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NUTRITIONAL MANAGEMENT FOR FARMERS AND LANDLESS AGRICULTURAL LABOURERS IN UNION TERRITORY OF DELHI

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Importance of nutrition in human diet hardly needs any stress. A good nutrition means a good health and a sound manpower base needed for agricultural growth. A poor nutrition on the contrary hampers health and productivity of labour resulting in the retardation of agricultural growth. Nutrient deficiencies may occur for many reasons including inadequate knowledge of proper nutrition, insufficient income, poor food preparations and food habits, and other socio-economic traits. There could be two major economic ways of improving nutritional status of the population: (*i*) by increasing income which is rather difficult in the short-run, and (*ii*) by managing limited income such that maximum possible nutritional standard is attained. The latter approach is more feasible and scientific too.

The present study seeks to examine the possibilities of minimizing diet cost by optimal combinations of different foods in rural Delhi in a manner that all the essential nutrients are at or above the required levels and the physiological needs of people are met. The specific objectives of the study are to know the existing nutritional standards and gaps of different agricultural families; to devise a least cost diet for farming community of the area; to maximize calories from the deficient diets; and to judge the efficiency in their income allocation among various nutrients.

METHODOLOGICAL FRAMEWORK

1. Sampling

The study was conducted in rural Delhi covering four villages, *viz.*, Holumbi Kalan, Ghoga and Sanoth in Alipur block, and Bawana in Kanjhawala block. These four villages are currently under Integrated Area Development-cum-Operational Research Project of the Indian Agricultural Research Institute. Each village has a speciality of its own and pooled together they typify the general situation in Delhi Union Territory as a whole.

In all, 100 households with 25 from each village belonging to five distinct agricultural groups, *viz.*, landless agricultural labourers, marginal farmers (less than one hectare), small farmers (1-2 hectares), medium farmers (2-4 hectares) and large farmers (more than four hectares) were selected. Thus five households in each category were randomly chosen from each village for investigation. The reference period of the study is the agricultural year 1976-77.

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2. The Model

The following linear programming models were used in this study.

(A) Diet Cost Minimization Model:

$$\text{Minimize } Z = \sum_{J=1}^{46} C_j X_j$$

where

Z = objective function and refers to the cost of diet.

C_j = the cost per gram of the jth food.

X_j = the number of grams of the jth food to be consumed.

subject to:

(*i*) Nutritional constraints

$$\sum_{J=1}^{46} a_{ij} X_j \geqslant b_i \qquad i=1, 2, \quad .. \quad .. \quad .. \quad 10.$$

where

a_{ij} = the number of grams/milligram/microgram of ith nutrient contained in one gram of jth food.

b_i = the minimum number of grams/milligram/microgram of ith nutrient and grams of food groups.

These are constraints of (1) calorie, (2) protein, (3) calcium, (4) iron, (5) phosphorus, (6) carotene, (7) thiamine, (8) riboflavin, (9) vitamin C and (10) niacin.

(*ii*) Palatability and variety or balanced diet constraints

Cereals constraint	$\sum_{j=1}^{6} x_j \geqslant b_{11}$
Pulses constraint	$\sum_{j=7}^{14} x_j \geqslant b_{12}$
Leafy vegetable constraint	$\sum_{j=31}^{32} x_j \geqslant b_{13}$
Other vegetable constraint	$\sum_{j=20}^{26} x_j \geqslant b_{14}$
Roots and tubers constraint	$\sum_{=21}^{30} x_j \geqslant b_{15}$

Fruits constraint $\sum_{j=33}^{36} x_j \geqslant b_{16}$

Milk constraint $x_j \geqslant b_{17} \quad j=15$

Fats and oils constraint $\sum_{j=17}^{19} x_j \geqslant b_{18}$

Sugar and jaggery constraint $\sum_{j=37}^{39} x_j \geqslant b_{19}$

Meat and fish constraint $\sum_{j=44}^{45} x_j \geqslant b_{20}$

Eggs constraint $x_j \geqslant b_{21} \quad j=46$

(*iii*) Food habit constraints

Wheat constraint $x_j \geqslant b_{22} \quad j=2$

Rice constraint $x_j \leqslant b_{23} \quad j=1$

Dal constraint $\sum_{j=8}^{9} x_j \geqslant b_{24}$

Soybean constraint $x_j \leqslant b_{25} \quad j=13$

Sugar constraint $x_j \geqslant b_{26} \quad j=37$

And the non-negativity constraints

all $x_j \geqslant 0 \quad j=1, 2. \ldots\ldots\ldots 46.$

This model for non-vegetarian consumers was then transferred into a model for vegetarian consumers by deleting non-vegetarian food items, *viz.*, X_{44}, X_{45}, X_{46}; and constraints of meat and fish and eggs.

