviate hunger, but nutritional aspects remain unknown. Few recent studies have revealed that increased PDS coverage also increased calorie intake but also increased dietary diversity mostly through income effects [14,15,16,17]. PDS may also result in the substitution of more nutritious superior coarse cereals and millets for PDS-subsidized wheat [18]. The dietary diversity of people in a geographical area is determined by a variety of factors, including production diversity [19], household income/expenditure levels, and demographic and socioeconomic characteristics of households [20]. To be adequately nourished and have food security, it is crucial to know what represents an appropriate diet for a health condition, as well as the resources, skills, and motivation to make good food choices. To address this gap, the current study attempts to determine the factors that influenced dietary diversity in Tamil Nadu of Public Distribution System beneficiary's households.

## 2. METHODOLOGY

Primary data have been employed in this study. The data consisted of general characteristics about the household size, age, gender, education, monthly income, monthly expenditure menu and quantity of the food prepared, food habits, Distance of fair price shop, livestock, and other variables were recorded based on seven days recall method for both rural and urban areas in Villupuram district of TamilNadu during April to May 2022.

**Comment [H4]:** Gap between words

### 2.1 Sampling design and method of Data collection

The study majorly relied on primary data collected through well-structured and pre-tested personal interviews. The multi-stage random sampling approach was used to gather the

data. In the first stage, according to the food security index of the Tamil Nadu State Human Development Report 2017, the Villupuram district has been selected which falls under the low food security index used for analyzing dietary diversity. During the second stage, one block for rural and one block for urban were randomly selected. In the third stage, four rural villages and four urban wards were selected at random. Finally, rural respondents were chosen from 30 PDS beneficiary rural households in each Village comprises of 120 household respondents. For urban respondents, in each ward 30 PDS beneficiary households were selected and comprises 120 household respondents. Thus, the total sample consisted of 240 respondents (120 rural and 120 urban). Based on monthly household income, the selected households were post-stratified into three income groups: Low Income Group (LIG), Middle Income Group (MIG), and High-Income Group (HIG). The "Chapter on Housing Requirement Projection for IX Plan" reported on the Income categories of households (2007-2012). LIG households earn less than Rs.3301 and between Rs.7500; MIG households earn between Rs.7501 and Rs.14500, and HIG households earn more than Rs.14501.

Comment [H5]: comprise

## 2.2 Tools of analysis

### 2.2.1 Percentage Analysis

Percentage analysis was used to study the general characteristics of the respondents which included age, education, gender, and occupational status.

### 2.2.2. Simpson index of dietary diversity

The Simpson Index of Dietary Diversity (SIDDD) was developed to assess household food consumption diversity. Except for beverages and processed foods, the index considered all food items. Edward Simpson proposed the index in 1949 for measuring species diversity [21]. In 1950, Orris C. Herfindahl developed and modified the Simpson index of dietary diversity for use in economic research [22]. Katanoda *et al.* (2006), Thiele and Weiss (2003), and Shinoj *et al.* (2015) conducted studies on dietary diversity [23,24]. In the study, the Simpson Index of Dietary Diversity (SIDDD) technique was used to analyze diversity in respondent consumption baskets. The Food and Agricultural Organization (FAO) classified food into 12 categories in 2013. This study considers only eight groups to determine the Simpson Index of Dietary Diversity (SIDDD) based on these groups. The eight food groups include cereals, pulses, milk, oil, meat, fruits and vegetables, spices & sugar, and other food. The diversity in terms of the number and distribution of various food items in the households' consumption baskets was calculated. Thus, dietary diversity is calculated as follows:

Comment [H6]: Italics

Comment [H7]: Italics

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

SIDDD = Simpson Index of dietary diversity,

$P_i$  = proportion of the  $i^{\text{th}}$  food item in total monthly consumption food items by members of the household.

The index has a range of 0 to 1, and its maximum value approaches 1 as the number of food items ( $n$ ) increases. If it is zero, it signifies that the individual consumes very few food items. SIDDD scores were collected for households of different income levels for comparison.

