Assessment of Food and Nutrient Intake of Communities across Three Agro-biodiversity Hotspots in India

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ASSESSMENT OF FOOD AND NUTRIENT INTAKE OF COMMUNITIES ACROSS THREE AGRO-BIODIVERSITY HOTSPOTS IN INDIA

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Abstract

Balanced and adequate nutrition is important in improving the health of the community in general and of vulnerable groups in particular. Assessment of the nutritional status of a community is important for development of implementation strategies and suitable policies. Dietary assessment indicates whether intake of macro and micro nutrient are adequate. Anthropometric measurements and comparisons of nutrient intakes with reference values are easy and non-invasive, economical and sufficiently reliable methods for the determination of nutritional status. The present study uses micro-level data drawn from 24 hours recall diet survey to calculate the mean food and nutrient intake by communities in three agro-biodiversity hotspots. The 24 hours recall diet survey was carried out among households in three study locations during June to November 2013 among the project intervention and non-intervention groups. Information on age, sex, physiological status, physical activity of the household members who took meals during the previous 24 hours was collected for computing consumption unit. The result shows that cereals are the chief source of energy in the study locations contributing 70-80% of the daily energy intake. Mean intake of green leafy vegetable are negligible in the study locations. The intake of sugar and jaggery among the intervention group of Meenangadi is 48% higher than recommended dietary intake, while in the non-intervention group it is 28% higher; and 20% higher among the non-intervention group in the Kolli Hills. The intake of vitamin A is the lowest among other nutrients across the internvention and non-intervention groups in the study locations.

Keywords: Food and Nutrient Intake, 24 Hours Recall, Agro-biodiversity Hotspots, India

Introduction

Alleviating food insecurity and malnutrition continue to be major developmental challenges. The nutritional status of humans is entwined in complex relationships determined by a chain of events from food production to consumption and set against the backdrop of cultures and nations (Kataki and Babu, 2002). Deficiencies of minerals and vitamins results in several biochemical and physiological defects. Micronutients such as minerals and vitamins have a major role to play in the proper utilization of macro nutrients. Optimal nutrition can protect humans against many diseases/disorders resulting from nutrient deficiencies or excess (Aberoumand 2011). Balanced and adequate nutrition is therfore important in improving the health of communities in general and of groups at risk in particular. The dietary assessment of the community indicates if the intake of the macro and micro nutrient are adquate. Nutritional status of the community can be assessed by direct indicators based on anthropometric measurements, as well as indirect indicators such as food and nutrient intakes compared to recommended levels. These approaches are easy, non-invasive, economical and sufficiently reliable for the determination of nutritional status (McMahan and Bistrain, 1991). Assessment of the nutritional staus of a community is important for policy making and development and implementation of intervention strategies.

The present study is a part of the research project, "Alleviating Poverty and Malnutrition in Agro-biodiversity Hotspots (APM)'' implemented jointly by the M.S.Swaminathan Research Foundation (MSSRF), Chennai, India and the University of Alberta (U of A), Edmonton, Canada, in three agrobiodiversity hotspots of India: Kundra block in the Koraput district of Odisha, Meenangadi panchayat in the Wayanad district of Kerala and Kolli Hills in the Namakkal district of Tamil Nadu. Enhancing nutrition through improving agricultural productivity, diversifying household diets based on kitchen gardens are some of the primary pathways adopted by the APM project. The baseline nutritional assessement information was collected using three survey instruments: Food frequency survey, 24 hours recall diet survey and Anthropometric assessment survey. These surveys were carried out among both the intervention and non-intervention groups. In the intervention group, activities are being carried out by the project to enhance overall nutritional status of the community. The non-intervention group serves as control, where no such interventions are being implemented, to enable comparison of the endline results. The present paper uses micro-level data of the 24 hours recall diet survey to calculate the average daily food and nutrient intake by the communities in three agro-biodiversity hotspots. While a single 24 hours recall is not considered to be representative of habitual diet at an individual level, but adequate for a survey of intake across a large group and for estimating mean intakes of community (Raina 2013).

