Agricultural Economics Research Review 2020, 33 (Conference Number), 39-47
DOI: 10.5958/0974-0279.2020.00016.6

An economic assessment of the food security of households in the rural–urban interface of Bangalore

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Abstract The study aims to assess the food security status of households in the north and south transects along the rural–urban interface of Bangalore. Based on the recommended daily calorie intake, 72.2% of the households in the north transect and 68.6% in the south transect were food-secure. In both transects, the proportion of food-secure households was lower for agricultural households than for others. To improve food security, especially in rural areas, employment and income opportunities are needed in agriculture, and infrastructure and small-scale industries are needed to create employment and income opportunities in off-farm activities.

Keywords Food security, rural–urban interface, small-scale industries

JEL codes C25, C55, C88, I15, Q12

The World Food Summit (FAO 1996) considers that food security is achieved when all people at all times have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO 2004). Food security is a major concern of policy, economic, and political debate worldwide as all countries want to ensure that all their citizens are food-secure for not only survival but also for economic development. Rising food prices affect the poor and food shortages and high prices lead to instability within nations and, potentially, conflict between them (Emerson 2011). Rapid urbanization has widespread implications for food security, nutrition, agriculture value chains, and livelihoods. Attention is due to low- and middle-income countries as these contribute to 67% of the world's urban population and the issues of food and nutritional security are most pressing (David et al. 2010). Many countries have launched programmes to achieve food security, but this goal is often thwarted by external factors. In Afghanistan, for instance, a rapid rise in wheat prices led to a fall in food consumption, calorie and protein intake, and dietary diversity; households[1] moved away from micronutrient-rich meat products to staples; and, as a result, urban and rural household food security declined (D'Souza 2008).

Over the past decades, agricultural production in India has increased considerably, especially of rice and wheat, the staple food crops. The per capita availability of food grains, and the physical access of households to food in different parts of India, have improved, too (Acharya 2009). Incomes have risen significantly, and the real expenditure on food has fallen, as India has implemented a slew of food security, welfare, and other programmes for different sections of the society, including women and children.

[1] A group of persons normally living together and eating food from a common kitchen constitutes a household. The qualification 'normally' extends to cover only temporary stay away but not temporary visitors in the group. Thus, a household member residing in a hostel is not counted, but a resident employee or domestic servant or paying guest (but not a tenant) is included in the employer or host's household. The total count of persons in a household is the household size.

However, India is one of the most 'undernourished' countries worldwide, according to its National Family Health Survey; calorie consumption, and the per capita availability of food grains, has been declining since 1987, and the percentage of underweight among children has remained constant between 1998 and 2006. The nutritional status of women and adolescent girls, who form more than 50% of the population, is crucial, as undernutrition in women leads to low birth weight and malnutrition among children. Despite rising income levels and employment opportunities—food and nutritional insecurity persists, especially among the women in the family, and this phenomenon appears to be more common in rural areas than in urban areas.

This study was undertaken in the rural–urban interface of Bangalore to study the extent and factors of food insecurity.

Methodology

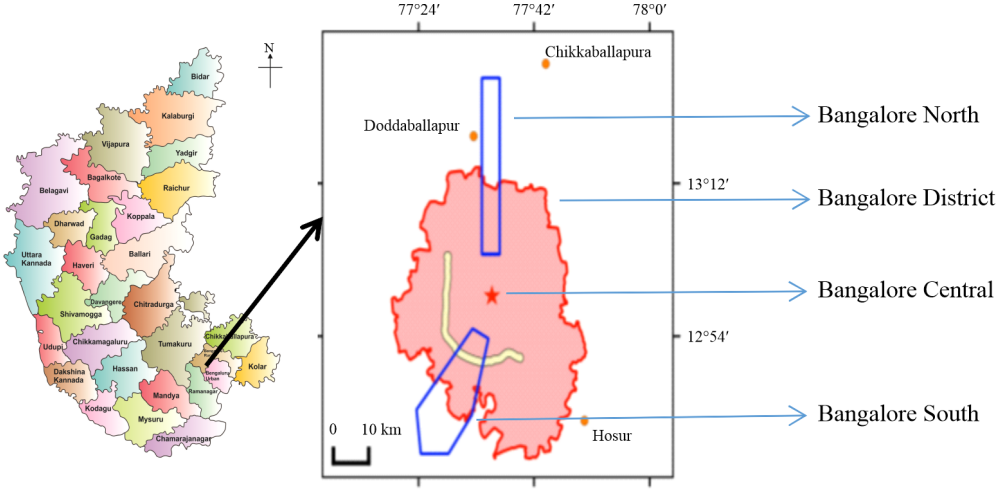
The study assesses the food security status of households in the rural–urban interface of Bangalore. The study area was divided into the northern transect (N-transect), a rectangular stripe of land 5 km wide and 50 km long. The lower part of this transect cuts into urban Bangalore and the upper part contains rural villages. The southern transect (S-transect) is a polygon covering a total area of 300 sq km; Vidhana Soudha, located in the city centre, was taken as the reference point (Figure 1).