(B) Calorie Maximization Model:

$$\text{Maximize } Z = \sum_{j=1}^{46} a_j X_j$$

where, Z = objective function and refers to the calories obtained from different foods.

a_j = the number of calories in one gram of jth food.

subject to:

(*i*) Income constraint

$$\sum_{j=1}^{46} C_j X \leqslant C$$

(*ii*) Nutritional constraints.

(*iii*) Palatability and variety constraints.

(*iv*) Food habit constraints.

These last three constraints are the same as in the case of 'diet cost minimization models,' except the values of requirement vectors. The requirement vectors are reduced in proportion with the reduction in the existing cost from the least cost.

3. The Data

Comprehensive information on monthly consumption of as many as 41 food items for each household along with family details in terms of age, sex and food habit of each member of the family was collected with the help of suitably structured questionnaire. Consumption data for five minor items, like turmeric, ginger, chillies, etc., were taken from the 28th Round of the National Sample Survey family consumption survey.

Monthly prices of the above commodities were collected from the Bureau of Economics and Statistics, Delhi Administration. The prices of commodities like vanaspati, spinach, lemon, soybean and meat were enquired from the respondents.

Nutrient contents of all food items were obtained from the National Institute of Nutrition publication.[1] The data on nutrient requirements for male adult unit (moderate worker) abbreviated as MAU (MW) were used from ICMR publication[2] using standard conversion ratios for population.

RESULTS

1. Nutrition Status

With a view to analysing the nutrition patterns of different categories of farming communities, detailed information on their consumption patterns in terms of food items were gathered. The daily average food consumption per MAU (MW) was observed at 1.07 kg. ranging from 0.96 kg. in the case of landless labourers to 1.30 kg. in the case of large farmers. It bore positive relationship with the size of holding. By and large, the consumption of cereals, pulses, vegetables, sugar and jaggery was more than the recommended

1. C. Gopalan, B. V. Rama Sastri, S. L. Balasubramaniam: Nutritive Value of Indian Foods, National Institute of Nutrition, Indian Council of Medical Research (ICMR), Hyderabad, reprinted 1977.
2. C. Gopalan and B. S. Narasinga Rao: Dietary Allowances for Indians, National Institute of Nutrition, ICMR, Hyderabad, 1977.

level. The quantities of physical goods were converted into major nutrients to know the nutrition status of different categories of households. The results of the nutrition status are presented in Table I. It is evident from the self-explanatory table that daily calorie intake of an MAU (MW) was slightly greater than 2700. These calorie intakes varied directly with the hierarchy of farm categories. This was mainly because of the upward trend in cereal consumption.

Regarding protein intake, the most striking feature was that in all the classes except landless labourers, the animal protein was zero. In labour category too, the animal protein was almost negligible. The average protein consumption was 84 gm./day. The average consumption of fats was about half of the protein and it presented an increasing trend except for the marginal farmers. The intake of carbohydrate and minerals also registered a clear-cut increasing trend with the size of holding.

2. *Nutrition Gaps*

The existing nutrient intakes of the farm households can be compared with those recommended by the Nutrition Expert Group (1968) to precisely estimate the extent of deficiency/excess. It may be observed that nutrients such as calories, carotene and riboflavin were deficient in the daily diet of rural Delhi. All the minerals, protein, vitamin C and niacin were, however, more than the minimum requirement. As for nutrition gap in different categories of agricultural households was concerned, the amount of calorie was found to be lacking in the diets of agricultural labourers and marginal and small farmers. The calorie deficiency decreased with an increase in the size of holding. The overall deficiency was, however, very insignificant. Protein unlike calorie was taken in excess in all categories of households. Minerals also exceeded their requirements. Carotene was deficient in all the four classes except the large farmers. There was also riboflavin deficiency in the first three categories. Only marginal farmers' diets were found to be lacking in niacin. Vitamin C deficiency was totally absent in the diets of all categories of agricultural households in Delhi.