Most existing literature on nutrition make use of secondary data generated by the Demographic and Health Survey (DHS) and National Family Health Survey (NFHS) of the Government of India. In addition, the National Nutrition Monitoring Bureau (NNMB) and the National Sample Survey Organisation (NSSO) carries out diet and nutrition surveys routinely once in 5 years. The present study makes use of micro-level primary data generated in the study locations, which happens to be a poorly accessed location and therefore likely to contribute to available literature.

Study area

India is one of twelve mega-diverse countries in the world and is considered as a major center of domestication of crop plants. In 2007, the Protection of Plant Varieties & Farmers' Rights Authority (PPV&FRA) of the Government of India (GoI) constituted a task force to characterize, demarcate and list the agrobiodiversity hotspots in India. The task force identified 22 hotspots across India, based on a listing of species of botanical and agricultural

importance, endemic and endangered species and socio-cultural aspects of the areas (Nayar et al. 2009b). The current research is being implemented in three of the agrobiodiversity hotspots identified by the task force – the Kundra block in the Koraput region, Wayanad district in the Malabar region and Kolli Hills block in the Kaveri region.

Koraput is a center of biodiversity for many food crops and forest species. Sixty-two tribal communities constituting 54.45% of its population live in the district (Mohanti et al. 2006). Koraput has low literacy rates and poor financial condition (Mishra and Taraputia 2013). Wayanad district, situated in the Western Ghats in the north-eastern part of Kerala, India, is considered one of the world's most important biodiversity hotspots. Tribal population represents 17% of the total population of the district, and is the largest tribal population in the state of Kerala (Josephat 1997). The district is characterized by high ethnic diversity, with five dominant tribal groups – Kurichiya, Kuruma, Paniya, Adiya and Kattunaikka- and seven minor communities (Kumar et al. 2003). Kolli Hills is a mountainous area with a temperate climate located on the eastern border of the Namakkal district in Tamil Nadu. The Kolli Hills region is characterized by significant *in-situ* crop genetic diversity of minor millets (Jayakumar et al. 2002; King et al. 2008). More than 95 per cent of the inhabitants are tribal people belonging to the Malayali tribal community (MSSRF 2002).

The average household size in all three study locations is approximately 4.5. The majority of the households are male headed households: 94 percent in Kundra, 85 percent in Meenangadi and 93 percent in the Kolli Hills. The number of years of education of the household head is highest in Meenangadi with 3.4 years and lowest in Kundra with 1.7 years. Crop production is the primary occupation of the majority of households: 87 percent in Kundra, 86 percent in Meenangadi and 91 percent in the Kolli Hills. The average farm size is 1.12 hectares in Kundra, 0.67 hectares in Meenangadi and 0.88 hectares in the Kolli Hills. About 99.2 percent of households in the Kolli Hills, 42.1 percent in Kundra and 20.3 percent in Meenangadi comprise of Scheduled Tribes.

Data collection and methods

The 24 hours recall diet survey was carried out in a sub-sample of randomly selected households in the three study locations during June to November 2013 among the project intervention and non-intervention groups. The total number of households residing in the project location/ intervention group are: 2004 in Kundra block, 1000 in Meenangadi panchayat and 841 in the Kolli Hills. About 500 households in the project intervention group and 100 households in the non-intervention group from among the total households, were surveyed by adopting systematic random sampling procedure.

The final sample size in the intervention group are: 156 households in Kundra , 104 households in Meenangadi and 106 households in the Kolli Hills; while in the non-intervention group: 48 households in Kundra, 50 households in Meenangadi and 45 households in the Kolli Hills. Field investigators trained in the survey methodologies were involved in data collection. Information on age, sex, physiological status, physical activity of the household member who took meals during the previous 24 hours were collected for calculating consumption unit (CU). Each respondent was asked to report whatever food item and drink that was consumed by each member of the household and the information meticulously recored. Respondents were asked to provide details like name of the preparation, ingredients used and quantity of raw material used for preparing each item during the previous 24 hours. The raw quantity of each ingredient used for preparing food was weighed using a digital weighing scale, different sizes of cups and spoons. Later, food-stuffs were compiled to calculate the CU, using Narasinga Rao et al. (2012).

