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HOUSEHOLD DIETARY DIVERSITY AND NUTRITION: EXAMPLES FROM KERALA INDIA

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Harnessing Science for Sustainable Development

UNIVERSITY OF ALBERTA

Foreign Affairs, Trade and Development Canada
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India Project Objectives

APM

Advancing Poverty and Malnutrition in AgriBiodiversity Hotspots

Objective 1 - Increased farm productivity by promoting integrated and sustainable use of local crop and livestock diversity with attention to under-utilized crops and breeds, vegetables and fruit trees

Objective 2 - Enhancing food and nutrition security at individual, household and community levels, understanding gender dimensions of poverty and socio-economic empowerment of women

Objective 3 - Enhancing on- and off-farm livelihood diversification options

Objective 4 - Need based capacity building of focal farm families involving *panchayats*, governmental, non-governmental and service providing institutions and policy makers

Note: the data used in the creation of this food security map was assembled from independent data sets from as early as 1991 and as late as 2001. The map itself does not pertain to any specific year, but instead represents urban food security over a 10-year period.

Food Insecurity in Rural India (2004 – 2006)

Level of Insecurity
- 0.218 – 0.352
- 0.352 – 0.487
- 0.487 – 0.621
- 0.621 – 0.756
- 0.756 – 0.89
- Not considered

Map 8b
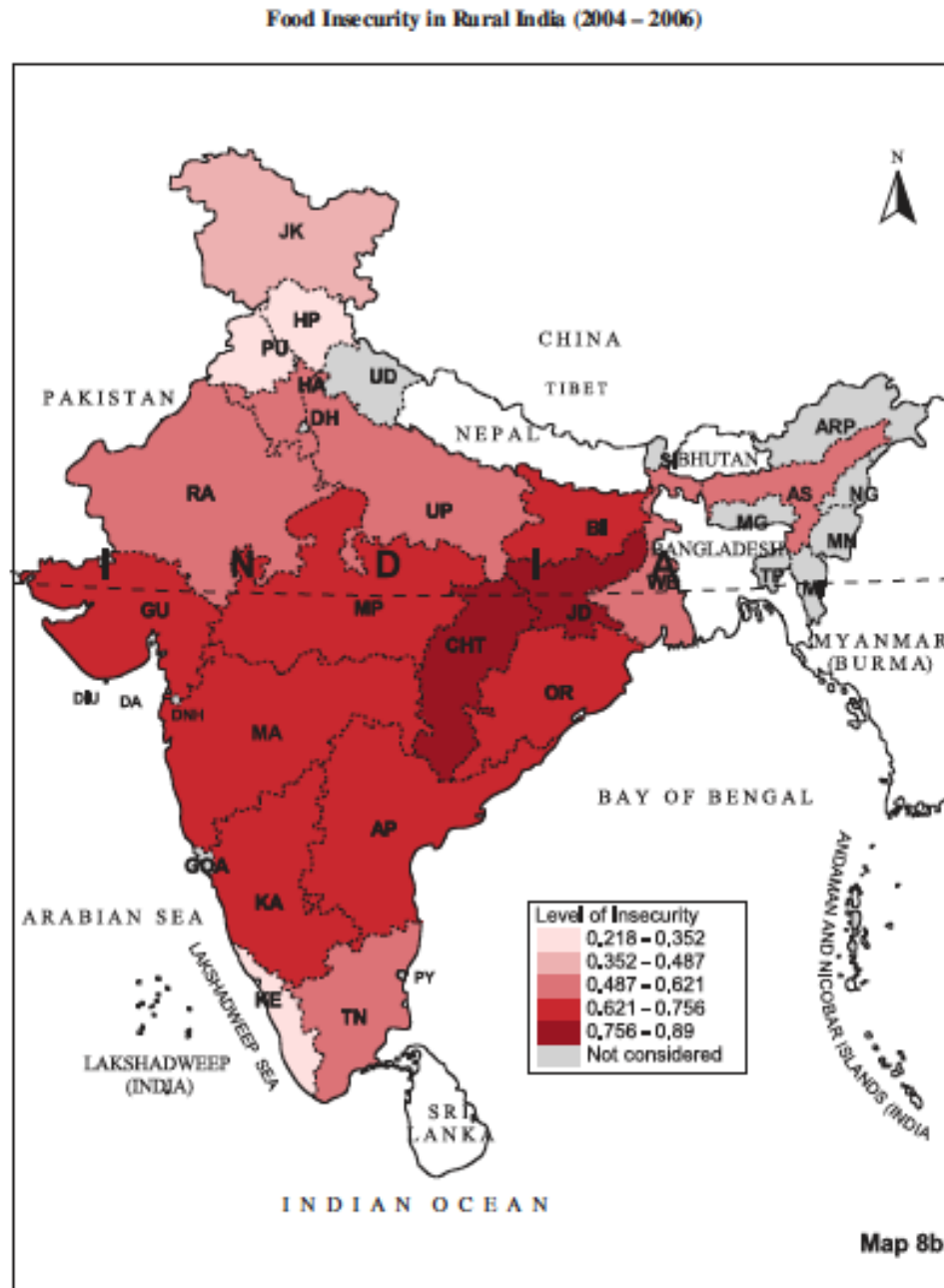
Ownership of home-gardens

	Have a home - garden before baseline survey (%)	Start a home-garden since baseline survey (%)	Abandon a home - garden since baseline survey (%)
Total sample (1801)	42.48	34.59	3.83
Intervention group (1502)	46.94	41.41	4.59
Non-intervention group(299)	20.07	0.33	0.00
Kolli-Hills (600)	9.17	31.67	4.00
Jeypore(600)	44.17	5.00	0.50
Wayanad(601)	74.04	67.05	6.99