3. *Least Cost Balanced Diets*

Development of the least expensive balanced diets with a view to examining the possibilities of cost reduction was taken up separately for vegetarian and non-vegetarian consumptions. The cost was obtained by using weighted average prices for all the 12 months. The weights were consumptions of a particular commodity in different months. The details of such diets which satisfied all the nutritional, and palatability (food habit) constraints are presented Table II.

TABLE I—AVERAGE DAILY PER MALE ADULT UNIT (MODERATE WORKER) INTAKE OF NUTRIENTS IN DIFFERENT CATEGORIES OF AGRICULTURAL HOUSEHOLDS IN UNION TERRITORY OF DELHI, 1976-77

Particulars of nutrients	Landless labourers		Marginal farmers	Small farmers	Medium farmers	Large farmers	All classes (only vegetarian)	Recommended nutrient levels for vegetarian
	Non-vegetarian	Vegetarian						
Calories	2545.60	2428.53	2550.12	2683.42	2843.12	3063.88	2713.81	2800
Protein (gm.)	81.42	74.47	79.95	82.83	91.27	92.32	84.17	55
Animal	3.09	0	0	0	0	0	0	—
Vegetable	78.33	74.47	79.95	82.83	91.27	92.32	84.17	—
Fat (gm.)	32.74	27.61	37.51	46.70	36.09	51.10	39.80	—
Carbohydrate (gm.)	473.01	457.00	455.39	470.97	521.87	544.86	490.02	—
Calcium (mg.)	595.88	605.54	688.33	749.69	801.16	940.62	757.07	400
Phosphorus (mg.)	2007.76	1950.30	1655.53	2060.65	2238.62	2710.98	2123.22	1400
Iron (mg.)	36.49	33.68	36.93	43.23	41.74	43.76	39.87	20
Carotene (ug.)	1558.60	1542.39	1618.44	2092.74	1716.37	3321.76	2058.34	3000
Thiamine (mg.)	2.55	2.43	2.00	2.56	2.74	3.02	2.55	1.4
Riboflavin (mg.)	1.21	1.21	1.11	1.35	1.57	1.57	1.36	1.5
Niacin (mg.)	26.10	25.19	13.55	24.44	29.15	31.08	24.68	19
Vitamin C (mg.)	50.94	50.98	67.06	73.00	65.49	81.40	67.59	50

TABLE II—LEAST COST* DIETS AND THEIR NUTRIENT CONTENTS FOR UNION TERRITORY OF DELHI, 1976-77

Food items	Quantity to be consumed (gm./day)		Nutrients	Levels of intake	
	Vegetarian	Non-vegetarian		Vegetarian	Non-vegetarian
1. Wheat	200	200	1. Calories	2802.20	2800.0
2. Barley	275	303	2. Protein (gm.) ..	86.5	91.2
3. Gram	55	45	3. Calcium (mg.) ..	1323.0	1187.3
4. Gram *dal* ..	25	20	4. Phosphorus (mg.) ..	2360.9	2351.5
5. Milk	200	100	5. Iron (mg.)	52.5	52.7
6. Mustard oil ..	40	40	6. Carotene (ug.) ..	5326.3	5435.8
7. Cabbage	75	75	7. Thiamine (mg.) ..	2.7	2.8
8. Carrot	100	100	8. Riboflavin (mg.) ..	1.7	1.8
9. Fenugreek (*methi*)	125	125	9. Niacin (mg.) ..	30.4	31.4
10. *Guava*	30	30	10. Vitamin C (mg.) ..	228.5	227.2
11. Sugar	20	20			
12. Jaggery	20	20			
13. Fish	—	30			
14. Eggs	—	30			

* Least cost vegetarian diet = Rs. 1.66/day/MAU (MW)
Least cost non-vegetarian diet = Rs. 1.86/day/MAU(MW).

