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**Nutrition Planning
Analysis of
Some Policy Options**

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NUTRITION PLANNING ANALYSIS
OF SOME POLICY OPTIONS

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Summary

Some possible policy alternatives for addressing consumption and nutrition problems are discussed. These are primarily concerned with the demand side. The cost effectiveness of a general food subsidy is analyzed by a simple model and some of the salient parameters identified. This is then extended to include some relevant variations due to regional, seasonal and quality variations. Alternate schemes treated briefly are fortification, income transfers and food stamp programs.

INTRODUCTION

The Development Perspective (1975-80) provides for an increase in private consumption at the rate of over 7 per cent per annum and this implies a per capita increase of 4.2 per cent per year. In order to examine the implication of these projections it is of interest to look at almost all aspects of the economic and socio-political structure of Pakistan.

This paper focuses primarily on just one part of the overall picture -- namely some options that might be considered on the demand side of the economy. Ideally one would like to understand each individual's milieu and characteristics to try and project his future behavior as a consumer with reasonable accuracy. In practice this is of course not feasible so that one must strive for a balance between a manageable amount of data on the one hand and yet capture enough of the key features of market behavior on the other hand to produce meaningful results. These features should ideally reflect socio-economic status, regional and seasonal variations. Largely because of the data readily available this note tends to emphasize the first class of features and for the most part ignore the other two.

Consumer Behavior - Nutritional Status

Explanation of a large part of differences in consumer behavior in Pakistan (and many other countries) may be

attributed to two basic parameters.

- a) Income Level
- b) Urban-Rural Location

Consequently programs aimed at changing per capita food intakes must give these adequate consideration. Real income may be affected in two basic ways -- at input or output side. Thus any policy which provides better purchasing power^{1/} for an individual may ultimately be reflected in improvement in his consumer bundle and maybe nutritional status. On the other hand policies which improve purchasing power of his present income will also be a gain to him. These latter may include provision of improved health or housing services besides the more obvious price subsidies or food grants. The urban-rural location is significant largely because urban dwellers typically have higher costs for housing, transportation, also wider purchasing opportunities, so that at equal income levels^{2/} the urban dweller has lower food intake.

The Development Perspective also aims at addressing directly the problem of malnutrition. This problem may be viewed in three principal parts. a) P.C.M. (protein-calorie malnutrition); b) specific nutrient deficiencies; c) other related areas -- public health, water supply, sanitation.

The first part may be addressed by the broad class of

policies mentioned in the previous paragraph while the second part typically requires programs which have a stronger target group orientation. This latter category might include goitre control in the sub Himalayan region by suitable injections or iodization of salt. Similarly fortification of an appropriate carrier might be a suitable policy for elimination of vitamin A deficiency. The third part is also important and in fact may be the dominant consideration in some instances. However these issues are not considered in this particular paper.

A large comprehensive nutrition survey of Pakistan was carried out in 1965-1966. While the information contained is a little out dated it does provide a good indication of possible problem areas. This together with more recent data which includes Household Income and Expenditure Surveys* and Food Balance Sheets provides a basis for preliminary policy considerations. Recent estimates suggest that 38.2% of the population have less than 95% of required caloric intake. It is proposed to reduce this to 9% by 1980-81. Some policy alternatives which might contribute are now considered.

FOOD SUBSIDIES

One approach which is accepted in principal in Pakistan is to subsidize the price of foods. This analysis first proposes

*For a detailed analysis of much of this data see Nasseem, S.M., "Mass Poverty in Pakistan: Some Preliminary Findings", The Pakistan Development Review, Winter 1973, pp. 317-352.

a simple model to focus on some of the issues involved^{3/}. The particular model uses a partial equilibrium analysis and does not include real welfare effects. However it does allow one to focus on some of the issues involved in subsidizing foods.

Suppose one subsidizes a food x.

There are a number of side effects to be considered.

(i) The fall in price will stimulate consumption of x by the rest of the population if their price elasticity of demand is negative.^{4/}

(ii) If the supply elasticity is positive then any increase in the marketed quantity will require a higher price for producers.

(iii) Substitution effects may be significant.^{5/}

(iv) The reallocation of resources will produce changes in welfare.

(v) Here only one food is considered. If the price of that food falls then real income of its consumer increases thereby inducing more purchases of other foods. Formal analysis here ignores this.