Each transect was subdivided into the rural, transition, and urban gradients based on the logic of the Urban–Rural Index (URI). A simplified Survey Stratification Index (SSI) was developed, where the SSI refers to the linear distance between the village centre and the city centre (Hoffman et al. 2017). Building density and distance were investigated separately before they were combined to calculate the SSI.

The lottery method without replacement was used to randomly select the villages in each stratum. The final list consists of approximately 30% settlements per stratum. The baseline list of households was collected from the Anganwadi centre of a chosen village. The stratified purposive random sampling method was used to select the households. The total sample of 1,275 households consisted of 616 households from the north transect of Bangalore and 656 households from the south transect (Figure 2).

Data

To address the study objectives, both primary and secondary data were used. The primary data was collected through personal interviews using a computer-assisted schedule. The interview schedule was quite exhaustive and it collected information from the respondents on all types of food items consumed. The data was analysed using descriptive statistics, food security index, and multiple linear regression model. To facilitate meaningful comparison and interpretation



Note: The red area corresponds to the districts under Bangalore's administrative authorities. The Outer Ring Road is shown in yellow. The blue contours indicate the northern and southern transects, the star marks represent the reference point (Vidhana Soudha) in the city centre.

Figure 1 Study area

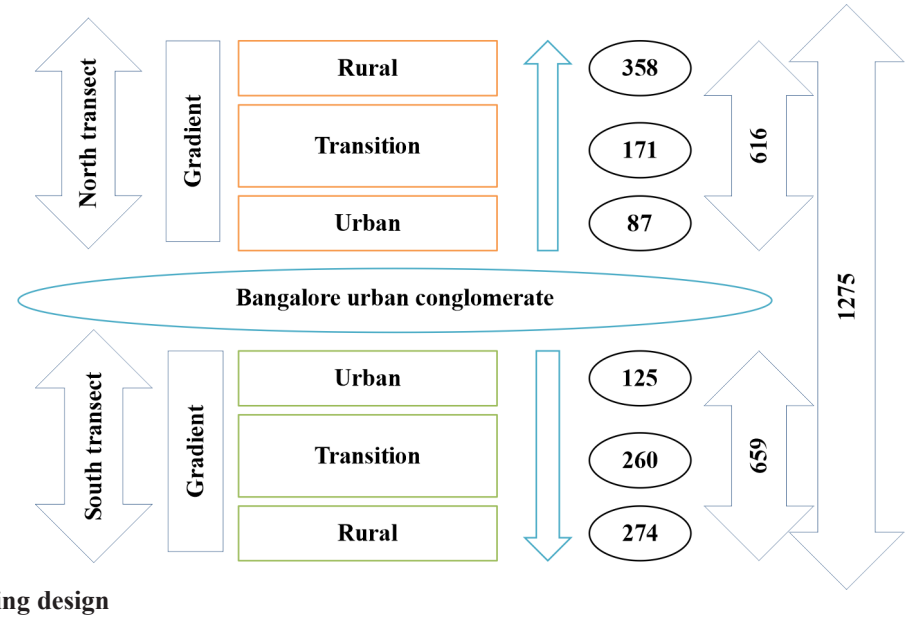


Figure 2. Sampling design

of the findings, statistical measures like percentages and averages were used. To determine the factors influencing food security, the following type of multiple linear regression model was used.

Factors influencing calorie intake

$$Y = a_0 + a_1 X_1 + a_2 X_2 + a_3 X_3 + a_4 X_4 + a_5 X_5 + a_6 D_1 + a_7 D_2 + a_8 D_3 + m \quad \ldots(1)$$

Where,

Y = Calorie intake (kcal per capita per day)

X_1 = Age (years)

X_2 = Education (no. of years)

X_3 = Family size (no.)