It may be observed from the table that the least cost vegetarian and non-vegetarian diets comprised 12 and 14 food commodities respectively. The solution satisfied all the nutritional restrictions giving the minimum required calorie at 2800. Protein, vitamins and minerals were, however, much above their minimum requirements. The diets also, as can be seen,

contained balanced quantities of various food groups to exactly conform to the recommendations. It cared, at the same time, for food habits of the people in the area expressed in terms of certain minima of products like wheat, sugar and gram *dal*.

The diets so formulated at the minimum expense cost Rs. 1.86 and Rs. 1.66 in respect of non-vegetarian and vegetarian foods respectively. But the consumption expenditures of labourers and marginal farmers were below these least costs. The income of the vegetarian labourers fell short by 7 paise per MAU (MW) daily, or Rs. 2.10 monthly or Rs. 25.55 yearly, whereas those of the vegetarian marginal farmers by 13 paise per day or Rs. 3.90 per month or Rs. 37.45 per annum. As compared to the least cost non-vegetarian food, the existing consumption expenditure of Rs. 1.68 by landless labourers provided a gap of 18 paise per day, Rs. 5.40 per month or Rs. 65.70 per year.

Such least cost diets could, however, not be taken with rigidity throughout the year. These types of diets ought to be prepared for each season separately. The present exercise could hence be taken to provide just guidelines to check or reduce malnutrition within the means of rural poor.

4. Calorie Rich Balanced Diets

Under the situation of short income it would not be possible for labourers and marginal farmers to attain the least cost diet; nevertheless, it would be worthwhile to raise the levels of nutrients by reshuffling the foods. Manipulation of all nutrients simultaneously is a complex and cumbersome proposition. Calorie being the most vital, an attempt was made to maximize that within the limited income subject to other nutrition, balanced diet and food habit constraints. But the rigidities of balanced diet and food habit were reduced proportionately with the reduction in diet cost. The details of such diets and nutrients thereof are presented in Table III. From the table it is clear that calorie rich vegetarian diet so computed contained 2667 calories against the existing 2429 in the case of agricultural labourers within the same expenditure of Rs. 1.59. In the reformulated diet of a marginal farmer, calorie could jump from existing 2550 to 2710, reducing the gap from 250 to 90. The calorie maximized balanced non-vegetarian diet of landless workers, however, contained only 2533 units of calorie which was lower than the existing level by 13 units. This peculiar situation might have arisen because the labourers used more calorie rich foods like cereals, sugar and jaggery and fats and oils as compared to the land-owners. But the computed diet is balanced and provides all necessary nutrients at the desired levels.

TABLE III—MAXIMUM CALORIE DIET FOR AN MAU(MW) WITH EXISTING CONSUMPTION EXPENDITURE* FOR AGRICULTURAL LABOURERS AND MARGINAL FARMERS IN UNION TERRITORY OF DELHI, 1976-77

Food items	Quantity (gm.) to be consumed/day			Nutrients	Levels of intake		
	Landless labourers		Marginal farmers		Landless labourers		Marginal farmers
	Veg.	Non-veg.			Veg.	Non-veg.	
1. Wheat ..	180.0	180.0	190.0	1. Calorie	2666.8	2533.5	2709.9
2. Barley ..	290.6	276.8	275.5	2. Protein (gm.) ..	82.9	82.6	83.9
3. Gram ..	49.5	40.5	52.3	3. Calcium (mg.) ..	1201.9	1069.6	1260.6
4. Gram *dal* ..	22.5	18.0	23.8	4. Phosphorus (mg.)	2217.6	2125.1	2273.6
5. Milk ..	180.0	90.0	190.0	5. Iron (mg.) ..	48.5	47.6	50.3
6. Mustard oil ..	36.0	36.0	38.0	6. Carotene (ug.) ..	4798.0	4892.6	5061.4
7. Cabbage ..	67.5	67.5	71.3	7. Thiamine (mg.) ..	2.6	2.5	2.6
8. Carrot ..	90.0	90.0	95.0	8. Riboflavin (mg.)	1.6	1.6	1.6
9. Fenugreek (*methi*) ..	112.5	112.5	118.8	9. Niacin (mg.) ..	29.7	28.5	29.6
10. *Guava* ..	27.0	27.0	28.5	10. Vitamin C (mg.)	205.6	204.4	217.1
11. Sugar ..	18.0	18.0	19.0				
12. Jaggery ..	18.0	18.0	19.0				
13. Fish ..	—	27.0	—				
14. Eggs ..	—	27.0	—				