A multiple linear regression model was utilized to further explain the variation in diversity scores across various groups of households and to correlate their variation to PDS household dietary diversity, and socioeconomic and demographic characteristics.

$$SIDDD_i = \alpha_0 + \alpha_1 Z_i + \alpha_2 E_i + \alpha_3 O_i + u_i$$

Where,

SIDDD<sub>i</sub> - Dietary diversity score is indicated by dependent variables (ranges 0 to 1)

$Z_i$  - Vector based on sociological and demographic characteristics like age (Years), gender (Male=1, Female= 0), education (Primary-0, secondary-1, Higher secondary-2, Graduate-3, and Illiterate-4), household size (Numbers), Distance of PDS shop and food consumption habits (non-vegetarian-1, Vegetarian-0)

$E_i$  - Vector of the economic status of households like monthly income and monthly expenditure (Rs/ Month).

$O_i$  - Vector of household ownership like Farmland (ha) and livestock (Numbers).

$u_i$  - Error term

### 3. RESULTS AND DISCUSSION

#### 3.1 General Characteristics of the Sample Households

Among 240 PDS beneficiaries, 120 were from rural households and 120 were from urban households. The average monthly income and number of earners could be seen in Table1.

**Table1 Average Monthly Income and Number of Earners**

Sector	Household Income (Rs/Month)	Number of Earners
Rural	11670	1.56
Urban	13958	1.33

According to the results, the average monthly income of urban and rural households is Rs. 14,167 and Rs. 16,621, respectively. In the rural sector, the average number of earners was 1.90 compared to 1.65 in the urban sector. Even though the number of earners in the urban sector was lower, urban household income was higher than rural.

**Table 2 Age of the Households**

Age (Years)	RURAL		URBAN	
	Number	Percentage	Number	Percentage
20-35	24	20	31	25.8
36-50	64	53.3	72	60
51-60	19	15.8	13	10.8
Above 60	13	10.8	4	3.3
Total	120	100	120	100

Table 2 shows the age of the households, 50 percent of the sample households in the rural sector, belonged to the 36-50 age group (53.3%), followed by the 51-60 age group (15.8%) in the rural sector. In urban households, more than 50 percent of the population belongs to the 36-50 age group (60%) followed by the 20-35 age group (25.8%). Age is a major factor influencing the household's decision, taste, and preference for food items.

**Table 3 Education of the headed Households**

Education of the respondents	RURAL		URBAN	
	Number	percentage	Number	percentage
Illiterate	6	5	0	0
Primary	27	22.5	17	14.2
Secondary	59	49.2	42	35
Higher Secondary	21	17.5	37	30.8
Graduate	7	5.8	24	20

**Comment [H8]:** Uniform points in decimal

Total	120	100	120	100
-------	-----	-----	-----	-----

Comment [H9]: Uniform points in decimal

According to education level, 49.2 percent of rural and 35 percent of urban households have a secondary education, while 22.5 percent have primary education in rural households and 30.8 percent have higher secondary education in urban households as shown in Table 3. Household heads with a higher level of education are expected to further improve their understanding of the quantity and quality of consumable food items.

**Table 4 Family Size of the Households**

Family Size	RURAL		URBAN	
	Number	Percentage	Number	Percentage
1 to 3	40	33.3	51	42.5
4 to 5	66	55.0	65	54.2
6 and above	14	11.7	4	3.3
Total	120	100	120	100

Comment [H10]: Uniform points in decimal

The family size would be useful in determining the family's dietary diversity and quantities purchased. The distribution of the family size of the households was presented in Table 5. The results revealed that 55 percent of rural PDS beneficiary households and 54.2 percent of urban PDS beneficiary households have 4 to 5 persons in the family. In addition, 33.3 percent and 42.5 percent of rural and urban PDS beneficiary households have 1 to 3 members in the family, and also 11.7 percent and 3.3 percent of rural and urban PDS beneficiary households have more than 6 members in the family.

**Table 5 Occupational status of the Households**

Occupation	RURAL		URBAN	
	Number	Percentage	Number	Percentage
Farming	48	40	8	6.7
Agricultural Labour	27	22.5	7	5.8
Office Workers	8	6.7	31	25.8
Business	10	8.3	29	24.2
Non-Agricultural Labour	12	10	24	20
Others*	15	12.5	21	17.5
Total	120	100	120	100

Comment [H11]: Uniform points in decimal

\* Indicates the Tailoring, Construction workers, Drivers, and Pensioners

From Table 5 results showed that about 62.5 percent of rural households were engaged in Farming activities. In the case of the urban sector, 25.8 percent were from government and private employees followed by businessmen with 24.2 percent and non-agricultural labor with 20 percent. The occupation was more diversified in the urban sector, whereas in the rural sector, agriculture formed the major share since cultivators and agricultural laborers constituted nearly 62.5 percent of the rural households. Thus, urban households had more economic opportunities, a fact historically established.