One consumption unit refers to coefficient of energy requirement of reference man, who is an adult male, aged from 20 to 39 years, weighing 60 Kg., doing sedentary work. The

CU for others are proportionately worked out on the basis of age, sex, physiological status, physical activity, and energy requirements. The intake of various food stuffs are computed and expressed as average per CU/day, based on the equation:

$$\text{Average Intake per CU/day (g)} = \frac{\text{Total Raw amount used (g)}}{\text{TotalCU of Household (Consuming the food)}}$$

By using the above equation, the mean intake of Food-stuff (per CU/day) and mean intake of Nutrients (per CU/day) were calculated and is presented in the next section.

Result and discussion

Daily mean food intake

The daily mean intake [gram(g)/CU/day) of food-stuff by the households in the project intervention and non-intervention groups are presented in Annexure 1(a) and 1(b). The figures projected in the annexure represent mean, median and standard deviation of the various intake of food-stuff by the households and a comparison of the above mean with the Recommended Daily Intakes (RDI) by the Indian Council of Medical Research (ICMR).

Figure 1(a): Daily Mean Intake of Food-stuffs (per CU/day) as percent of RDI in the intervention group

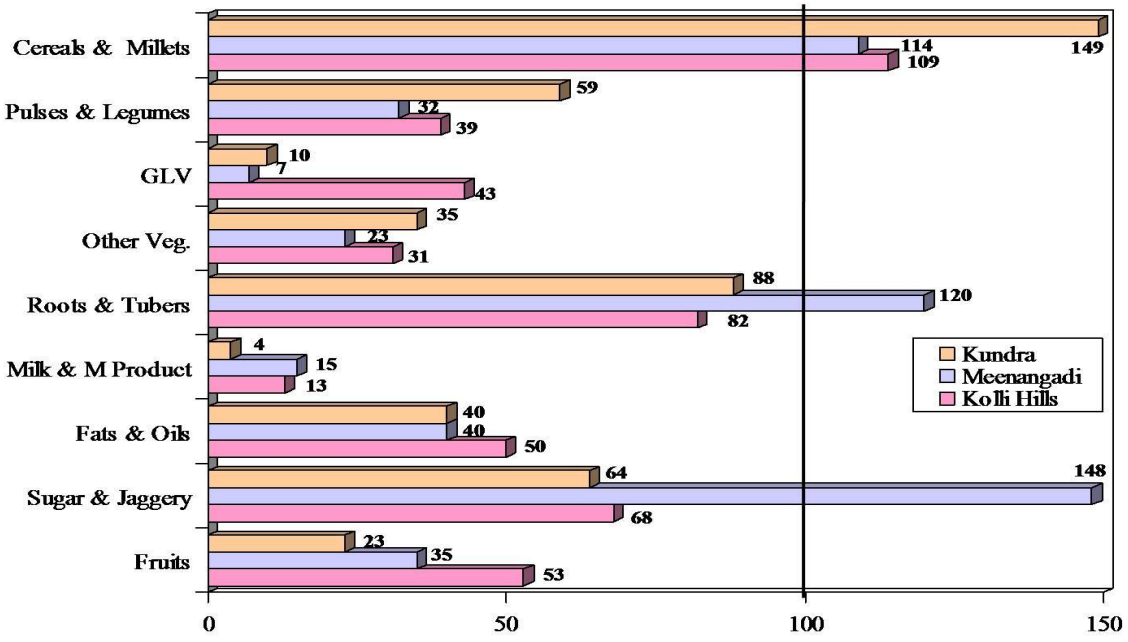
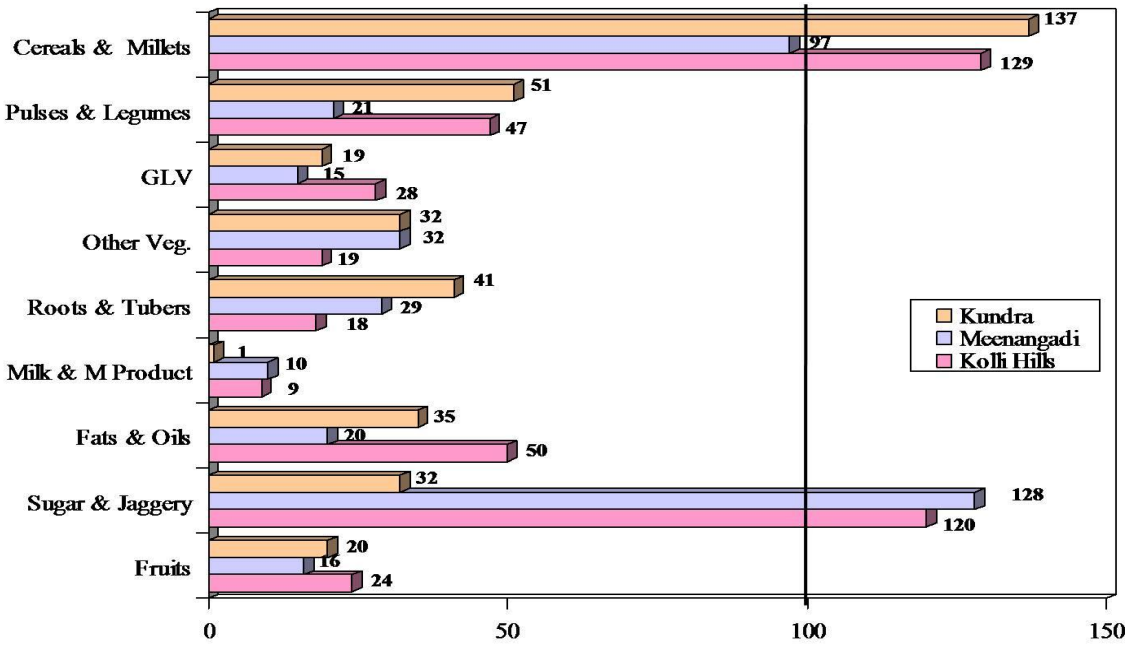