Suppose it is desired to intervene to try and increase the intake of a particular food by some segment of a population. Without loss of generality it will be assumed that the food is wheat and the segment under consideration is a target group. This may typically be those suffering from subnutrition

Before the intervention let the price of wheat be p and let the average consumption of the target group members be q_1 per capita* and that of the whole population q per capita. If the total population is P and there is a fraction α of them in the target group, then the wheat consumption by the target group, before intervention, Q_1 is

$$Q_1 = \alpha q P$$

Let the objective of the proposed intervention be to raise the per capita consumption of the target group by Δq_1 per capita by lowering the price to all consumers. Thus the percentage change q_1' ($=\Delta q_1/q_1$) should satisfy the relation

$$q_1' = (\tilde{\eta}_{p1} - \theta_1 \eta_{y1}) p' = \eta_{p1} p'$$

where

$\tilde{\eta}_{p1}, \eta_{y1}$ are the price and income elasticities of wheat for group 1

θ_1 is the income share of group 1 spent on wheat

p' is the percentage change in wheat price (negative)

To achieve the objective one needs to induce a price change Δp given by

*Subscript 1 is used on variables which refer to the target group, and dropped for variables referring to the whole population.

$$\Delta p = pq_1' / (\tilde{\eta}_{p1} - \theta_1 \eta_{y1}) = pq_1' / \eta_{p1}$$

This price change requires consideration of a number of effects. These include increased consumption by the non target group because of the fall in price and a short fall in production unless the price to producers is increased sufficiently. The percentage increase by the whole population q' due to the price change Δp is given by

$$q' = (\tilde{\eta}_p - \theta \eta_y) p' = \eta_p p'$$

The total increase in demand ΔQ is then given by

$$\Delta Q = \Delta qP$$

If the supply elasticity is ϵ then the percentage increase in price p_s' required to generate this additional output is obtained from

$$q' = \epsilon p_s'$$

Note that equilibrium between supply and demand requires

$$\epsilon \Delta p_s = \eta_p \Delta p$$

Because of the divergence between the required higher producer price and the lower consumption price a direct subsidy S is required given by

$$S = (Q + \Delta Q) (\Delta p + \Delta p_s) = (Q + \Delta Q) \left(1 + \frac{\eta_p}{\epsilon}\right) \Delta p$$

The subsidy per unit of food S_2 is given by

$$S_2 = \left(1 + \frac{\eta_p}{\epsilon}\right) \Delta p = \left(1 + \frac{\eta_p}{\epsilon}\right) \frac{q'}{\eta_p}$$

There will also be an administrative cost D

The increased intake by the target group ΔQ_1 is

$$\Delta Q_1 = (\alpha \Delta q_1) P$$

It is to be noted that $Q + \Delta Q$ may be written in the form

$$Pq \left[1 + \frac{\Delta q}{q} \right] = Pq \left[1 + \eta_p \frac{\Delta p}{p} \right] = Pq \left[1 + \frac{\eta_p}{\eta_{p1}} q' \right]$$

Thus the total subsidy cost S is given by

$$S = \Delta Pq \left(1 + \frac{\eta_p}{\eta_{p1}} q' \right) \left(1 + \frac{\eta_p}{\epsilon} \right)$$

The cost per capita of the target group per unit increased intake by that group is given by s_1 where

$$\begin{aligned} s_1 &= \frac{\Delta pq}{\alpha \Delta q_1} \left[1 + \frac{\eta_p}{\eta_{p1}} q_1' \right] \left[1 + \frac{\eta_p}{\epsilon} \right] + \frac{D}{\Delta q_1 \alpha P} \\ &= p \frac{Q}{\eta_{p1} Q_1} \left[1 + \frac{\eta_p}{\eta_{p1}} q_1' \right] \left[1 + \frac{\eta_p}{\epsilon} \right] + \frac{D}{\Delta q_1 \alpha P} \end{aligned}$$

where the final term reflects administrative costs

This now allows us to compare some of the salient features of cost effectiveness for a food subsidy program. The cost effectiveness per unit increase consumption of a given food by the undernourished group may be analysed by joint consideration of all terms in the equation. Again note that this just refers to the subsidized food. To get some feeling for this equation we now discuss each term separately. Ideal (low cost) candidates for subsidy should have the following properties

- a) Low p current unit market price
- b) High $\frac{Q_1}{Q}$ fraction of the food consumed by undernourished groups
- c) High η_{p1} high elasticity of demand by undernourished groups
- d) Low q_1' percentage increase in groups intake
- e) Low $\frac{\eta_p}{\eta_{p1}}$ ratio of average elasticity to the group elasticity
- f) Low $\frac{\eta_p}{\epsilon}$ ratio of demand to supply elasticities for the whole economy
- g) Low $\frac{D}{\Delta q_1 \alpha P}$ administrative costs.