Uses of home-garden produce

|	Consumed & not sold (%)	Sold & not consumed (%)	Home consumption &sold (%)	Shared (%)	Traded (%)
Total sample (890)	82.25	2.25	16.40	49.10	8.31
Intervention group (830)	81.69	2.41	16.87	50.12	8.19
Non-intervention group (60)	90.00	0.00	10.00	35.00	10.00
Kolli-Hills (186)	86.56	4.30	4.84	38.71	5.91
Jeypore (264)	56.82	0.00	43.94	34.85	12.88
Wayanad (440)	**95.68**	**2.73**	**4.77**	**62.05**	**6.59**

Home-garden impacts

	More green leafy vegetables(%)	More root and tuber vegetables (%)	More fruits (%)	Supplementary income(%)	Sharing the Surplus(%)	Free from chemical fertilizer (%)
Total sample (890)	87.08	46.07	50.22	17.08	47.87	65.17
Intervention group (830)	87.23	47.35	50.60	17.83	49.04	65.54
Non-intervention group (60)	85.00	28.33	45.00	6.67	31.67	60.00
Kolli-Hills (186)	67.20	75.81	17.20	6.99	35.48	79.03
Jeypore (264)	98.11	22.35	34.47	43.56	32.95	29.92
Wayanad (440)	88.86	47.73	73.64	5.45	62.05	56.14

Vegetables, greens and fruits production

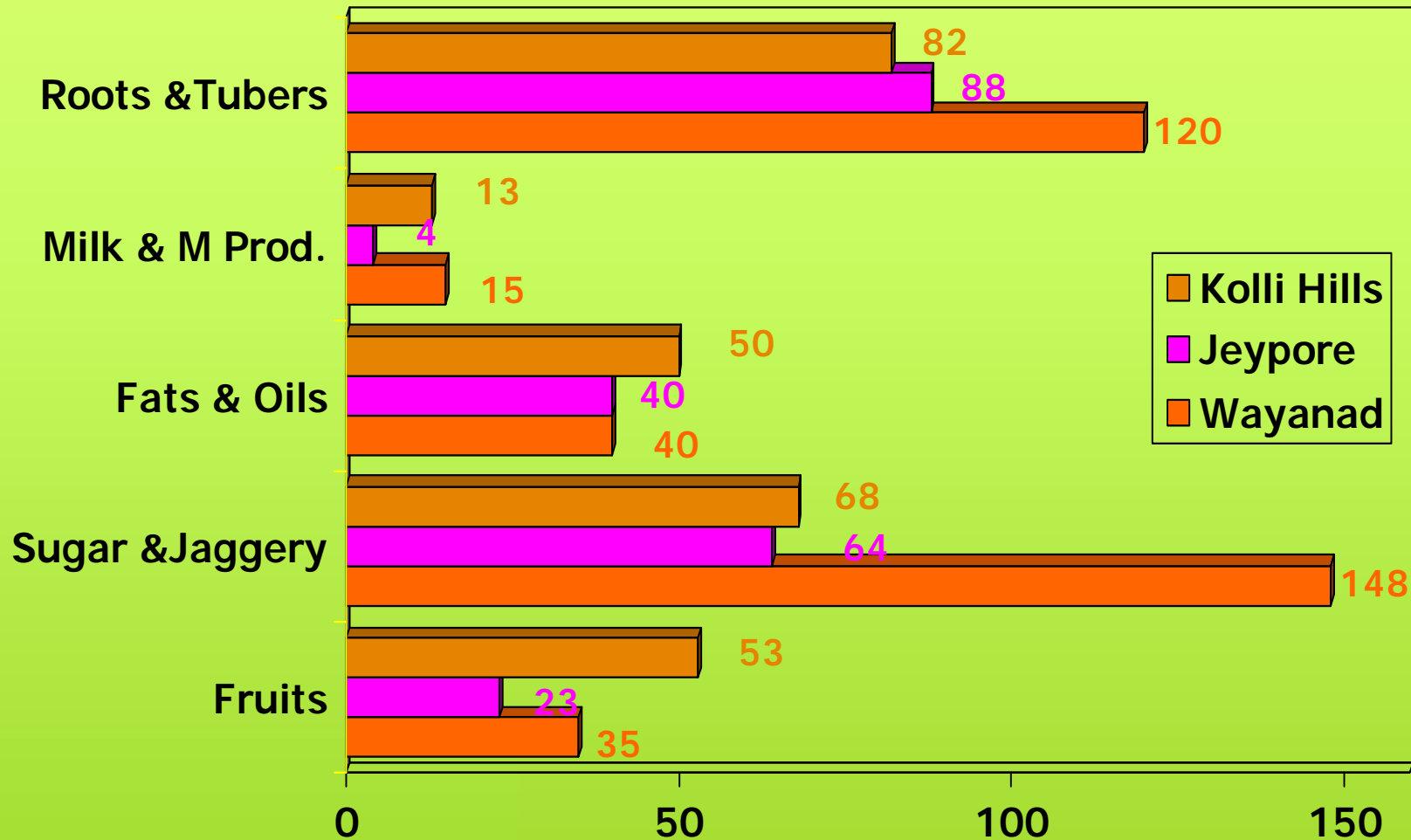| Vegetables			Greens			Fruits		
Crop	Production (Kg)	% share	Crop	Production (Kg)	% share	Crop	Production (Kg)	% share
Cowpea (48.20%)	11.57 (27.05)	52.35 (35.40)	Amaranth (48.99%)	13.14 (44.34)	86.51 (27.48)	Mango (36.63%)	36.71 (40.83)	91.57 (21.61)
Brinjal (42.92%)	18.33 (47.87)	57.60 (37.49)	Moringa (13.48%)	16.72 (66.39)	97.29 (12.56)	Guava (34.16%)	10.71 (15.70)	98.53 (8.31)
Tomato (35.51%)	27.30 (107.03)	34.57 (32.04)	Tropical amaranth (10.34%)	66.86 (180.60)	53.37 (39.11)	Jackfruit (27.87%)	64.85 (76.53)	97.51 (11.77)
Ladies-fingers (31.01%)	14.74 (65.13)	38.97 (33.25)	Bassella (6.18%)	6.45 (6.19)	99.09 (6.74)	Papaya (15.51%)	19.17 (13.23)	97.87 (10.43)
Pumpkin (31.01%)	29.67 (44.44)	85.51 (24.62)	Colocasia (4.16%)	6.54 (5.00)	98.92 (6.58)	Coconut (13.37%)	101.33 (226.76)	86.75 (26.50)
Beans (28.88%)	21.17 (69.89)	49.26 (32.08)	Gongura (3.82%)	59.46 (174.15)	65.85 (38.52)	Banana (8.54%)	29.18 (18.17)	93.51 (16.51)
Bitter-gourd (25.28%)	6.04 (9.35)	52.57 (34.96)	Spinach (3.71%)	56.33 (127.64)	56.06 (42.54)	Custard apple (5.96%)	15.40 (12.14)	100.00
Flat beans (20.79%)	13.49 (12.93)	54.70 (35.06)	Other green (2.81%)	5.70 (4.63)	82.80 (29.83)	Pineapple (5.06%)	13.47 (11.85)	98.00 (8.42)
Radish (17.64%)	12.51 (16.77)	50.41 (33.82)	Centella (0.67%)	101.67 (196.27)	55.17 (49.48)	Fashion (2.02%)	11.22 (7.81)	100.00
Ash-gourd (16.29%)	17.25 (15.47)	86.44 (26.57)	Chekurmanis (0.34%)	8.67 (5.51)	100	Lemon (1.91%)	5.68 (3.81)	90.59 (24.36)