Figure 1(b): Daily Mean Intake of Food-stuffs (per CU/day) as percent of RDI in the non-intervention group



The daily mean intake of food-stuff (per CU/day) as percent of RDI for intervention and non-intervention groups are elucidated in Figures 1(a) - 1(b). On an average, cereals and millets are consumed by households above the RDI in both the intervention and non-intervention groups, Meenangadi being the exception in the latter. The pulses and legumes are consumed marginally by both intervention and non-intervention groups, the quantity being consumed is least in Meenangadi. The green leafy vegetables (GLV) consumption is negligible in both the groups across sites, exception being Kolli Hills particularly among the intervention group with a figure of 43 percent of RDI. There is no significant difference between intervention group and non-intervention group in the case of consumption of other vegetables, which ranged between 23 to 35 percent of RDI. There is significant difference in the consumption of roots and tubers between the intervention group and non-intervention group, the consumption being higher in intervention group. The percent of RDI in the intervention households ranged from 82% (Kolli Hills) to 120% (Meenangadi); while in non-intervention households it ranged from 18% (Kolli Hills) to 41% (Kundra). The consumption of milk is almost negligible in both the groups across the study sites. The consumption of fats and oils are marginal, 50% of RDI in both the groups in the Kolli Hills, 40% and 35% respectively in intervention and non-intervention groups in Kundra, 40% and 20% respectively in intervention and non-intervention groups in Meenangadi. The consumption of sugar and jaggery is 68% of RDI in the intervention group of the Kolli Hills, while almost double in non-intervention group. In Kundra, sugar and jaggery are consumed two-third of RDI in intervention group and one-third of RDI in non-intervention group; while in Meenangadi, 48% and 28% higher than the RDI respectively. Fruits are consumed marginally by the intervention group, which ranged from 23% (Kundra) to 53% (Kolli Hills), while in the non-intervention group it ranged from 16% (Meenangadi) to 24% (Kolli Hills).

Daily median nutrient intake

The daily median intake of nutrients by the households in the project intervention and non-intervention groups are presented in Annexure 2(a) and 2(b). The figures projected in the

annexure represent mean, median and standard deviation of the various nutrients by the households and a comparison of the above median with the Recommended Daily Allowances (RDA) by the ICMR. The median intake is used for comparison with RDA, because it is better suited for skewed distributions to derive at central tendency since it is much more robust and sensible.