X_4 = Land holding (ha)

X_5 = Per capita income (INR per month)

D_1 = Gender (1if male, 0 otherwise)

D_2 = Urban (1 if place of residence is urban, 0 otherwise)

D_3 = Transition (1 if place of residence is transition, 0 otherwise)

a_i = Regression coefficients for independent variables defined above for i = 1 to 8.

m = Random disturbance term

Factors influencing food security

$$Y = a_0 + a_1 X_1 + a_2 X_2 + a_3 X_3 + a_4 X_4 + a_5 X_5 + a_6 D_1 + a_7 D_2 + a_8 D_3 + m \quad \ldots(2)$$

Where,

Y = Food Security Index (FSI)

X_1 = Family size (no.)

X_2 = Per capita income (INR per month)

X_3 = Employment in agriculture and allied (person-days per year)

X_4 = Off-farm employment (person-days per year)

X_5 = Non-farm employment (person-days per year)

D_1 = Urban (1 = if place of residence is urban and '0' otherwise)

D_2 = Transition (1 = if place of residence is transition, and '0'otherwise)

D_3 = North transect (1 = if place of residence is in north transect and '0' otherwise)

a_i = Regression coefficients for independent variables defined above for i = 1 to 8

m = Random disturbance term

For examining the food security status of households, the information on the quantity of food items consumed was recorded based on a 14-day recall period. Various

aspects related to per capita food intake was probed. The data were analysed using the STATA software package.

Results and discussion

Socio-economic characteristics of the sample respondents

The socio-economic characteristics (age, education, family size, and average landholding size) are presented below. The distribution of sample respondents by age is given in Table 1. The results show that in the north transect the average age of respondents was 47 years in the rural and transition areas and 43 years in urban areas. In the transition areas, 44% of the respondents were in the 50+ age group; 33% were in the 35–50 age group and 23% in the <35 age group.

With respect to literacy rate, when we move from rural to urban areas, the percentage of illiteracy decreases from 31% to 20% in the north and from 36% to 27% in the south. The educational status of respondents in urban areas was better than in rural and transition areas because the living standards and educational facilities were better. The results showed that there was no statistically significant difference among respondents across all the gradients (rural, transition, and urban) and transects. The family size averaged about five members across gradients and transects, and the difference was statistically non-significant.

In the north transect the landholding size averaged 1.93 ha in rural areas, 1.77 ha in transition areas, and 4.64 ha in urban areas. In the south transect the landholding size averaged 1.83 ha in rural areas, 1.91 ha in transition areas, and 1.08 ha in urban areas. The mean difference in landholding size was found statistically significant across the gradients but statistically non-significant in the south transect.

The average rainfed area was 3.80 ha in urban areas, 0.8 ha in rural areas, and 0.7 ha in transition areas; however, the difference was statistically non-significant. In the north transect the average irrigated area was 1.13 ha in rural areas, 1.07 ha in transition areas, and 0.84 ha in urban areas. Only a few farmers practise agriculture in the urban areas in both transects, and most of them cultivate fruit crops, forest trees, and a small quantity of ragi for their own consumption.

Household calorie intake

The actual calorie intake was higher in rural areas than in transition and urban areas (Table 2). The Recommended Dietary Allowances[2] (RDA) are 2,730 kcal per consumption unit[3] (CU) per day for rural areas and 2,320 kcal per CU per day for urban areas (Indian Council of Medical Research 2010). Across different gradients, the calorie intake in the north transect was 3,125 kcal per CU per day in rural areas, 2,986 kcal per CU per day in transition areas, and 2,786 kcal per CU per day in urban areas. In the south transect the calorie intake was 3,089 kcal per CU per day in rural areas, 3,055 kcal per CU per day in transition areas, and 2,758 kcal per CU per day in urban areas. In both the transects, the actual calorie intake and the proportion of actual calorie intake to the recommended intake was higher in rural areas than in urban and transition areas.

Factors influencing calorie intake

The factors influencing calorie intake across the rural–urban interface of Bangalore are elucidated in Table 3. The education level and family size negatively and significant influenced calorie intake, whereas landholding size and the urban dummy had a positive and significant influence. The results are in line with the study conducted by Kumar et al. (2016).