Number of Fruits and Vegetables Grown Before and After
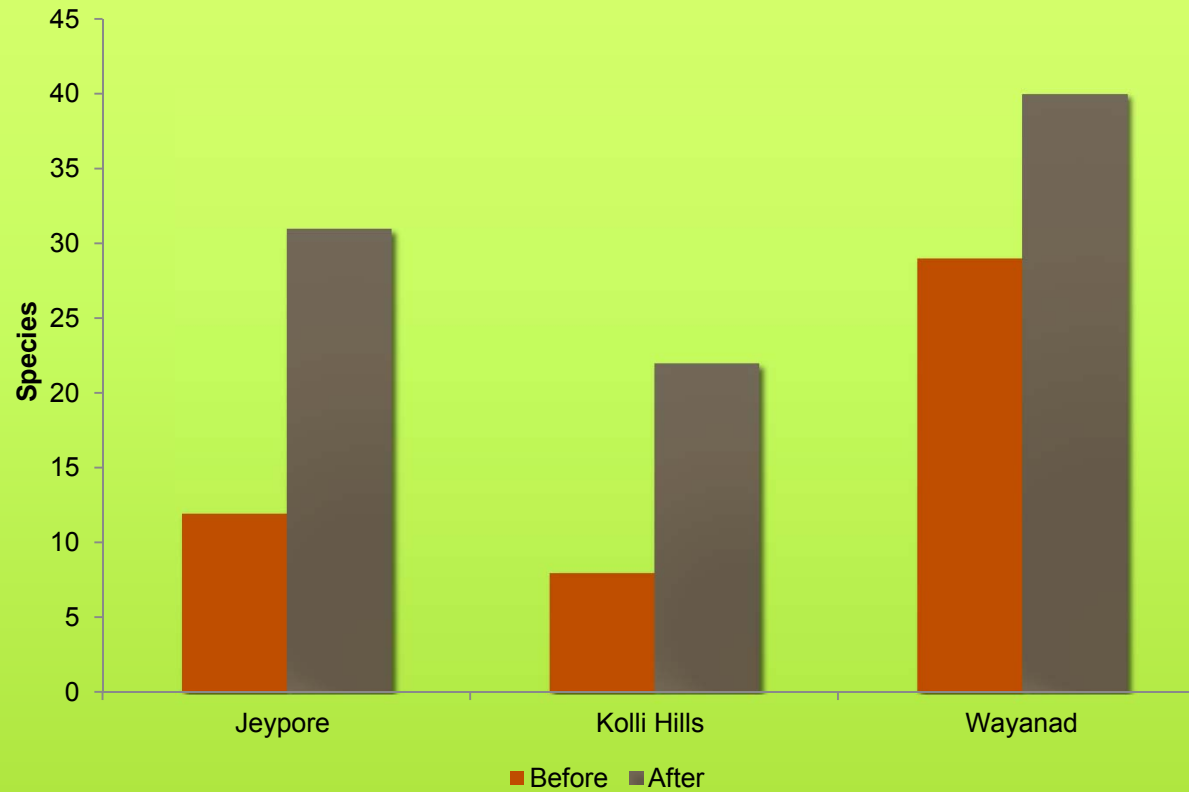
Mean Intake of Foodstuffs (per CU/day) as % of RDI by Intervention Area