Figure 2(a): Daily Median Intake of Nutrients (per CU/day) as percent of RDA in the intervention group

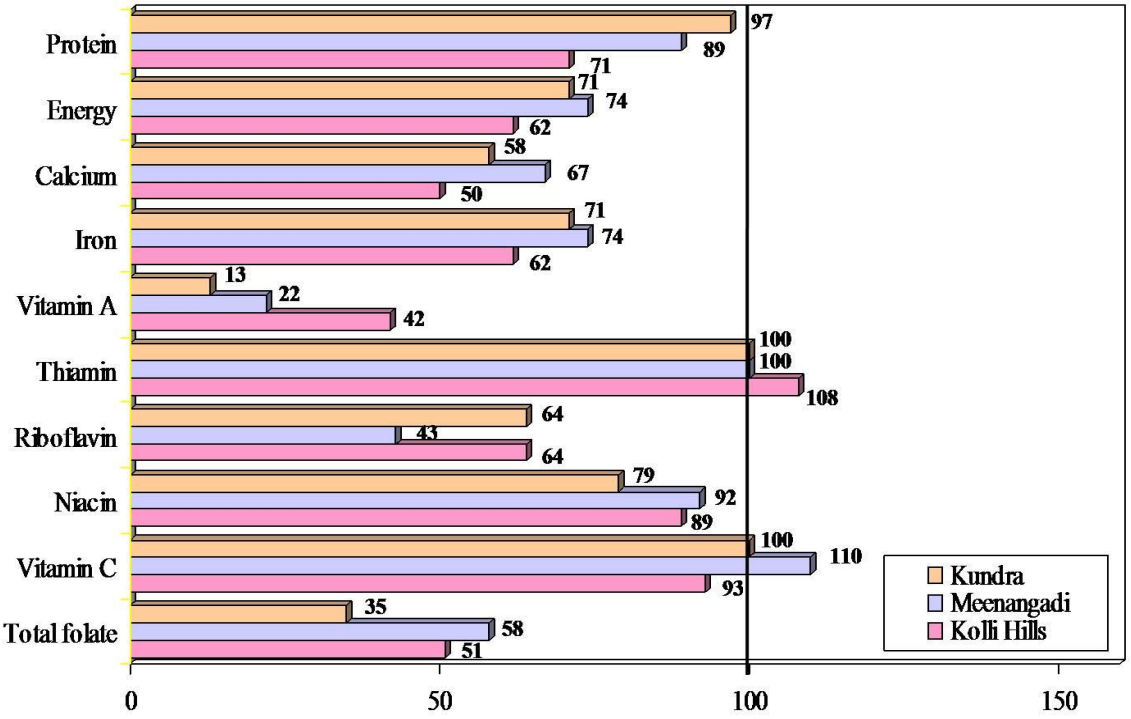
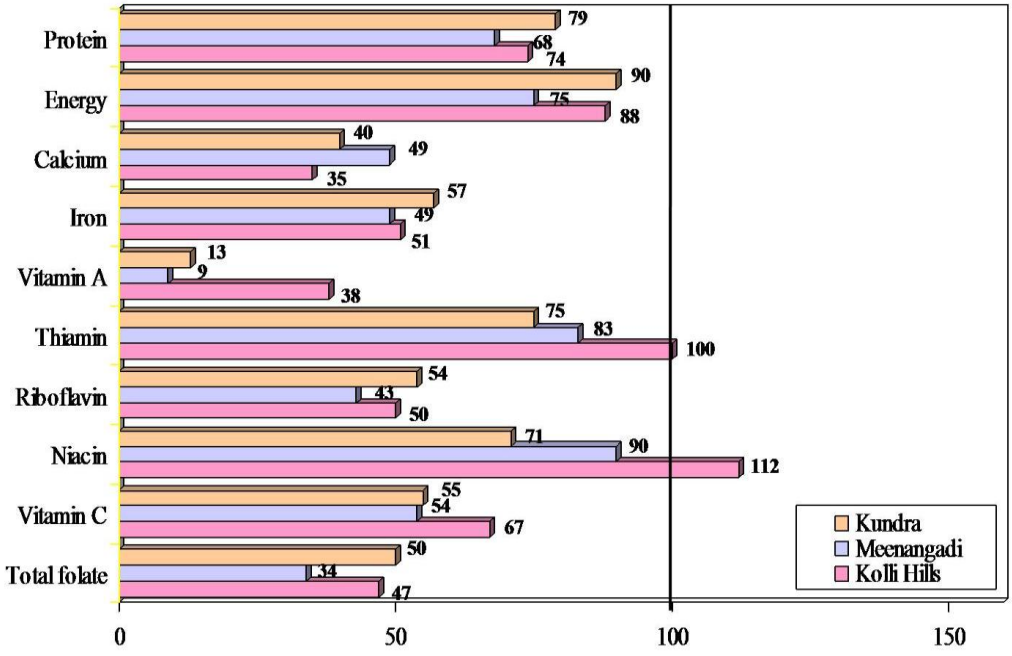