Each of these is now discussed.

- a) The analysis will first be done in terms of a normalized p . One should have current prices per unit and also the nutrient content per unit of food.
- b) High $\frac{Q_1}{Q}$. A high value of this ratio implies that before the subsidy program begins the undernourished already consume a relatively high fraction of the food. To analyse this parameter one must view the distribution of food consumption by income group. To do this we introduce the concept of intensity of consumption.

"Intensity" of Consumption

Further insight into the composition of food consumption may be gained by evaluation of the intensity of consumption.

This parameter μ_{ij} is defined by the ratio

$$\mu_{ij} = \frac{q_{ij}}{n_i}$$

where q_{ij} is fraction of total consumption, by quantity, of food j by income group i

n_i fraction of population in income group i

As before, urban and rural populations are treated separately. The μ_{ij} parameter gives a convenient measure of the relative preference by income class for various foods. Thus a food consumed by all groups in similar amounts would yield values for $\mu_{ij} = 1$. When $\mu_{ij} > 1$ this indicates a certain predilection for that food by that group. The implications are obvious for policies which seek to focus on particular groups. Some estimates are given in Tables 1 and 2 for urban and rural groups. Among the foods listed one observes a wide range of values. For urban groups the foods most favored relatively by the lower income classes are unrefined sugar (gur, etc.) gram, wheat and beef while high income groups tend to consume a relatively larger share of mutton, ghee and butter, refined sugar and milk. There are two noticeably

different patterns between urban and rural across income classes. These are for unrefined sugar and vegetable oil. Traditionally most rural classes consume relatively large shares of their sugar intake in the many unrefined forms so perhaps it is not too surprising to find ~~some~~ somewhat uniform patterns across income groups here. However, the vegetable oil consumption in rural areas seems to follow a different pattern from the urban areas. The rural poor consume an above average amount of vegetable oil compared to other rural dwellers. From an expenditure standpoint vegetable oil assumes an even more significant role, relatively speaking, in the budget of the poor. The ghee situation is a perplexing one and in recent years has become an even bigger problem. The situation is considered further in the production section but at this stage it is sufficient to observe that ghee and vegetable ghee form an important component of most peoples' consumption basket but particularly vegetable ghee is favored by the poor.

When other factors are equal the relatively high μ_{ij} parameters would be attractive for policies focusing on the appropriate income groups. Thus as one may use the Gini coefficient to compare income distribution one could have a food equality coefficient, F_D , to compare the relative merits of different foods as vehicles for focusing policy. This could be based on the area ratio as indicated in Fig. 1. Three

TABLE 1

Intensity^{1/} of Consumption by Income Group - Urban
(1970-71)

<u>Income Group</u>	<u>Wheat</u>	<u>Rice</u>	<u>Gram</u>	<u>Milk</u>	<u>Ghee & Butter</u>	<u>Oil</u>	<u>Mutton</u>	<u>Beef</u>	<u>Sugar Refined</u>	<u>Sugar Other</u>
0 - 40	1.05	.81	1.09	.80	.60	.90	.30	.98	.75	1.45
40 - 80	1.00	1.05	.99	1.02	1.00	1.00	.87	1.09	1.04	.77
80 - 100	.90	1.30	.86	1.45	1.80	1.20	3.50	.78	1.42	.56

$$\underline{1/} \text{ Intensity} = \mu_{ij} = \frac{\text{fraction of total consumption, by quantity, of food } j \text{ by income group } i}{\text{fraction of population in income group } i}$$

Source: estimated from Household Income and Expenditure Survey 1970-71.

TABLE 2

Intensity^{1/} of Consumption by Income Group - Rural
(1970-71)

<u>Income Group</u>	<u>Wheat</u>	<u>Rice</u>	<u>Gram</u>	<u>Milk</u>	<u>Ghee & Butter</u>	<u>Veg. Oil</u>	<u>Mutton</u>	<u>Beef</u>	<u>Sugar Refined</u>	<u>Sugar Other</u>
0 - 40	.98	.78	1.04	.74	.80	1.15	.56	.92	.77	.98
40 - 80	.99	1.07	.98	1.09	1.07	.87	.89	.99	.99	1.01
80 - 100	1.06	1.30	.96	1.30	1.26	.96	2.1	1.18	1.48	1.02

$$\underline{1/} \text{ Intensity} = \mu_{ij} = \frac{\text{fraction of total consumption, by quantity, of food } j \text{ by income group } i}{\text{fraction of population in income group } i}$$