Mean Intake of Foodstuffs (per CU/day) as % of RDI by Intervention Area

Legend:
- Kolli Hills
- Jeypore
- Wayanad

Roots & Tubers: Kolli Hills 82, Jeypore 88, Wayanad 120
Milk & M Prod.: Kolli Hills 13, Jeypore 4, Wayanad 15
Fats & Oils: Kolli Hills 50, Jeypore 40, Wayanad 40
Sugar & Jaggery: Kolli Hills 68, Jeypore 64, Wayanad 148
Fruits: Kolli Hills 53, Jeypore 23, Wayanad 35
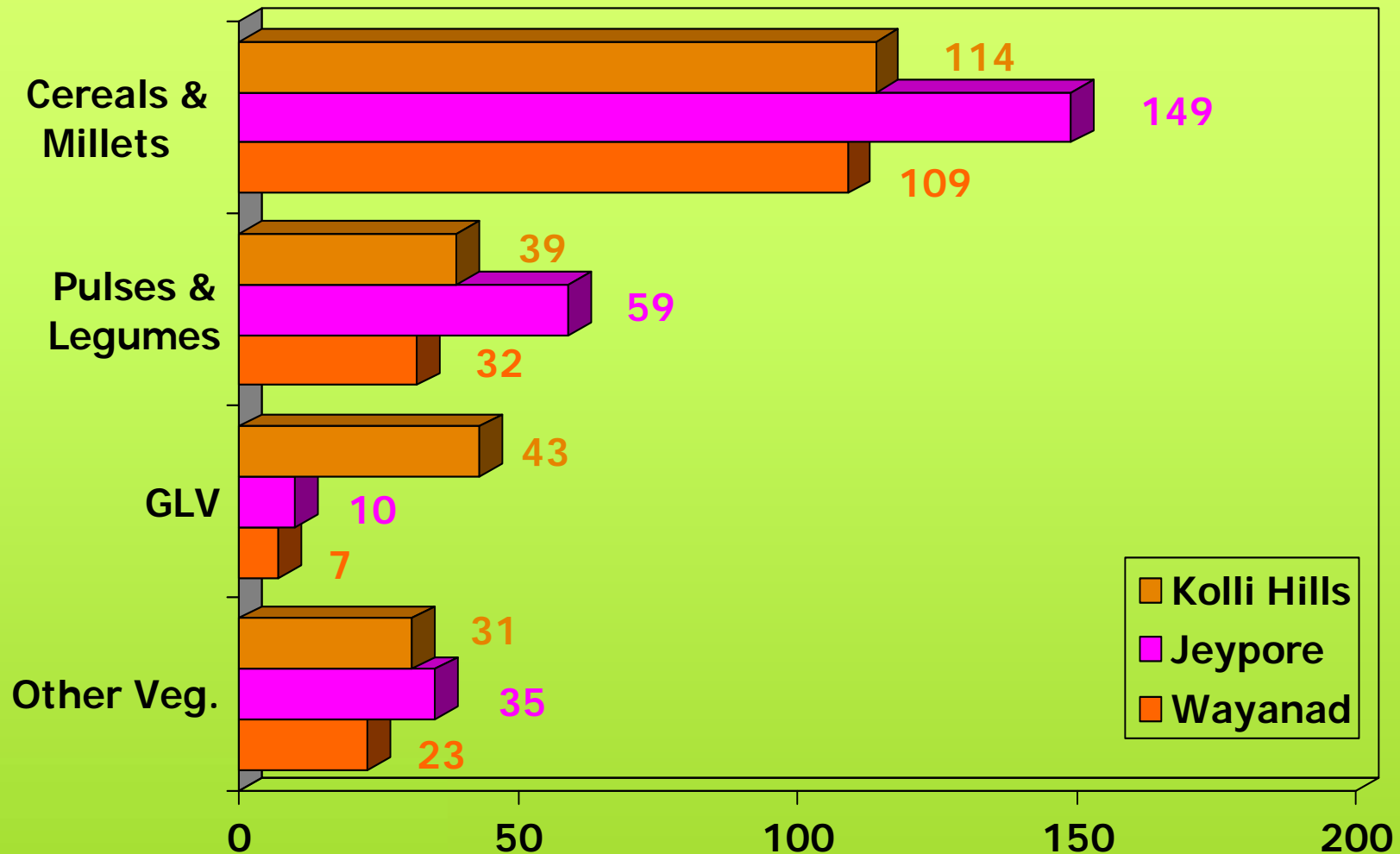
% HHs Consuming Various Nutrients in amounts < 50% of RDA

Nutrients	% HHs. Consuming <50% RDA		
	Kolli Hills	Jeypore	Wayanad
Proteins	19	5	14
Energy	7	5	4
Calcium	50	39	35
Iron	35	21	25
Vitamin A	58	85	83
Thiamin	9	9	6
Riboflavin	47	37	48
Niacin	7	10	2
Vitamin C	15	30	34
Free Folic Acid	95	97	90