Figure 2(b): Daily Median Intake of Nutrients (per CU/day) as percent of RDA in the non-intervention group



The daily median intake of nutrients (per CU/day) as percent of RDA for intervention and non-intervention groups are presented in Figures 2(a) - 2(b). The median intake of protein is higher in intervention group compared to non-intervention group across the study areas except in the Kolli Hills. The energy intake of RDA is higher in non-intervention groups of the Kolli Hills (88%), Kundra (90%) and Meenangadi (75%) compared to intervention groups of the Kolli Hills (62%), Kundra (71%) and Meenangadi (74%). The calcium intake is higher in intervention group across the study area by 15-18% than the non-intervention group. Iron intake is also higher in the intervention group compared to non-intervention group, by around 12% - 13% in the Kolli Hills and Kundra, and 25% in Meenangadi. Vitamin A intake is low in Kundra and Meenangadi, and marginal in the Kolli Hills both among intervention and non-intervention groups. Thiamine intake in the Kolli Hills fulfills the RDA among both groups; while it fulfills the intervention groups in Kundra and Meenangadi. Riboflavin intake is marginal among both groups across the study areas. Niacin intake among intervention group ranged from 79% of RDA in Kundra and 92% in Meenangadi, whereas in non-intervention group this ranged from 71% in Kundra and 112% in the Kolli Hills. Vitamin C intake also fulfils the RDA in the intervention groups but marginal in the non-intervention group. Total folate intake is marginal among the both groups across study areas.

Limitation of the study

The nutrient values for the following items were not available and hence could not be included in the analysis.

1. Nutrient values of a few (traditional) food items collected from commons.
2. Nutrient values of some packed foods like biscuit, rusks, etc.
3. A large number of households were using packed (eg. Chilli powder) masala packets. For which nutrient values were not available.

Conclusion

The present study is developed from a 24 hour recall diet survey, aimed to create a baseline indicator for the project, ‘‘Alleviating Poverty and Malnutrition in Agro-biodiversity Hotspots (APM)’’. The results shows that cereals are the chief source of energy in the study locations contributing to 70-80% of the daily energy intake. Mean intake of GLV are negligible in the study locations. It is advisable to include atleast 50 gram of GLV daily in one’s diet. The GLV are a rich source of calcium, iron, β-carotene, vitamin C, riboflavin and folic acid. The intake of sugar and jaggery among the intervention group of Meenangadi is 48% higher than RDI, while in the non-intervention group it is 28% higher; and 20% higher among the non-intervention group in the Kolli Hills. Such an excess consumption may lead to diabetics (Jenkins et al. 1978) and heart diseases respectively (Gurr 1987) among adults and dental carries in children. The intake of vitamin A is the lowest among other nutrients across the internvention and non-intervention groups in the study locations. Lack of vitamin A leads to night blindness and other ailments and can be easily overcome by increasing use of animal foods including liver oils of some fishes. The second lowest nutrient intake is total folate, which may lead to loss of appetite and weight loss. Additional signs are weakness, sore tongue, headaches, heart palpitations, irritability, and behavioural disorders (Haslam and Probert, 1998).In adults, anemia can be a sign of advanced folate deficiency. In infants and children, folate deficiency can slow growth rate. Women with folate deficiency who become pregnant are more likely to give birth to low birth weightpremature infants, and infants with neural tube defects. Folate is present both in animal and plant food. To enhance nutrition in the study locations, APM project implemented different set of activities. For instance activities which would increase nutritional intake and food security like introduction

ofstructured and unstructured kitchen gardens, enhancement of already existing kitchen gardens, crop yield enhancement measures in cereals and pulses, aiding back yard poultry, community fish farming, mushroom cultivation, providing saplings of nutritious trees like drumstick, papaya, guava, etc. Apart from physical activities many nutritional awareness programmes and trainings have also been provided to the communities especially women and adolescent girls. The impact of the project is to be studied in the near future.