Food security status of households

The food security status of households is presented in Table 4. The recommended daily calorie intake defines the food security line, and consumption below the minimum level of calorie requirement indicates food insecurity. Based on the recommended daily calorie intake, 72.2% of the households in the north transect and 68.6% in the south transect, or most households in the study area, were food-secure.

Factors influencing food security

We use the multiple linear regression model to examine the impact of several variables—family size,

[2] The Recommended Dietary Allowances (RDA) are estimates of the intakes of nutrients which individuals in a population group need to consume to ensure that the physiological needs of all subjects in that population are met (ICMR 2010).

[3] The energy consumption of an average male doing sedentary work is taken as one consumption unit (CU). The other coefficients are worked out on the basis of calorie requirements relative to that of a sedentary adult man.

Table 1 Socio-economic characters of sample respondents in the rural–urban interface of Bangalore

Particulars	North transect			Test of significance	South transect			Test of significance
	Rural (n=358)	Transition (n=171)	Urban (n=87)		Rural (n=274)	Transition (n=260)	Urban (n=125)	
I. Age group (Head of the family)								
a. Average age (years)	47	47	43		48	46	41	
b. Below 35 years (number)	64 (18.44)	38 (23.03)	26 (30.59)	X^2=30.2*	33 (14.29)	44 (17.81)	42 (35.59)	
c. 35–50 years (number)	134 (38.62)	55 (33.33)	33 (38.82)		92 (39.83)	107 (43.32)	47 (39.83)	Chi^2= 6.43^{NS}
d. Above 50 years (number)	149 (42.94)	72 (43.64)	26 (30.59)		106 (45.89)	96 (38.87)	29 (24.58)	
2. Literacy (Education)								
a. Primary (number)	88 (25.36)	46 (27.88)	17 (20.00)	X^2=7.48^{NS}	50 (22.22)	59 (25.12)	16 (13.64)	
b. High school (number)	108 (31.12)	50 (30.30)	23 (27.06)		57 (25.93)	71 (29.86)	40 (33.64)	
c. College (number)	44 (12.68)	29 (17.58)	28 (32.94)		35 (15.84)	29 (11.85)	30 (25.45)	Chi^2= 3.40^{NS}
d. Illiterate (number)	107 (30.84)	40 (24.24)	17 (20.00)		89 (35.98)	88 (33.18)	32 (27.27)	
III. Average family size (number)	5	5	5	F=0.80^{NS}	5	5	4	F= 1.00^{NS}
IV. Land holding size (ha)								
a. No. of farmers	257	91	2	X^2=708*	166	114	4	Chi^2= 572*
b. Average rainfed area (ha)	0.80 (41.45)	0.70 (39.55)	3.80 (81.89)	F=0.33^{NS}	0.90 (49.18)	0.80 (41.88)	-	F= 3.15**
c. Average irrigated area (ha)	1.13 (58.55)	1.07 (60.45)	0.84 (18.10)	F=39.68*	0.93 (50.81)	1.21 (63.35)	1.08 (100.00)	F= 0.15^{NS}
d. Average landholding (ha)	1.93	1.77	4.64	F=5.67*	1.83	1.91	1.08	F=1.54^{NS}

Note: Figures in parentheses represent percentages

Table 2 Calorie intake of respondents as per the RDA in the rural–urban interface of Bangalore

Area	Actual calorie intake (kcal/CU/day)		Recommended calorie intake based on ICMR (kcal/capita/day)	Difference (kcal/capita/day)	
	North	South		North	South
Rural	3,125	3,089	2,730	395 (114.4)	359 (113.0)
Transition	2,986	3,055	2,730	256 (109.4)	325 (111.9)
Urban	2,786	2,758	2,320	466 (120.1)	438 (118.9)

Source: Indian Council of Medical Research, 2010; RDA-Recommended Dietary Allowance
Note: Figures in parentheses indicate percentages
Difference=Actual calorie intake – Recommended calorie intake

Table 3 Factors influencing calorie intake across the rural–urban interface of Bangalore using multiple linear regression analysis

[Dependent variable= calorie intake (kcal/capita/month)] (n=1,275)