**Table 6: Distribution of Households Based on Income**

Monthly Income Group	RURAL		URBAN	
	Number	Percentage	Number	Percentage
LIG (< Rs.7500)	54	45	30	25
MIG (Rs.7501-14500)	51	42.5	63	52.5

HIG (> Rs.14500)	15	12.5	27	22.5
Total	120	100	120	100

Comment [H12]: Uniform points in decimal

Table 6 represents the distribution of households based on income. The sample households were post-stratified into three income groups based on the "Chapter on Housing Requirement Projection for XI Plan" to understand the pattern of household dietary diversity (2007-2012). They were i) LIG (Low Income Group) (Earning less than Rs.7500 per month) (ii) Middle Income Group - MIG (Monthly income of Rs.7501 to 14500) and (iii) High Income Group - HIG (Earning more than Rs.14500 per month). In rural households, 45 percent were low income, followed by 42.5 percent who were middle income. However, in urban households, the middle-income group contributes 52.5 percent followed by 25 percent of the low-income group. The high-income group contributes 12.5 percent and 22.5 percent to rural and urban households respectively.

**Table 7: Distribution of Smart Card Details of the Sample Households**

Particulars	RURAL		URBAN	
	Number	Percentage	Number	Percentage
NPHH	95	79.2	118	98.3
PHHA	25	20.8	2	1.7
Total	120	100	120	100

Comment [H13]: Uniform points in decimal

From the table 7 shows the distribution of smart card details of the households which reveals that 79.2 percent and 98.3 percent have a Non-Priority Household (NPHH) in rural and urban households respectively. Meanwhile, priority households of Antyodaya Anna Yojana cards contribute 20.8 percent and 1.7 percent in rural and urban households respectively.

**Table8: Quality and Quantity of Essential commodities Distributed to the Households**

Name of the Commodities	RURAL		URBAN	
	Quality Satisfied (No)	Quantity Adequacy (No)	Quality Satisfied (No)	Quantity Adequacy (No)
Rice	98(81.7)	95(79.2)	64(53.3)	93(77.5)
Wheat	110(91.7)	112(93.3)	73(60.8)	120(100)
Sugar	120(100)	120(100)	120(100)	120(100)
Palm Oil	89(74.2)	95(79.2)	53(44.2)	89(74.2)
Kerosene	99(82.5)	106(88.3)	67(55.8)	87(72.5)
Toor Dhal	120(100)	120(100)	120(100)	85(70.8)

Table 8 shows the quality and quantity distribution of essential commodities in the households. In rural households, quality satisfaction for rice and wheat contributes 81.7 percent, and 91.7 percent, respectively, while in urban households, quality satisfaction for rice and wheat contributes 53.3 percent, and 60.8 percent, respectively. Sugar and Toor Dhal were also 100% quality satisfied in both the rural and urban sectors. The quantity adequacy for rice and wheat was 79.2 percent and 93.3 percent in rural households and 77.5 percent, and 100 percent in urban households respectively.

Comment [H14]: Per cent

Comment [H15]: Per cent

Comment [H16]: Per cent

### 3.2 Household Dietary Diversity across Rural and urban areas

Dietary diversity is essential for diet nutrient adequacy and individual dietary status. Higher household income levels increased access to different food categories, resulting in greater dietary diversity. This study now finds a relationship between dietary diversity and household monthly income. Table 9 shows the Simpson index of dietary diversity score for rural and urban areas across different income levels. The variety of food items consumed by households in urban areas was greater than in rural areas. However, the consumption of

PDS products was higher in rural households than in urban households. The SIDD value of food items was different in rural areas for LIG (0.78), MIG (0.76), and HIG (0.85), and in urban areas for LIG (0.82), MIG (0.86), and HIG (0.85). (0.88). The high-income group consumes a wider range of food products than other income groups in both rural and urban areas. However, urban households consume a wider range of food items and have greater access to buy a wider range of food items, which could be attributed to easy and reliable market accessibility as well as the households having a high and consistent income.