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Annexure 1 (a): Daily mean intake of food-stuffs by the Households in the Intervention Group (g/CU/day)

Food Groups	No. of HHs	Average	FOOD GROUPS														
			CEREALS & MILLETS			Pulses & Legu-mes	VEGETABLES			Nuts & Oil Seeds	Fruits	FLESH FOODS			Milk & Milk Pro.	Fats & Oils	Sugar & Jaggery
			Cereals	Millets	Total		Green Leafy Veg.	Other Veg.	Roots & Tubers			Fish	Other Flesh Foods	Total			
Kundra	156	Mean	558	0.6	559	44	10	70	88	0.8	23	3	11	14	12	8	16
		SD	211.13	7.06	210.41	38.09	26.33	81.66	77.85	4.93	36.82	20.90	46.47		27.35	17.56	18.82
		Median	550	0	550	37	0	50	72	0	11	0	0		0	6	11
	Mean Intake as % RDI				*149*	*59*	*10*	*35*	*44*		*23*				*4*	*40*	*64*
Meenangadi	104	Mean	409	0	409	24	7	46	87	24	35	47	36	83	46	8	37
		SD	167.61	0	167.61	33.07	21.44	61.69	119.41	24.07	51.24	77.20	74.23		82.57	7.43	32.7
		Median	371	0	371	9	1	27	44	20	20	6	0		0	5	30
	Mean Intake as % RDI				*109*	*32*	*7*	*23*	*44*		*35*				*15*	*40*	*148*
Kolli Hills	106	Mean	441	0	441	29	43	61	49	6	53	0	0.5	0.5	40	10	17
		SD	147.12	0	147.12	41.64	57.01	76.93	59.09	14.14	63.26	0	5.58	5.58	79.02	9.41	16.43
		Median	426	0	426	9	19	46	31	1	37	0	0	0	0	8	14
	Mean Intake as % RDI				*118*	*39*	*43*	*31*	*25*		*53*				*13*	*50*	*68*
Recommended Daily Intakes					**375**	**75**	**100**	**200**	**200**		**100**				**300**	**20**	**25**

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Annexure 1 (b): Daily mean intake of food-stuffs by the Households in the Non-intervention Group (g/CU/day)

Food Groups	No. of HHs	Ave-rage	FOOD GROUPS															
			CEREALS & MILLETS			Pulses & Legu-mes	VEGETABLES			Nuts & Oil Seeds	Fruits	FLESH FOODS			Milk & Milk Pro.	Fats & Oils	Sugar & Jaggery
			Cereals	Millets	Total		Green Leafy Veg.	Other Veg.	Roots & Tubers			Fish	Other Flesh Foods	Total			
Kundra	48	Mean	514	0	514	38	19	63	81	0.8	20	0	7	7	4	7	8
		SD	180.18	0.00	180.18	24.69	38.55	63.00	64.20	4.22	27.20	0.00	24.96	24.96	11.95	2.96	7.62
		Median	467	0	467	36	0	54	76	0	6	0	0	0	0	6	7
	Mean Intake as % RDI				**137**	**51**	**19**	**32**	**41**		**20**				**1**	**35**	**32**
Meenangadi	50	Mean	365	0	365	16	15	64	57	24	16	29	23	52	31	4	32
		SD	137.30	0.00	137.30	22.90	44.48	73.60	93.00	25.70	32.16	67.48	86.08	-	58.91	3.51	23.22
		Median	363	0	363	0	0.1	48	22	19	0	0	0	0	0	3	24
	Mean Intake as % RDI				**97**	**21**	**15**	**32**	**29**		**16**				**10**	**20**	**128**
Kolli Hills	45	Mean	485	0	485	35	28	38	35	1.4	24	0	0	0	28	10	30
		SD	157.38	0.00	157.38	30.80	39.59	65.88	54.79	2.24	31.44	0.00	0.00	0.00	80.32	7.52	69.18
		Median	466	0	466	37	19	0	22	0.9	14	0	0	0	0	9	20
	Mean Intake as % RDI				*129*	*47*	*28*	*19*	*18*		*24*				*9*	*50*	*120*
Recommended Daily Intakes					**375**	**75**	**100**	**200**	**200**		**100**				**300**	**20**	**25**