Source: estimated from Household Income and Expenditure Survey 1970-71.

foods are sketched $f_d(i)$, $i = 1, 2, 3$. For each of these the food equality coefficient F_D is less than, equal to, greater than one respectively corresponding to the degree that food is favored by the poor. These are roughly rich persons, equalitarian, poor persons foods. For Pakistan the ordering of some F_D values is given in Table 3. Note the high position of wheat and gram and the somewhat low ranking of milk which does not support those who sometimes propose it as a vehicle for nutrition programs aimed at low income groups.

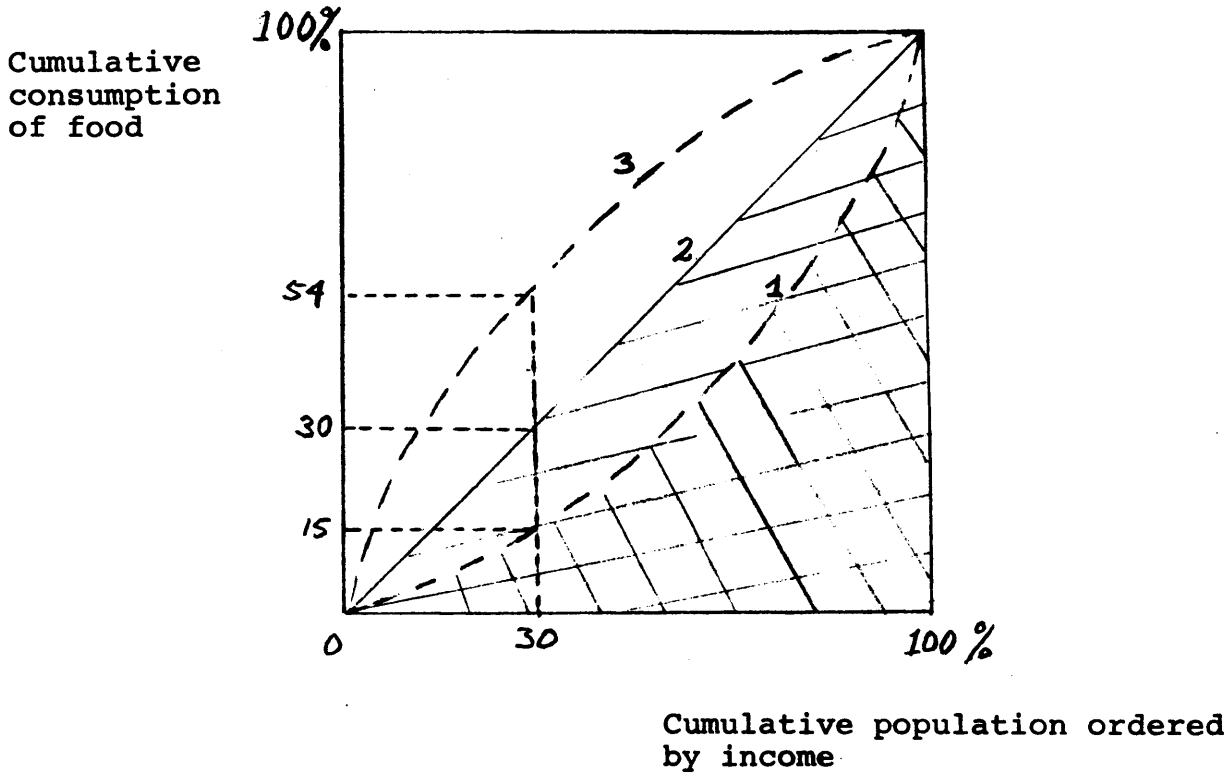
c) High η_{p1} . High elasticity of demand among low income groups is desirable because then a small drop in price will induce a relatively large response in consumption. Some values for compensated price elasticities (η_{p1}) are given in Table 4.* When one allows for the income effect the price elasticities are increased.

This is true in particular for cereals which represent a large income share. However the low values for cereals suggest that price adjustment may not in fact be a very suitable approach for achieving increased intake.

d) Low q_1' . The lower the percentage increase sought the lower the value of s_1 . As one seeks a greater increase the per unit costs rise due to the proportionately larger subsidy costs.