**Table 9: SIDD value of rural and urban areas across different income groups**

Income groups	Rural	Urban
Low income	0.78	0.82
Medium income	0.76	0.86
High income	0.85	0.88

### 3.2 Factors influencing the dietary diversity of households in rural and urban areas

To examine the impact of various factors on dietary diversity, the SIDD score was used as the dependent variable, and socio-demographic, asset ownership, and economic factors were used as the independent variables. Table 10 and Table 11 shows the parametric estimates of dietary diversity for rural, urban, and overall areas using a multiple linear regression model.

The STATA 15 software is used to assess the influence of different factors on dietary diversity, the SIDD score was used as the dependent variable, and socio-demographic, ownership of assets, and economic factors were used as independent variables. Moreover, the coefficient of independent variables like age of the households (0.0002), Food habits (0.001), Education of the respondent households (0.002), monthly household income (0.0005), farm size (0.002), fair price shop distance (0.005), Ownership of cattle (0.004), Monthly food expenditure (0.003) was positively related except gender of the household (-0.015) and household size (-0.007) were negatively related in rural areas.

**Table 10: Factors influencing the dietary diversity of households in rural areas**

Variable Code	Variable Name	Rural	P-value	Std. Error
a <sub>0</sub>	Intercept	0.789	3.1E-52	0.016
AGE	Age of the head of household (Years)	0.0002*	0.0954	0.000
GEN	Gender of the head household (Male=1, Female=0)	-0.015	0.153	0.003
HHSIZE	Household Size (Numbers)	-0.007***	0.001	0.002
FH	Food Habit (vegetarian=0, non-Vegetarian=1)	0.001	0.875	0.004
EDU	Education of the respondent households (primary=0, secondary=1, Higher secondary=2, Graduate=3, Illiterate=4)	0.002	0.392	0.002
MINCOME	Monthly Household Income (Rs/month)	0.0005***	0.000	2.18E-07
FSIZE	Farm size (ha)	0.002	0.317	0.001
PDS DIST	Fair price shop Distance (km)	0.005*	0.079	0.0007
LIVESTOCK	Ownership of cattle (Numbers)	0.004*	0.094	0.002
MFOODEXP	Monthly food expenditure (Rs/month)	0.0002***	0.003	9.5E-06
R <sup>2</sup>	0.75			

F value	22.84			
Number of observations	120			

\*\*\*, \*\* and \* Significance level at 1%,5% and 10% respectively.

The Table 10 results revealed that 64 percent of the variation in the overall performance of dietary diversity for rural households has been explained by the independent variables. The age of the headed household was statistically significant, indicating that they have better knowledge of different food groups as well as the nutritional content of an active healthy life. At one percent level, household size was highly significant. The gender, farm size, and education level of the household head were found to be insignificant, with no effect on the dietary diversity of the household.

**Comment [H17]:** Two words i.e. Per cent

The monthly household income was found to be highly significant at the one percent level due to the main source of income in rural areas both on-farm and off-farm income. In rural areas, the distance between fair-price shops was significant. It clearly shows that a greater distance from the market means less market access, which affects the food basket and the occurrence of consumption of various food items. The owning of cattle had a significant influence on dietary diversity at the 10% level. In rural areas, increasing animal milking by one unit would significantly raise the SIDD score by 0.004.

Similarly, for urban PDS beneficiaries, households could be seen from table 11 results of the SIDD index variables. The  $R^2$  signifies that 64 percent of the variation in the overall performance score has been explained by the independent variables. The coefficient of independent variables like the gender of the households (0.001), Food habits (0.003), Education of the respondent households (0.001), monthly household income (0.000), farm size (0.001), Fair price shop distance (0.0007), household size (0.008), Monthly food expenditure (0.0005) were positively related except the age of the household head (-0.001) and ownership of cattle (-0.008) were negatively related for urban areas.