Variables	Coefficients	t value
Age (years)	–3.957	–1.128
Education (no. of years)	–17.125***	–1.950
Family size (number)	–62.72*	–3.58
Land holding (ha)	83.14***	1.93
Per capita income (INR per month)	0.001	1.30
Gender (D_1)	144.190	1.52
Urban (D_2)	174.116***	1.87
Transition (D_3)	27.130	0.40
Constant	1,028*	0.00
R^2 value	0.47	
F value	8.61*	

Note: 1. *Significant at 1%, ***significant at 10%
2. Gender (D_1): 0= female & 1= male,
3. Urban (D_2): 1=urban, otherwise '0'
4. Transition (D_3): 1= transition, otherwise '0'

landholding size, per capita income, dummy for urban, dummy for transition, and transect dummy—on the food security index score (Table 5). The estimates of the determinants of food security reveal that the variables included in the model explain up to 42% of the variation in food security; the calculated F value was statistically significant. The model included several dependent variables; those that significantly and positively influenced the food security status are employment from agriculture and non-farm sources, per capita income, and urban dummy. Family size negatively influenced food security. The per capita food availability declines as family size increases due to population growth (Mannaf and Uddin 2012); hence, if a family is large, the household is likely to experience food insecurity.

Employment sources and food security status

The employment opportunities and food security status across the rural–urban interface of the north transect (Table 6) indicate that the non-farm sector generated the highest number of person-days of employment. The person-days of employment from all the sectors

Table 4 Food security status of households across the rural–urban interface of Bangalore

Particulars	North transect				South transect			
	Rural	Transition	Urban	Total	Rural	Transition	Urban	Total
Food-secure households (number)	234	135	76	445	170	180	102	452
Percentage of households food-secure (%)	65.36	78.95	87.36	72.24	62.04	69.23	81.60	68.59

Table 5 Factors influencing food security across rural-urban interface of Bangalore using multiple linear regression analysis

[Dependent variable= Food Security Index (FSI)]

(n=1,275)

Variables	Coefficients	P value
Family size (number)	-0.076*	0.000
Per capita income (INR per month)	0.0020**	0.049
Employment generation (person-days/year)		
a. Agriculture and allied	0.0006*	0.003
b. Off-farm	0.0002	0.051
c. Non-farm	0.0005*	0.000
Urban (D_1)	0.095**	0.045
Transition (D_2)	0.087	0.061
North transect (D_3)	0.064	0.084
Constant	1.20*	0.000
R^2 value	0.42	
F value	15.10*	

Note: 1. *significant at 1%, **significant at 5%
2. Urban (D_1): 1=urban, otherwise '0',
3. Transition (D_2): 1=transition, otherwise '0',
4. North transect (D_3): 1= north transect, otherwise '0'

averaged 269 person-days in the urban gradient (the highest), 255 person-days in the transition gradient, and 252 person-days in the transition gradient. Almost all the family members (except children and students) in urban areas were employed in the formal or informal sector; hence, the average person-days was higher in urban areas than in transition and rural areas. Most households in rural areas were employed in the non-farm sector and in transition and urban areas in the government sector. About 40%, 53% and 63% of the employment was generated from the non-farm sector in, respectively, the rural, transition, and urban gradients. The employment generated from the agriculture sector was 32%, 15%, and 0.50% in, respectively, the rural, transition, and urban gradients.

The monthly or annual income generated in the public sector was higher than in the agriculture sector; therefore, in all the three gradients, the percentage of food-secure households was greater for households employed in the government sector, and they enjoyed better food security. While it was the least in agriculture sector.

About 58%, 63%, and 68% of the households in, respectively, the rural, transition, and urban gradients

Table 6 Sources of employment and status of food security in north transect

Particulars	Rural				Transition				Urban			
	Person-days/ person/year	Number of persons	Employment generation (%)	Food-secure households (%) (n=160)	Person-days/ person/year	Number of persons	Employment generation (%)	Food-secure households (%)(n=181)	Person-days/ person/year	Number of persons	Employment generation (%)	Food-secure households (%) (n=91)
Agriculture	215	127	31.83	50.79	192	71	15.40	53.19	98	2	0.50	96.02
Agriculture labourer	280	24	7.83	45.83	230	31	8.06	51.61	-	-	-	-
Livestock	138	69	11.10	52.17	165	38	7.08	52.63	179	15	6.85	60.00
Off-farm	295	16	5.50	56.25	297	36	12.08	58.33	296	35	26.43	65.71
Non-farm	315	108	39.65	58.33	326	143	52.67	62.93	302	82	63.17	68.29
Govt. employee	270	13	4.09	69.23	320	13	4.70	70.33	300	4	3.06	75.00

employed in the non-farm sector were food-secure. In all the sectors of employment, the number of food-secure households increased from rural to urban gradients. In 2009–10, just under 30% of the urban workforce in India was informally employed, of which 50% were self-employed (street vendors, petty shop owners, tailors, business people, etc.), and 50% were wage employees (home-based workers, waste-pickers, helpers, newspaper distributors) (Chen and Raveendran 2011).