Nutritional Status (% Prevalence) of Adolescents (12+ - 17+ yrs): According to age/sex specific BMI
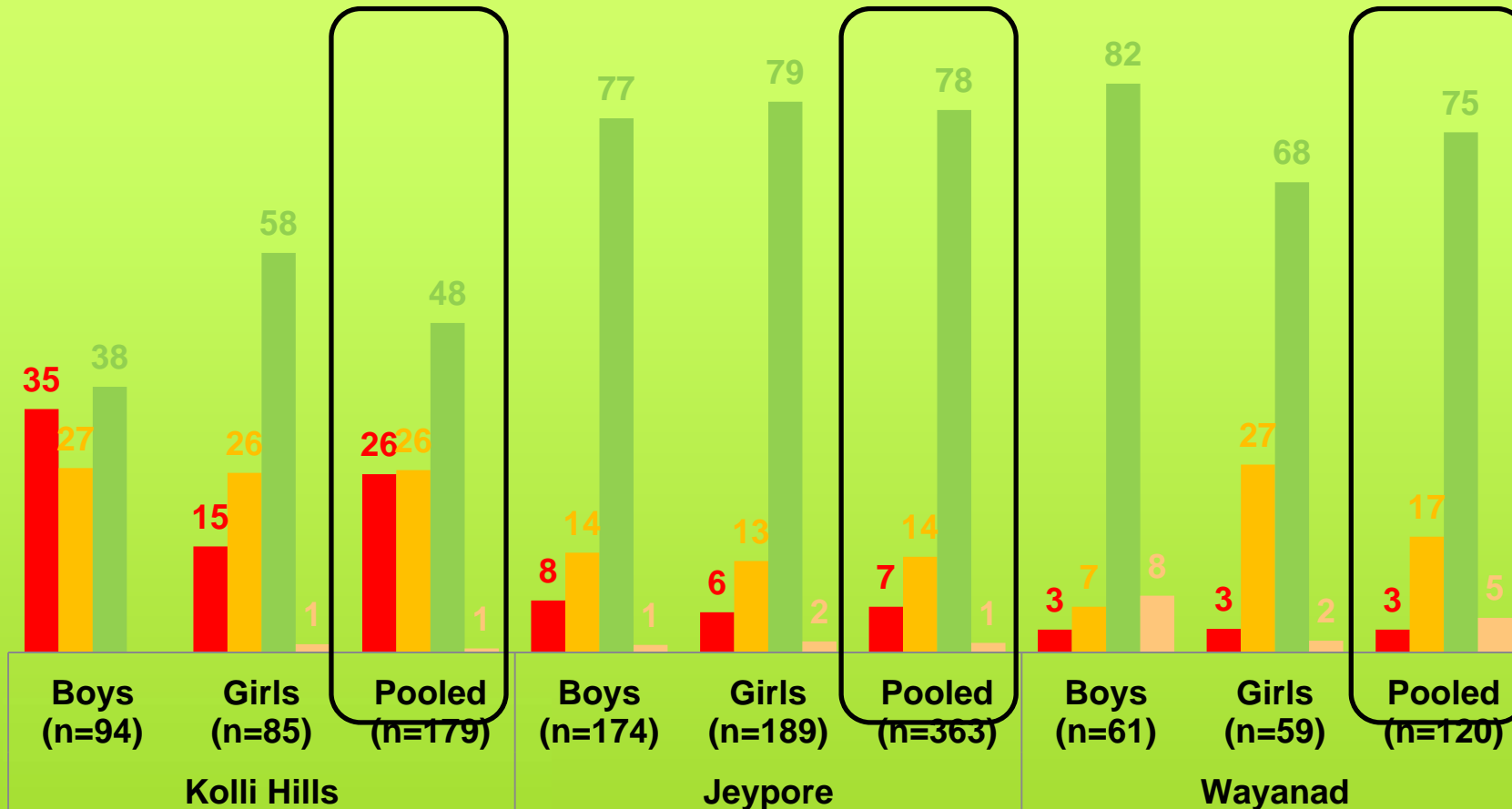
Nutritional Status of Adult Men & Women according to BMI (18 yrs & above)
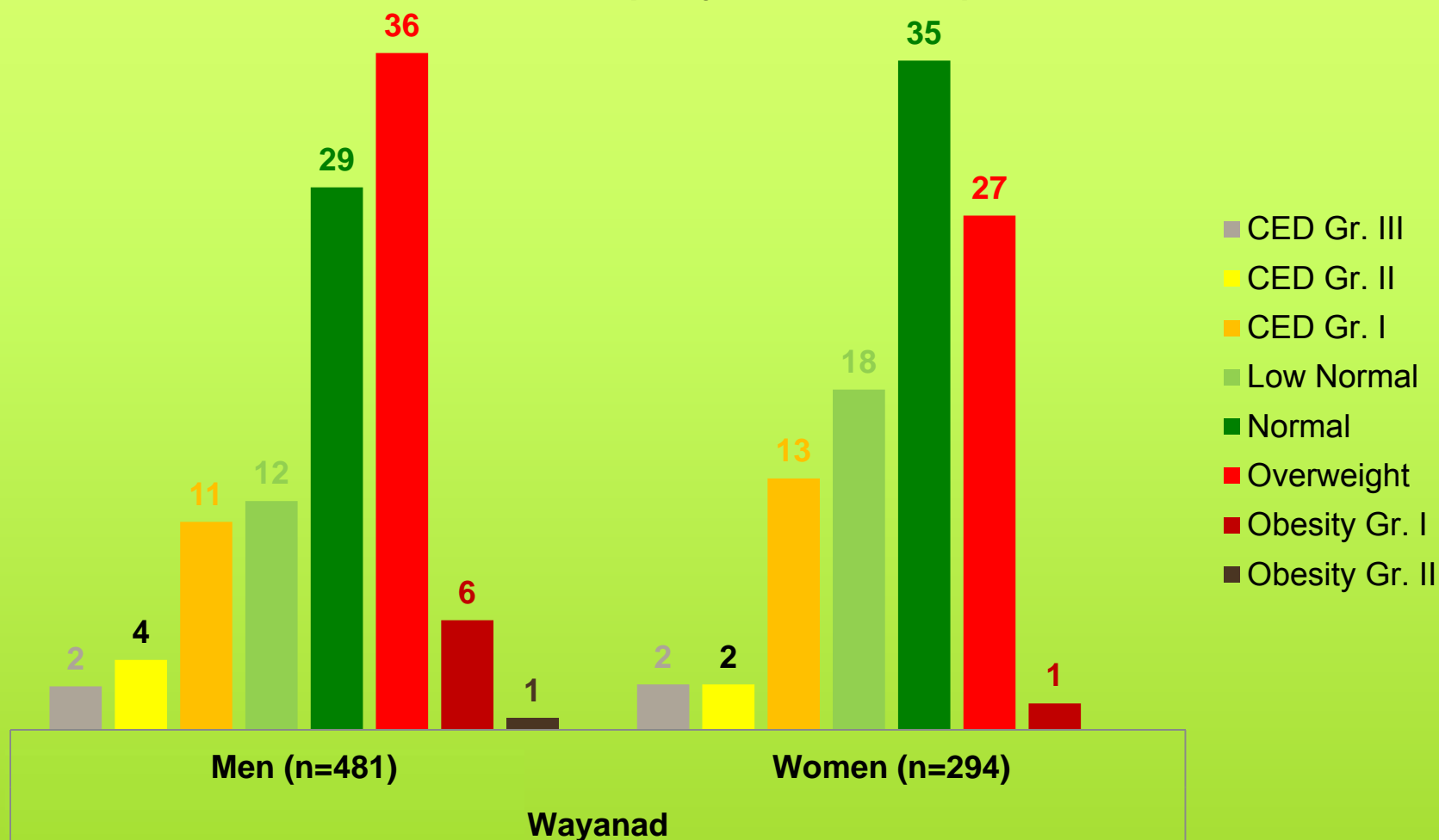
What Does Happen When we Introduce Home Gardens ?