**Table 11: Factors influencing the dietary diversity of households in urban areas**

Variable code	Variable name	Urban	P- value	Std. Error
a <sub>0</sub>	Intercept	0.838	4.68E-67	0.023
AGE	Age of the households (Years)	-0.001***	0.008	0.000
GEN	Gender of the households (Male=1, Female=0)	0.001	0.833	0.005
HHSIZE	Household Size (Numbers)	0.008***	0.0003	0.002
FH	Food Habit (vegetarian=0, non-Vegetarian=1)	0.003**	0.0432	0.005
EDU	Education of the households (primary=0, secondary=1, Higher secondary=2, Graduate=3, Illiterate=4)	0.001	0.703	0.002
MINCOME	Monthly Household Income (Rs/month)	0.000***	2.80E-08	3.35E-07
FSIZE	Farm size(ha)	0.001	0.718	0.001
PDS DIST	Fair price Shop Distance (Km)	0.0007*	0.0596	0.021
LIVESTOCK	Ownership of cattle (Numbers)	-0.008	0.391	0.001
MFOODEXP	Monthly food expenditure (Rs/month)	0.0005***	0.001	3.85E-06
R <sup>2</sup>	0.64			
F value	16.24			
Number of observations	120			

\*\*\*, \*\* and \* Significance level at 1%,5% and 10% respectively.

The age of the headed household was statistically significant which indicates that have better knowledge of different food groups and also the nutritional content of active healthy life. However, a similar result was found [19]. The household size was highly significant at the one percent level that determines the dietary diversity of the households. Similarly, food habit was significant and positive which indicated that non-vegetarian households have more varieties of food than vegetarian households. It was observed that the monthly household income was highly significant at a one percent level due to the main source of income from the office workers and business people in urban areas. The Fair price shop distance was significant in urban areas. It shows that a larger distance from the market means worse market access, which in turn affects the food basket and frequency of consumption of different food items. A similar result was found [19,25]. The ownership of cattle was significant at one percent level influences on dietary diversity. However, higher-income households would access a greater variety of items in their consumption basket as compared to low-income households. The F-Statistics showed the overall significance of the model was significant. The gender, farm size, and education of the household were found to be insignificant and does not have any influence on the household dietary diversity.

It could be reasonable to infer that urban household size, age of the household in rural areas, the distance of fair price shop, monthly household income, and monthly food expenditure of the households have a positive and significant influence on dietary diversity in rural and urban areas that have a good diet and a healthy life. Contrarily, age of the household, cattle ownership in urban areas and gender of the households, household size in rural areas have a negative influence and do not determine the dietary diversity of the households.

#### **4. CONCLUSION**

The study found that empirically examining the influencing factors on the dietary diversity of PDS beneficiaries' households in the Villupuram district based on the socio-economic characteristics of the low, medium, and high-income households in the study areas would reveal that income is a major factor influencing the household dietary patterns. The majority 79.2 percent of rural households and 98.3 percent of urban households have a non-priority household (NPHH) smart card rather than a priority household (PHH) smart card. Monthly income, age, household size, and distance from the fair price shop may enhance dietary diversity, thereby improving the dietary diversity of households. Due to a higher intake of nutritious foods in urban areas, rural PDS beneficiary households have a significantly different dietary diversity pattern than urban PDS beneficiary households.

Price subsidy on staple food commodities has different effects on the consumption pattern and dietary diversity of poor, middle, and higher-income people in Public Distribution System. For low-income people, the distribution of price subsidies for the staple food of rice, wheat, and pulses was more constrained for other commodities in the Public Distribution System beneficiary households. This suggests that PDS beneficiaries of poor people buy cheaper items rather than high-value commodities such as fruits, milk, meats, and fish. A variety of food baskets could provide food security while also improving quality of life by increasing nutritional security and dietary diversity. Since rice incentives caused poor people to switch away from high-value commodities such as milk, meat, fish, and fruits reducing dietary diversity, extending price subsidies for nutritionally rich food items other than rice is expected to assist poor people in diversifying their diet toward healthy and nutrient-dense foods. From the policy perspective, it is important to focus on dietary diversity with the proper understanding of the socio-economic characteristics to provide nutrient-rich foods like ragi through the Public Distribution System which enhances the dietary diversity of the low-income group compared to the high-income group people.