*At the extreme end of the income spectrum elasticities are much higher (about 1:0 for staples!) so that these individuals may benefit even more than the lowest 40 per cent.

Fig. 1 DISTRIBUTION OF FOOD BY INCOME CLASS



NOTE: Each food is represented by a separate curve. Curves 1, 2, 3 represent foods favored by high income, "equalitarian," low income groups. The figure indicates for example that the lowest 30%, by income, of the population consume 15%, 30%, and 54% of total amount of foods 1, 2, 3 consumed by the whole population.

FOOD EQUALITY COEFFICIENT $F_D(1)$ = ratio of cross hatched to shaded area.

TABLE 3

Food Equality Coefficients
(1970-71)

F_D ^{1/}	<u>Urban</u>	<u>Rural</u>
10	Sugar (unrefined)	Vegetable oil
9	Gram	Gram
8	Wheat	Sugar (unrefined)
7	Beef	Wheat
6	Vegetable oil	Beef
5	Rice	Ghee and butter
4	Milk	Rice
3	Sugar (refined)	Milk
2	Ghee and butter	Sugar (refined)
1	Mutton	Mutton

^{1/} High numbers correspond to low F_D - foods highly favored by low income groups.

TABLE 4

Own Price Elasticities for low income groups

	URBAN (0-40)	RURAL (0-40)
COMMODITY		
WHEAT	- .031	- .23
RICE	- .113	- .22
PULSES	- .386	- .28
MILK	- .254	-1.26
BUTTER	- .256	- .48
GHEE	-1.72	-1.15
V. GHEE	-2.16	- .43
MUTTON	-1.54	-1.35
BEEF	- .92	- .73
VEGET.	- .36	- .08
SUGAR	- .18	- .37

NOTE: These estimates are obtained by first computing expenditure elasticities using Household, Income and Expenditure Surveys 1968 - 1972. The approach first proposed by Frisch, R. is then used to derive the price elasticities. For a theoretical discussion of this link see Sato, K., "Additive Utility Functions for Double-Log Consumer Demand Functions." Journal of Political Economy, January - February, 1972, 80:102-24.

e) Low η_p/η_{p1} . This means it is desirable that the low income group should respond to a price variation (drop for a subsidy) more than the population at large. Some estimates are given in Table 5.

f) Low η_p/ϵ . Here one would like to have a highly elastic supply (i.e., $\epsilon \rightarrow \infty$). Thus foods like wheat or rice for which the economy may be viewed as open are good but mutton is not. However this ratio (particularly ϵ) would depend on the extent to which world markets are allowed to interact.

g) Low $\frac{D}{\alpha \Delta q_1 P}$. Administrative costs per unit per capita of the target group would tend to be as low as Δq_1 and the number of people in the target group increases. The administrative costs of a general subsidy program tend to be lower than one which seeks to benefit only specific members of the population. This latter kind would generally require some form of means test which tends to be expensive and difficult to administer.

Some estimates of the combined effect of all (excluding administrative costs) of these influences are obtained for increasing consumption of various foods by 10 per cent among low income groups -- those in the bottom 40 percent of urban and rural income classes. These are given in Table 6. Rather sweeping assumptions are made about supply elasticities. If one is dependent on domestic production then values for ϵ should

TABLE 5

Estimate of Price Elasticity Ratio (η_p/η_{pl})^{1/}

<u>Food</u>	η_p/η_{pl} <u>rural (0-40)</u>
Wheat	.76
Rice	.15
Pulses	.67
Milk	.25
Butter	.77
Ghee	.50
V. Ghee	-1.00 ^{2/}
Mutton	.83
Beef	.23
Vegetable	3.58
Sugar	1.67

^{1/} η_p is for the population at large and η_{pl} is for the low income rural group (0-40).

^{2/} This value based on the assumption of a free market in this food is questionable.

Source: Based on Household, Income and Expenditure data, 1968 - 1972.

TABLE 6

Estimate of cost/unit of food to increase low income group consumption ^{1/}

Food	Q/Q_1	$\eta_{p1}^{2/}$	$1 + \frac{\eta_p}{\eta_{p1}} q_1'$	$1 + \frac{\eta^{3/}}{\epsilon}$	$S_{1/p}$	$p^{4/}$	$S_1^{5/}$	$S_2^{6/}$
Wheat	2.5	- .21	1.07	1.22	15.54	1.62 (wheat flour)	25.2	0.94
Rice	3.16	- .20	1.01	1.05	16.76	2.31	38.7	1.21
Pulses	2.37	- .33	1.07	1.29	9.91	2.38	23.6	0.93
Milk	3.29	-1.01	1.03	1.50	5.03	3.00	15.1	0.45
V.Ghee	2.45	- .86	.90	1.00	2.57	26.00 (est.)	66.8	3.02
Beef	2.66	- .78	1.02	1.26	4.38	7.00	30.7	1.13
Mutton	5.21	-1.40	1.08	2.72	10.93	12.50	136.6	2.43

^{1/} Note administrative costs are not included. The low income group consists of the lower 40% of urban and rural population and the increase postulated is 10%.