- Interested in the possibility of substitutions amongst foods – does nutritional quality actually increase

- Not sufficient to know that home garden participation has increased – has that labour been pulled away from something else that might have had as big or bigger impact on nutrition?

- Not sufficient to know that more fruits and vegetables are available – and that they are being consumed – need to know they don't supplant something else in the diet *

Food Frequency Data

- Collected data on foods eaten in the household

- **Asked Frequency of Consumption   :**
- **1. Daily   2. Twice / thrice a Week**
- **3. Once a Week   4. Once in Fifteen Days**
- **5. Once in a Month   6. Seasonally   7. Occasionally 8. Never**

-

- Individual items in all the major food groups – then translated into quantities consumed at HHld level

Price Data

- Collected price data from community village experts and from a number of sales outlets associated near to each village

- My hope was that there would be variability from vendors

- In the end too little variability to allow price differences across villages

Is Dietary Diversity Related to Food Security?

- Dietary diversity definitely related to health, (e.g. Krebs-Smith et al., 1987; Cox et al., 1997; Hatloy, Torheim and Oshaug, 1998; Torheim et al., 2004). Most of these studies show that food diversity is strongly correlated with dietary quality and nutrient adequacy.

- Although dietary quality and diversity do not reflect the same constructs, diversity indicators are often preferred to nutrient adequacy dietary quality indicators because the data required for calculating food diversity is easier to collect (Torheim et al., 2004)

What is meant by dietary diversity?

- Dietary diversity (food diversity) can be measured as the number and quantities of foods of different types eaten.

- Food diversity has been mainly measured using count measures, such as the Diet Diversity Score (Kant et al., 1993) or the Food Variety Score (Hatloy, Torheim and Oshaug, 1998).

- Count measures (Drescher, Thiele and Mensink (2007)) can not distinguish between healthy and unhealthy foods consumed. Often then unhealthy foods are deleted prior to creating the nutritional diversity index. If the proportion of unhealthy foods has changed over time, deleting unhealthy foods would defeat longitudinal studies of diversity.

- Count measures also fail to consider the distribution of foods consumed. The distribution of foods is especially important for diet quality because there is a qualitative difference between the consumer eating two food items in equal shares (50% each) as compared to eating one food at 1% and the other one at 99% of diet.

Healthy Food Diversity Index
(Drescher, 2007)

- The Berry-Index (BI) was proposed by Berry (1971) and it takes the form:

$$bi = 1 - \sum_n (s_i^2)$$

- where, n is the number of foods available, and s_i is the quantitative (or expenditure) share of food i of the total amounts of foods. High values indicate high diversity. The Berry-Index lies in the range of 0 and $1 - 1/n$.