In the south transect, agriculture sector was the major source of employment for rural households (33%) in the agriculture-dominated areas of Bangalore (Table 7), where the influence of urbanization was lower than in transition and urban areas. In transition areas the agriculture sector was the second major source of employment (23%). The non-farm sector constituted more than 30% of the total employment generated in all the three gradients and generated the most employment in the transition (38%) and urban (49%) gradients.

Livestock contributed to 13%, 14%, and 11% of the total employment in, respectively, the rural, transition, and urban gradients. The number of person-days of employment averaged 296 in the urban gradient (the highest), 253 person-days in the transition gradient, and 253 person-days in the rural gradient. More than 60% of the households in all the three gradients employed in the government sector were food-secure (64% in the rural gradient, 67% in the transition gradient, and 78% in the urban gradient). The proportion of food-secure households was low for the households employed in the agriculture sector and as agriculture labour when compared to other sectors, because farm income or farm produce depends on the climate, but the income of people employed in the government sector and in off-farm and non-farm activity is stable and regular.

Conclusions

This study investigated the extent and factors of food insecurity in the rural–urban interface of Bangalore. The study presupposed that, despite rising income levels and employment opportunities, food and nutritional insecurity persists, especially among women in the family, and this phenomenon appears to be more common in rural areas than in urban areas. Based on

Table 7 Sources of employment and status of food security in south transect

Particulars	Rural				Transition				Urban			
	Person-days/ person/year	Number of persons	Employment generation (%)	Food-secure households (%) (n=260)	Person-days/ person/year	Number of persons	Employment generation (%)	Food-secure households (%)(n=132)	Person-days/ person/year	Number of persons	Employment generation (%)	Food-secure households (%) (n=62)
Agriculture	218	154	33.03	51.09	222	59	22.87	55.93	65	4	0.84	92.26
Agriculture labourer	250	44	10.82	47.72	267	17	7.93	52.94	-	-		-
Livestock	143	95	13.36	58.94	172	47	14.12	57.44	184	18	10.71	61.11
Off-farm	313	28	8.62	57.14	278	23	11.17	60.86	335	27	29.24	66.66
Non-farm	310	102	31.11	58.16	303	72	38.10	56.94	316	48	49.03	54.16
Govt. employee	283	11	3.06	63.64	278	12	5.83	66.66	350	9	10.18	77.77

Note: 1. Off-farm= flour mill, flower shop, fruit shop, dairy care taker, poultry farm, etc.
2. Non-farm= Tailor, newspaper distributer, driver, real estate, clothing store, shop keeper, phone retailer, etc.

the recommended daily calorie intake, 72.2% of the households in the north transect and 68.6% of the households in the south transect, or most households in the study area, were food-secure. The variables such as employment from agriculture and non-farm sources, per capita income, and urban dummy are significant and they positively influence food security. The proportion of food-secure households was lower for households employed in the agriculture sector and as agriculture labour than in other sectors in both the transects. Food insecurity exists, but it is low.

To improve the food security status in rural areas, employment and income opportunities in agriculture and off-farm activities need to be created with suitable infrastructure and small-scale industries.

The central and state governments sponsor many food security programmes, but food insecurity persists. The government should consider using the public distribution system to make various food items available and creating employment opportunities that generate an income sufficient to buy the necessary components of balanced diet and minimize food insecurity.

Acknowledgments

This research paper is part of the Indo-German Collaborative Research project titled 'The Rural-Urban Interface of Bangalore - A Space of Transition in Agriculture, Economics and Society', Sub-Project 'Food Insecurity at Different Stages of Urbanization'. The Department of Biotechnology (DBT), Government of India is duly acknowledged for the financial support for this project.

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