Annexure 2 (a): Daily median intake of Nutrients by the Households in the Intervention Group (CU/day)

Intervention Group	No. of HHs	Average	NUTRIENTS										
			Proteins (g)	Energy (Kcal)	Calcium (mg)	Iron (mg)	Vit. A (µg)	Thiamin (mg)	Ribo-flavin (mg)	Niacin (mg)	Vit. C (mg)	Total Folate (µg)	Free Folic Acid (µg
Kundra	156	Mean	60.6	2433	410	14.7	202	1.20	0.94	14.9	48.5	109	41
		SD	23.52	791.99	314.47	9.12	378.20	0.55	0.42	6.51	55.43	63.42	23.78
		Median	58.3	2383	349	12.0	75	1.10	0.85	13.8	30.1	91.35	35
	Median Intake as % RDA		*97*	*103*	*58*	*71*	*13*	*92*	*61*	*86*	*75*	*46*	*35*
Meenangadi	104	Mean	58.0	2127	505	13.8	223	1.25	0.82	17.2	44.6	116	62
		SD	25.85	785.27	370.42	7.09	331.43	0.50	0.34	6.72	41.38	74.48	29.28
		Median	53.2	1955	401	12.5	133	1.10	0.80	16.5	29.2	92.3	58
	Median Intake as % RDA		*89*	*84*	*67*	*74*	*22*	*92*	*57*	*103*	*73*	*46*	*58*
Kolli Hills	106	Mean	45.5	2017	373	14.6	432	1.25	0.83	18.0	86.4	128	56
		SD	18.59	677.59	293.64	13.39	590.20	0.51	0.36	6.76	93.91	85.32	29.26
		Median	42.3	1890	299	10.6	252	1.20	0.80	17.3	50.75	110	51
	Median Intake as % RDA		*71*	*81*	*50*	*62*	*42*	*100*	*57*	*108*	*127*	*55*	*51*
Recommended Daily Allowance			**60**	**2320**	**600**	**17**	**600**	**1.2**	**1.4**	**16**	**40**	**200**	**100**

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Annexure 2 (b): Daily median intake of Nutrients by the Households in the Non-intervention Group (CU/day)

Intervention Group	No. of HHs	Average	NUTRIENTS										
			Proteins (g)	Energy (Kcal)	Calcium (mg)	Iron (mg)	Vit. A (µg)	Thiamin (mg)	Ribo-flavin (mg)	Niacin (mg)	Vit. C (mg)	Total Folate (µg)	Free Folic Acid (µg
Kundra	48	Mean	51.1	2170	305	10.6	210	0.98	0.76	12.5	40.9	108	41.9
		SD	15.18	641.79	177.14	3.58	419.48	0.29	0.21	3.86	56.10	46.11	14.6
		Median	47.5	2093	241	9.75	75.2	0.90	0.75	11.4	22.1	100	40.4
	Median Intake as % RDA		**79**	**90**	**40**	**57**	**13**	**75**	**54**	**71**	**55**	**50**	**40**
Meenangadi	50	Mean	45.8	1797	371	10.3	154	1.04	0.63	15.1	39.5	83.5	47.3
		SD	29.22	714.12	331.45	8.01	305.59	0.46	0.33	6.12	55.27	53.84	23.85
		Median	40.7	1745	296	8.4	55.4	1.00	0.60	14.4	21.5	68.9	43.9
	Median Intake as % RDA		**68**	**75**	**49**	**49**	**9**	**83**	**43**	**90**	**54**	**34**	**44**
Kolli Hills	45	Mean	46.3	2142	271	11.2	281	1.15	0.75	17.3	39.8	103	50
		SD	15.17	615	175.14	7.74	366.48	0.44	0.28	6.89	48.39	52.68	22.05
		Median	44.4	2037	209	8.7	227	1.20	0.70	17.9	26.9	93	48
	Median Intake as % RDA		**74**	**88**	**35**	**51**	**38**	**100**	**50**	**112**	**67**	**47**	**48**
Recommended Daily Allowance			**60**	**2320**	**600**	**17**	**600**	**1.2**	**1.4**	**16**	**40**	**200**	**100**