- Healthy Food Diversity Index – adds to the Berry Index and weights foods by their recommended status in relevant foods guides
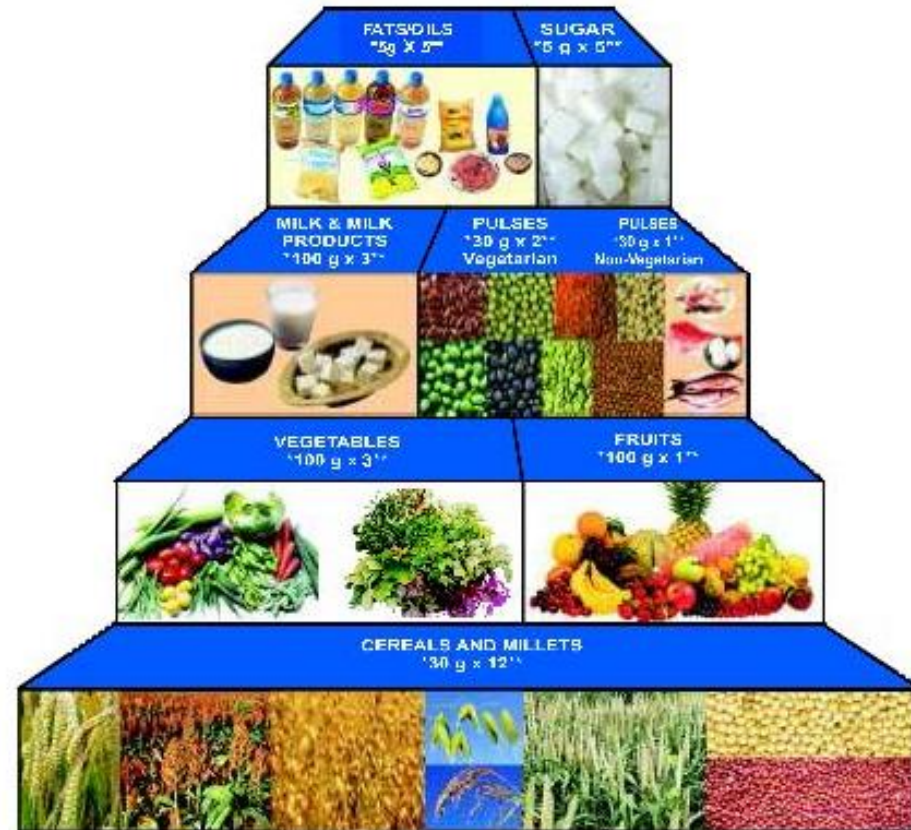
Fig. 1 Food Pyramid

Figure 3
BALANCED DIET FOR ADULT MAN (SEDENTARY)

* Portion Size.   ** No. of Portions

Elderly man: Reduce 3 portions of cereals and millets and add an extra serving of fruit

Source: Dietary Guideline for Indians: A Manual, National Institute of Nutrition, Hyderabad, 2010

Kerala	Participant Households	Dietary Diversity Count (1-11)	Dietary Diversity Berry Index	Healthy Food Diversity Index	Quantity of green leafy vegetables (gms)
Mean	No nutrition garden	10.80	0.84	0.08	1186.79*
Mean	Nutrition garden	10.86	0.84	0.08	1344.45
Kerala	Non-participant Households				
Mean	No nutrition garden	10.79	0.84	0.08	1096.35
Mean	Nutrition garden	10.82	0.83	0.08	1154.82
Tamil Nadu	Participant Households				
Mean	No nutrition garden	10.46	0.84	0.09	1499.67*
Mean	Nutrition garden	10.44	0.84	0.09	1372.74
Tamil Nadu	Non-participant households				
Mean	No nutrition garden	10.48	0.84	0.09	1256.06
Odisha	Participant Households				
Mean	No nutrition garden	10.50	0.84*	0.09	1552.44
Mean	Nutrition garden	10.57	0.84	0.09	1575.50
Odisha	Non- participant Households				
Mean	No nutrition garden	10.50	0.84*	0.09	1636.49
Mean	Nutrition garden	10.69	0.85	0.09	1537.69

Dietary Diversity Regression - Example

Dietary Diversity		Count	Berry Index	Healthy Food Diversity Index
Kerala	*Kids*	-ve	-ve	
	HHld Size	+ve	+ve	+ve
	Literacy	+ve		
	Nut Know			
Tamil Nadu	*Kids*	-ve	-ve	
	HHld Size	+ve		+ve
	Literacy	+ve		
	Nut Know		+ve	

Dietary Diversity		Count	Berry Index	Healthy Food Diversity Index
Jeypore	*Kids*	-ve	-ve	
	HHld Size	+ve	+ve	+ve
	Literacy			
	Nut Know	+ve	+ve	
	Home Garden		+ve	
	Income		+ve	
	Gender		-ve	-ve

Expenditure Shares Various

	Mean	Std Dev	Minimu	Maximu
Rice Parboiled	0.03	0.01	0.00	0.16
Rice Raw milled	0.01	0.01	0.00	0.06
Other cereals and millets	0.06	0.03	0.00	0.22
Cow Peas	0.01	0.00	0.00	0.02
Other Pulses	0.02	0.01	0.00	0.12
Amaranth	0.01	0.00	0.00	0.03
Other green leafy vegetables	0.02	0.01	0.00	0.17
Elephant foot yam	0.01	0.01	0.00	0.12
Other roots	0.15	0.06	0.00	0.41
Other vegetables	0.10	0.04	0.02	0.29
Milk	0.01	0.01	0.00	0.04
Egg	0.00	0.00	0.00	0.00
Fish	0.05	0.02	0.00	0.23
Meat	0.41	0.13	0.00	0.74
Nuts	0.02	0.01	0.00	0.15
Fruit	0.11	0.04	0.02	0.35
Fats and oils	0.01	0.01	0.00	0.04