## REFERENCES

1. Khed V. Nutritional status and dietary diversity of households in Vijayapura district of Karnataka. 2018; 2058:2018- 5240.
2. Mishra A, Singhal N, Sivakumar B, Bhagat N, Jaiswal A, Khurana L. Nutrition transition in India: Secular trends in dietary intake and their relationship to diet-related non-communicable diseases. *Journal of diabetes*.2011; 3(4):278-292.
3. Soumya Gupta, Naveen Sunder Prabhu L. Pingali. Market Access, Production Diversity, and Diet Diversity: Evidence from India. *Food and Nutrition Bulletin*. 2020; Vol. 41(2):167-185.
4. Pinstrup Andersen P. Agricultural research and policy for better health and nutrition in developing countries: a food systems approach. *Agricultural Economics*. 2007; 37:187-198
5. Charambagwala R, Ranger M, Waddington H, White H. The determinants of child health and nutrition: a meta-analysis. Washington, DC: World Bank.2004;
6. FAO, I. F. A. D, UNICEF, WFP, WHO. The state of food security and nutrition in the world. 2017. Building resilience for peace and food security. FAO, Rome. URL: <http://www.fao.org/3/a-i7695e.pdf>
7. Umanath Malaiarasan, R. Paramasivam, Dietary Diversity Under Public Distribution System: An Evidence From Tamil Nadu, India,
8. WHO/FAO (World Health Organization /Food and Agriculture Organisation of the United Nations). Preparation and use of food-based dietary guidelines. Geneva: Nutrition Programme, World Health Organisation.1996
9. Ruel M. Is dietary diversity an indicator of food security or dietary quality? A review of measurement and research needs. *International Food Policy Research Institute*.2002;
10. Kant A K. Dietary patterns and health outcomes. *Journal of American Dietetic Association*.2004;104:615–635.
11. Tarvinga A, Muchenje V, Mushunje A. Determinants of rural household dietary diversity: The case of Amatole and Nyandeni districts, South Africa. *International Journal of Development and Sustainability*. 2013;2(4).
12. Headey D, Ecker O. Rethinking the measurement of food security: From first principles to best practice. *Food Security*. 2013;5(3):327-343
13. Pingali P, Mitra B, Rahman A. The bumpy road from food to nutrition security—Slow evolution of India's food policy. *Global food security*.2017;15:77-84.
14. Kaul T. Household responses to food subsidies: evidence from India. *Economic Development and Cultural Change*.2018; 67(1):95-129.

15. Kishore A, Chakrabarti S. Is more inclusive more effective? The 'New Style' public distribution system in India. *Food Policy*.2015; 55:117-130.
16. Krishnamurthy P, Pathania V, Tandon S. Food price subsidies and nutrition: evidence from state reforms to India's public distribution system. *Economic Development and Cultural Change*.2017;66(1):55-90
17. Rahman A. Universal food security program and nutritional intake: Evidence from the hunger-prone KBK districts in Odisha. *Food policy*.2016;63:73-86.
18. Khera R. Cash vs. in-kind transfers: Indian data meets theory. *Food Policy*.2014; 46: 116- 128
19. Sibhatu KT, Krishna V V, Matin Q. (2015) Production diversity and dietary diversity in smallholder farm households. *PNAS*,2015; 112(34):10657-10662.
20. Drescher L S, Thiele S, Roosen J, Mensink G. Consumer demand for healthy eating considering diversity – an economic approach for German individuals. *International Journal of Consumer Studies*.2009;33:684–696.
21. Simpson EH. Measurement of diversity *Nature* 1949; 163:688.
22. Herfindahl OC. Concentration in the U.S. Steel Industry. Unpublished doctoral dissertation, Columbia University 1950
23. Joshi PK, Shinoj P, Kumar P. Dynamics of food consumption and nutrient insecurity in India. *Proceedings of the Indian National Science Academy* 2016;82(5):1587-1599.
24. Katanoda K, Kim HS, Matsumura Y. New Quantitative Index for Dietary Diversity (QUANTIDD) and its annual changes in the Japanese. *Nutrition*. 2006;22(3):283-287.
25. Liu J, Shively E, James K B. Access to variety contributes to dietary diversity in China. *Food Policy*.2014;49: 323–331.

#### **ABBREVIATIONS**

SIDD- Simpson Index of Dietary Diversity  
PDS - Public Distribution System  
LIG - Low Income Group  
MIG - Middle Income Group  
HIG -High Income Group  
FAO -Food and Agriculture Organisation