^{2/} η_{p1} is weighted average of urban and rural low income groups for uncompensated elasticity.

^{3/} The value of ϵ is chosen equal to 1 except for v. ghee where η/ϵ is set to zero.

^{4/} Karachi prices rupees per seer (2.06 lb.). June 1975, source - Key Economic Indicators G.O.P. Nov. 1975.

^{5/} S_1 is the cost per unit increased intake by the low income group per capita.

^{6/} S_2 actual subsidy per unit of food: rupees/seer.

only be about .1 to .2 for cereals and pulses but adequate import availability may justify the higher values chosen. Much of v. ghee is imported so that the assumption of $\eta_{p/\epsilon} = 0$ in this instance may be reasonable.

It appears that three factors tend to dominate in establishing the per unit cost s_1 for a given commodity

- a) the price per unit of that commodity
- b) the elasticity of demand by the low income group
- c) the intensity of demand among that group.

Because of the low elasticities for cereals, changes in price to all consumers to achieve higher intakes by the low income groups is quite expensive. Middle income groups (40-80) tend to have elasticities of the same order so that they also benefit to about the same extent as the low income group. If they are also considered part of the target group then the effective cost ($s_{1/p}$) becomes roughly halved. At the extreme low end of the economic spectrum one could expect higher elasticities for cereals but if the target group is say 40% of the population then trying to achieve higher intake of cereals by adjusting the price is not particularly cost effective.

A little reflection could indicate the reason behind this. It seems that people first try to satisfy their basic caloric needs as cheaply as possible. This is typically by cereal

intake. To insure survival they must be reasonably close to their needs so that additional income will be used only to a small degree (as reflected in low elasticities) to increase quantity of cereal intake. Much of the increase in income goes to other foods, or higher qualities or other basic needs.

The cost estimates given for this type of subsidy program do not reflect many factors. The whole supply side is not considered. Thus the general equilibrium effects of the program on the economy should be evaluated. In particular, producer subsidy increases farm income and demand. Much of the increased demand will be met by the larger producers. Part of the subsidy might be defrayed by higher tax receipts. Also, if food is domestically produced then farmers (producers) and those involved in transportation and distribution will also benefit both from increases volume and high prices. If the additional food is to be imported then effects on balance of payments must be evaluated. The whole supply side merits careful analysis but for the moment we return to the program per se. For making comparisons with other type programs the actual implementation and administrative cost should be included. This will entail additional cost but will also provide benefits. On the other hand cost may be reduced by appropriate targeting of the program. This may be done in a number

of ways.

a) Regional variations: Foods which have lower local costs (due to transportation differentials for example) should be given higher weight in the choice process. In N.W.F.P. pulses follow a different consumption pattern and might be an efficient protein source in this region.

b) Seasonal Variations: Before harvest time is a particularly trying period for the poor. Again modification of the program to reflect his "enforced" change in consumption patterns would be desirable.

c) Quality effects: Recent analysis indicates that as income increases consumers show a strong tendency to purchase higher priced varieties of foods. This offers certain possibilities for focussing programs by subsidising only low price varieties. For beef the approach might be to limit the price of "cheaper cuts" (varieties favored by the poor) and let producers make appropriate profits by increasing the price of other cuts. A lot of beef production is simply a complement to energy power needs or milk production so that allowing the price of some cuts to rise to market clearing levels would effectively reduce these power costs. Currently all beef prices are held to about Rs 7.50/seer. This policy would need careful investigation of where each income groups supply comes from to account for different unit prices as in many areas people

traditionally do not choose different cuts. Yet prices paid for beef in 1971-72 (H.I. and E) indicate variations of as much as 3 to 1 in unit costs.

To improve cost effectiveness of wheat subsidies one might consider subsidies to lower priced varieties only. One mechanism would be that shops should have adequate supplies of lowest price varieties on hand. Failing this they could be required to sell the next higher priced variety at the bottom price. This would entail essentially monopoly control by government over the complete supply system. In addition one needs to evaluate a number of general equilibrium effects, including the impact on processing transportation and distribution.