Waynard   Expenditures on Individual Foods

Intervention	rice parbo	rice raw m	other cere	cow pea	rest of pul	amaranth	rest of grn	efyam	Colocasia	rest of roo	Bitter gou	rest of veg
HHLDS	40.36	16.95	40.35	9.07	41.07	9.52	37.27	11.13	22.87	144.95	6.68	123.12
NON Intervention												
HHLDS	39.01	15.00	30.98	8.16	29.02	11.16	30.85	7.33	21.65	132.17	4.36	96.83
Intervention												
HHLDS	**41.19**	17.41	**40.81**	**9.31**	**42.30**	9.50	37.80	**11.36**	**24.26**	149.04	6.72	125.32
with HG												
Intervention												
HHLDS	**33.38**	13.04	**36.38**	**7.02**	**30.68**	9.61	32.76	**9.13**	**11.11**	110.38	6.34	104.52
without HG												

Waynard Expenditures on Individual Food Stuffs cont.

Intervention	Ginger fresh	rest of spices	Total milk	Total eggs	Total fish	Total meat	Total Nuts oils	Jackfruit	Mango	rest of fruits	Total Fats oils
HHLDS	3.80	84.22	155.79	1.09	126.29	346.52	63.88	8.85	36.32	187.01	28.07
NON Intervention HHLDS	2.38	71.13	119.89	0.92	109.61	305.06	53.56	11.52	31.28	130.48	17.92
Intervention HHLDS with HG	3.89	84.40	**160.19**	1.10	126.82	350.53	63.46	8.82	**37.53**	**191.29**	**27.81**
Intervention HHLDS without HG	3.05	82.65	**118.57**	0.95	121.75	312.64	67.46	9.06	**26.08**	**150.81**	**30.20**

Expenditure Shares Equations

OTHER CEREALS	Estimated	Standard		
Variable	Coefficier	Error	t-statistic	P-value
C	0.02	0.01	2.28	[.023]
Rice Parboiled	-0.28	0.12	-2.42	[.016]
Rice raw	1.96	0.26	7.50	[.000]
TEXP	0.00	0.00	1.57	[.118]
AGE	0.00	0.00	1.38	[.167]
FEMGENDER	0.00	0.00	-0.92	[.359]
LITERACY	0.00	0.00	1.64	[.102]
HAVEHG	0.00	0.00	0.30	[.768]

Cow Peas

Cow Pea	Estimated	Standard		
Variable	Coefficient	Error	t-statisti	P-value
C	0.00	0.00	1.24	[.216]
Rest of Pulses	**0.14**	**0.01**	**13.93**	**[.000]**
AMARANTHES	**0.08**	**0.04**	**2.16**	**[.031]**
Other green leafy vegetables	0.00	0.01	0.43	[.666]
Elephant Foot Yam	0.00	0.02	0.03	[.977]
Other Roots and Tubers	**0.01**	**0.00**	**3.28**	**[.001]**
Other Vegetables	0.00	0.00	-0.93	[.354]
TEXP	0.00	0.00	-1.51	[.131]
AGE	**0.00**	**0.00**	**1.87**	**[.063]**
FEMGENDER	**0.00**	**0.00**	**1.76**	**[.079]**
LITERACY	0.00	0.00	-0.70	[.485]
HAVEHG	0.00	0.00	-0.21	[.834]

Elephant Foot Yam

Elephant Foot Yam				
	Estimated	Standard		
Variable	Coefficient	Error	t-statist	P-value
C	0.01	0.00	3.46	[.001]
COWPEA	0.00	0.10	0.03	[.977]
Other Pulses	0.03	0.03	1.05	[.296]
Other Green Leafy Vegetables	**0.14**	**0.02**	**5.73**	**[.000]**
Amaranth	-0.10	0.10	-1.07	[.284]
Other Roots	**0.01**	**0.00**	**2.58**	**[.010]**
Other Vegetables	**-0.02**	**0.01**	**-3.04**	**[.003]**
TEXP	**0.00**	**0.00**	**-2.85**	**[.004]**
AGE	0.00	0.00	-0.33	[.738]
FEMGENDER	0.00	0.00	-0.89	[.371]
LITERACY	0.00	0.00	-1.53	[.126]
HAVEHG	0.00	0.00	0.71	[.479]

Dependent variable: LTEXP
Current sample: 1 to 601
Number of observations: 601

Variable	Coefficient	Error	t-statistic	P-value
C	2.05363	0.395548	5.19185	[.000]
PSTAR	0.557349	0.064558	8.63335	[.000]
LPDI	0.154241	0.018279	8.43792	[.000]
LAGE	0.193966	0.061725	3.14245	[.002]
GENDER	-0.18399	0.034218	-5.37707	[.000]
LITERACY	7.91E-03	8.59E-03	0.920304	[.358]
KIDSDUMMY	0.262548	0.029209	8.9885	[.000]
INTERVEN DUMMY	0.046843	0.04021	1.16496	[.245]
HG	0.098725	0.037983	2.59916	[.010]

So is substitution impt

- In the context of this work important to know if substitutions being made are to the benefit or detriment of the diet

- Traditional tools for looking at these issues limited – not time series

- Often the output is the only measure – and looking at diets of the same households across time

- Need to understand more about the decision making in terms of 'prices'- transactions in many cases

Constraint Faced in Maintaining a Home Garden