* Existing consumption expenditure:
1. Landless labourers (veg.) = Rs. 1.59/day.
2. Landless labourers (non-veg.) = Rs. 1.68/day.
3. Marginal farmers = Rs. 1.53/day.

5. *Nutrition Efficiency*

A probe into the nutrition efficiency in terms of income spent and nutrients derived would be very helpful in conceiving of a rational nutrition policy.

TABLE IV—NUTRITION EFFICIENCY INDICES OF DIFFERENT CATEGORIES OF AGRICULTURAL HOUSEHOLDS IN UNION TERRITORY OF DELHI, 1976-77

Agricultural household category	Existing intake		Existing consumption expenditure (Rs.)	Existing intake/rupee		Intake/rupee at least cost		Efficiency index (per cent)	
	Protein (gm.)	Energy (cal.)		Protein (gm.)	Energy (cal.)	Protein (gm.)	Energy (cal.)	Protein	Energy
1. Agricultural labourer									
(a) Non-vegetarian	81.42	2545.60	1.68	48.46	1515.24	49.04	1505.38	98.82	100.65
(b) Vegetarian	74.47	2428.53	1.59	46.84	1527.38	52.14	1687.95	89.84	90.49
2. Marginal farmer	78.83	2550.12	1.53	51.52	1666.74	52.14	1687.95	98.81	98.74
3. Small farmer	82.83	2683.42	2.02	41.00	1328.43	52.14	1687.95	78.63	78.70
4. Medium farmer	91.27	2843.12	1.83	49.87	1553.62	52.14	1687.95	95.65	92.04
5. Large farmer	92.32	3063.88	2.20	41.96	1392.67	52.14	1687.95	80.48	82.51
All categories (vegetarian)	84.17	2691.13	1.83	45.99	1470.56	52.14	1687.95	88.20	87.12

The efficiency indices for calorie and protein are illustrated in Table IV with the help of following formula:

$$\text{Efficiency index} = \frac{\text{Calorie/Protein per rupee of existing diet}}{\text{Calorie/Protein per rupee of least cost diet}} \times 100.$$

It can be seen from the table that the category of landless labourers (non-vegetarian) was the most efficient one followed by marginal farmers and then by medium farmers in both protein as well as calorie allocations. The efficiency of small farmers was the lowest in respect of both calorie and protein intakes.

CONCLUSIONS

The results presented above on nutritional status, gaps and efficiency, on the one hand, and computation of balanced and calorie maximized diets, on the other, illustrate very clearly the extent of malnutrition and nutritional inefficiency prevailing in different categories of farm households in rural Delhi. The average daily food consumption of an MAU (MW) is about 1 kg. and it bears direct relationship with the size of holding. The overall calorie intake is 2700 which is 100 units short of the requirement. The calorie shortage is visible only in the landless labour and marginal farm categories. Minerals and vitamins, by and large, do not lack in the diets.

The least cost balanced diet formulation suggests that a minimum of Rs. 1.86 and 1.66 would be needed daily by an MAU (MW) to obtain non-vegetarian and vegetarian diets respectively. The daily consumption expenditures of labourers and marginal farmers do not, however, allow for the attainment of least cost diets. Within their available limited means, the calorie gaps can, however, be narrowed from 250 to 90 in the case of marginal farmers, and from 370 to 133 in the case of landless labourers. This kind of management analysis would help to reduce the extra expenditure incurred by the small, medium and large farmers and yet get balanced diets with less expenditure.

An insight into the nutritional efficiency reveals that landless labourers' category is the most efficient one followed by marginal and then by medium farmers. The small farmer possesses the lowest efficiency. These efficiency indices can serve a very useful purpose in nutrition planning. Low 'efficiency index' groups should be given top priority in practical nutrition programme and education.