Focussing on a group:

An estimate of cost-effectiveness by focussing can be obtained by considering the parameter Q/Q_1 . If one could focus completely, i.e., by checking that the only ones getting the subsidized food belong to the target group then Q/Q_1 would approach 1. However, the administrative costs rise sharply either because of the need for special outlets or some type of certification scheme. Thus one might consider some form of means test or a medical test. This latter might be done in conjunction with the M.C.H. centers. Similarly the gains obtained by subsidizing only at certain seasons involves costs.

Change in Nutrient Intake:

A nutrition program is primarily directed towards nutrition goals and yet people do not "demand" nutrients. Changes in nutrient intake are effected by changes in food intake. In the previous section we analysed the cost/unit of increasing the intake of a given food by the low income group. This may now be converted to change in nutrient intake. Let unit of food i contain the following quantities of nutrients, t_i

$$t_i = (t_{i1}, t_{i2}, \dots, t_{ik})$$

where t_{ij} is the number of units of nutrient j in one unit of food i . The cost/unit of increasing nutrient j in low income group by subsidizing food i is given by

$$S_{ij} = \frac{p_i Q}{t_{ij} \eta_{pl} Q_1} [1 + \alpha_1 \frac{\eta_p}{\eta_{pl}}] [1 + \frac{\eta_p}{\epsilon}]$$

Some typical cost estimates are given in Table 7 using 1975 prices. Again wheat seems to be one of the better commodities to use to increase nutrient intake but pulses certainly warrant consideration for both calories and protein.

Food Fortification:

The intake of many nutrients may be increased by fortifying a suitable carrier. If this is technically feasible and a suitable point of intervention may be devised, e.g., for salt or sugar if there are only a few supply sources, then one

should compare costs. Thus if the cost of fortifying unit of food i is v_{ij} per unit of nutrient j ; if the low income group consume Q_1/Q of that food then the cost per unit of nutrient delivered to the group is c_{ij}

$$c_{ij} = v_{ij}Q/Q_1$$

This then serves as a basis for comparison with the direct subsidy approach. For example to "deliver" calcium a direct subsidy to wheat costs 3.03 rupees per 100 mgs while the fortification approach would cost $2.50 v_{ij}$ where v_{ij} is the cost of adding 100 mgs to a unit (100 gms.) of wheat. A typical estimate for v_{ij} is about 1% of the price. So that if calcium deficiency alone is the problem a fortification program is considerably more cost effective.

Income Transfer

Income transfer may also be used to increase nutrient intake. This method is particularly desirable if a large share of the income increase goes to purchasing additional nutrients. Some estimates of "expenditure elasticities for nutrients" are given below.

Nutrient	Calories	Animal Protein	Veg. Protein
Exp. Elast. (all income groups)	.24	.63	.15
Exp. Elast. (rural low income groups)	.41	2.41	.24

TABLE 7

Typical Costs of Increasing Nutrient Intake by General
Subsidy to Food

Food	Commodity price/100grms (rupees)	s ₁ /100grms	Increased nutrient in ^{1/} Low Income Group per rupee		
			Calories	Protein grms	Calcium mgs
Wheat	.17	2.78	131	3.6	31.4
Rice	.25	4.14	86	1.7	5.8
Pulses	.25	2.52	143	8.4	56
Milk	.32	1.62	35	2.0	72
V.Ghee	2.78	7.15	49	0.2	0 .2
Beef	.75	3.28	39	7.0	4.9
Mutton	1.34	14.6	14	1.3	10.1

^{1/} Nutrient content is based on values given by Chughtai, M.I.D., and Waheed Khan, A., "Nutritive Value of Food-Subsuffs and Planning of Satisfactory Diets in Pakistan", Punjab University, Lahore, 1960.

If we consider average/capita caloric intake of the low income rural group is 2000/day then a 1% expenditure increase will produce an increase of about 8.2 calories/day or about 250 calories/month. This would cost about 0.50 rupees/month at 1974-75 expenditure levels. These were of the order 50 rupees/capita/month for low income rural groups. This may be compared with the direct subsidy approach where a similar increase via general wheat subsidy would cost $250/131 = 1.91$ rupees/capita/month (using 1974 wheat flour retail prices). This does not include administrative costs. Again if the program can be focussed towards the more deserving groups income supplement may be a far more cost effective way to increase nutrient intake.

In urban areas focussing may be done by a ration shop system. In rural areas it is somewhat more difficult.

One approach to focussing is to use some form of food coupon system. Since food coupons can only be used for food they induce the consumers to increase food intake. There are many schemes which may be adopted, but usually food coupons would require some form of means test. This would be difficult to implement in urban areas but one possibility that merits consideration is to use ownership of land

as a criterion for rural areas. Currently ration shops tend to be more readily available in urban areas so a food coupon system might serve as a suitable complement for rural areas.

Another practical problem which seems to arise with ration shops is that users often complain about adulteration of supplies, incidence of vermin, etc. If people had coupons which could be traded at any outlet, they could exercise some discretion in making purchases.

Conclusion

A number of policy alternatives are proposed for consumption and nutrition planning. Before implementing any of these one must adequately weight the relevant institutional and socio-political factors. The analysis addressed in this paper is primarily economic and even this should be extended to include general equilibrium effects. The following observations may be made:

1. Food Subsidy: For a general food subsidy the better foods are wheat, rice and pulses but the costs are quite high largely due to the low elasticities for these foods.
2. Focussing on a target group will lower the food costs of a program but the administrative costs will rise.
3. For increasing caloric intake a straight income supplement to low income groups achieves at least the same cost effectiveness as a wheat subsidy. The relative administrative costs need to be considered.
4. Food coupons warrant consideration as a means to reach the rural landless poor and also to introduce an element of competition. This latter might be a means to reducing some of the abuses of ration shops.

A general equilibrium framework would give a better indication of any large scale subsidy program. In particular the increased effective demand generates a feedback effect

which produces more income earning opportunities and also may generate additional government revenue to help defray part of the cost.

Notes

- 1/ Purchasing power should be distinguished from employment per se. Current estimates are that unemployment levels in Pakistan are about 2% so that the problem is one of income primarily. The large rural population with a high self employed component together with the loose structure of the urban labor market does not readily "lend" itself to western style analysis of "unemployment" problems.
- 2/ For further discussion of this issue in Pakistan see McCarthy, F.D., "Nutrition, Food and Prices in Pakistan", Discussion Paper No. 4, M.I.T., International Nutrition Planning Program.
- 3/ This model is largely based on one proposed by Reutlinger and Selowsky, "Malnutrition and Poverty: Magnitude and Target Group-Oriented Policies", unpublished mimeo, World Bank, April 1975.
- 4/ For most foods in Pakistan this is true. However, the demand for salt (of interest because of consideration as a carrier) is relatively inelastic while in urban areas even wheat has income elasticity close to zero among higher income groups.
- 5/ Substitution between sugar (Desi and Refined) and Gur and Shakkar is one of the more obvious.
- 6/ A consumer's demand for goods is a function of the prices faced and income. The change in demand for any commodity due to a variation in any of the prices may be decomposed into an income effect and purely price (income compensated) effect.

Usually an increase in income has a positive effect on demand but a price increase on a commodity will typically induce a negative effect on its demand. The combined effect may go either way. Typical analysis for a 3 good situation would postulate a utility function $u(x_1, x_2, x_3)$ and income M given by

$$p_1x_1 + p_2x_2 + p_3x_3 = M$$

It can then be shown that $x_i = t_i(p_1, p_2, p_3, M)$, $i = 1, 2, 3$

If p_1, p_3 and x_3 are assumed constant but p_2 is allowed to change then it follows that

$$\frac{\partial x_1}{\partial p_2} = \left. \frac{\partial x_1}{\partial p_2} \right|_{u = \text{constant}} - x_2 \frac{\partial x_1}{\partial M}$$

or $\eta_{p_2}^{x_1} = \left. \eta_{p_2}^{x_1} \right|_{\text{compensated}} - \theta_2 \eta_y^{x_1}$

where $\eta_{p_2}^{x_1}$ is the elasticity of demand for x_1 with respect to p_2 while $\eta_y^{x_1}$ is the income elasticity of demand for x_1 and θ_2 is the share of x_2 in the budget.

Total effect = Substitution effect + Income Effect

Similarly one may show for the more general situation of
L goods x_i , $i = 1, \dots, L$ with corresponding prices p_i
that

$$\frac{dx_k}{x_k} = \sum_i \frac{x_k}{p_i} \left| \text{comp.} \left(\frac{dp_i}{p_i} \right) + \frac{x_k}{y} \left(\frac{dy}{y} - \sum_i \theta_i \frac{dp_i}{p_i} \right) \right.$$