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IFPRI

Economic Analysis of Human Nutrition in Developing Countries:

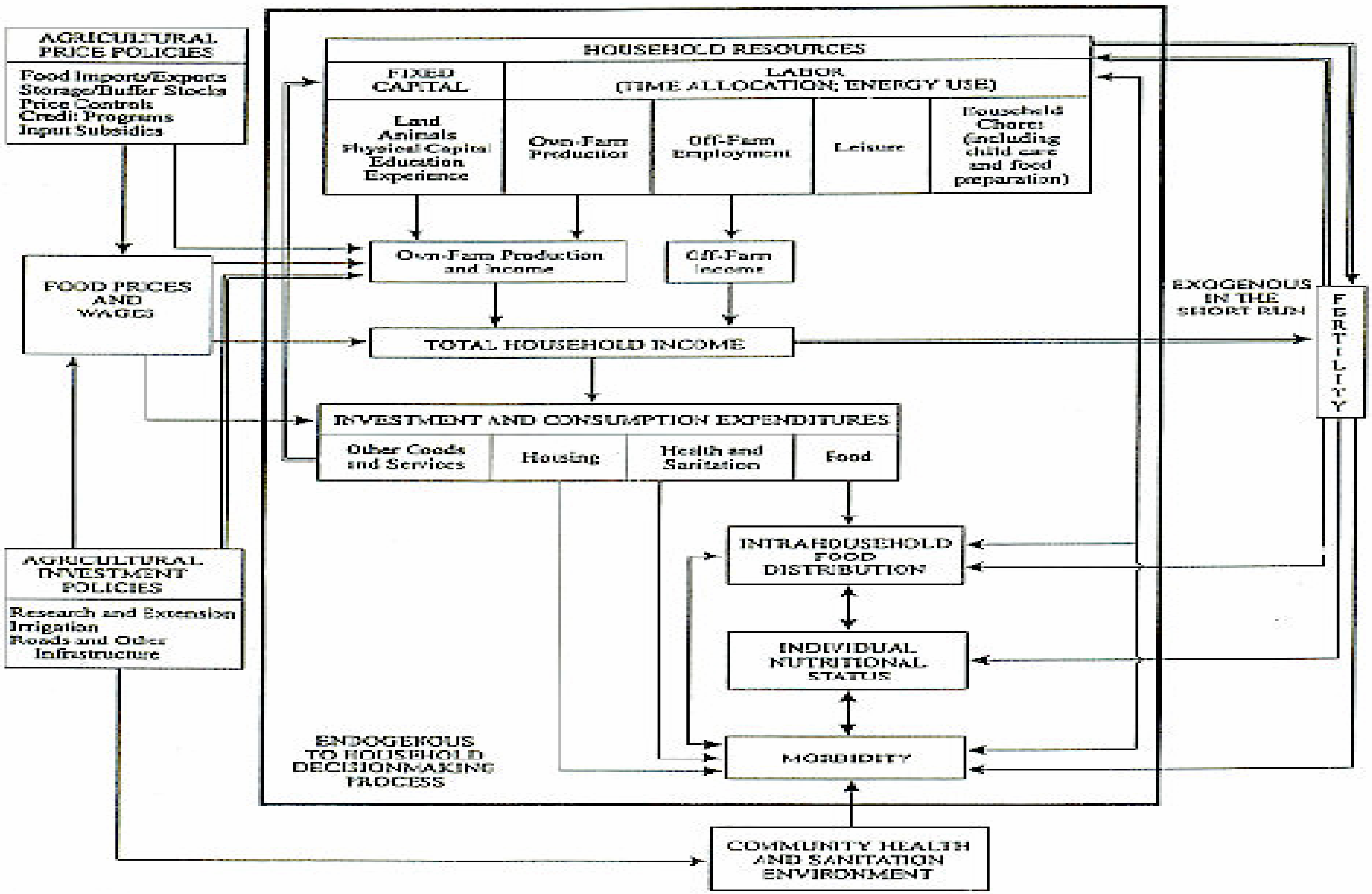
FOCUS ON FOOD/DIET

Howarth E. Bouis, IFPRI

Future Harvest[sm] Research Centers

IFPRI is one of 16 research centers that receives funding from the Consultative Group on International Agricultural Research (CGIAR).

Figure 1—Agricultural policies, household resource allocation, and nutrition



Source: Eileen Kennedy and Howarth E. Bouis, Linkages Between Agriculture & Nutrition: Implications for Policy & Research (Washington, DC: International Food Policy Research Institute, 1993), p. 3.

Lagged effect

Methodology of Economic Analysis

- Household Decision-Making
  - Maximize “utility”
  - Subject to resource constraints:
    - » Assets
    - » Education
    - » Time
  - “Utility” is a function of:
    - » Goods and services consumed
    - » Better health
    - » Leisure

Methodology of Economic Analysis

- Example of Introduction of Irrigation System
  - Income goes up
  - Time Allocation
    - Seasonal migration affected?
    - Different cropping pattern?
  - Health/Sanitation
    - Groundwater (arsenic); schistosomaisis?
  - Food prices at region/nation?

Methodology of Economic Analysis

- Estimating Calorie-Income Elasticities

DATA COLLECTED (partial list):

1. Agricultural Production, Labor And Other Input Use By Plot
2. Livestock, Backyard Gardening
3. Non-Farm Employment
4. Assets and Expenditures
5. Individual Food Intakes
6. Morbidity And Health Care
7. Nutritional Knowledge and Healthcare and Childcare Practices
8. Anthropometry
9. Blood (Micronutrient Status)
10. Women's Status (e. g. assets brought to marriage)
11. Time Allocation
12. Credit Taken and Given
13. Land Ownership and Land Rental
14. Market-Level and Village-Level

INCOME ELASTICITY

%Δ Quantity (x)

%Δ Income

OWN-PRICE ELASTICITY

%Δ Quantity (x)

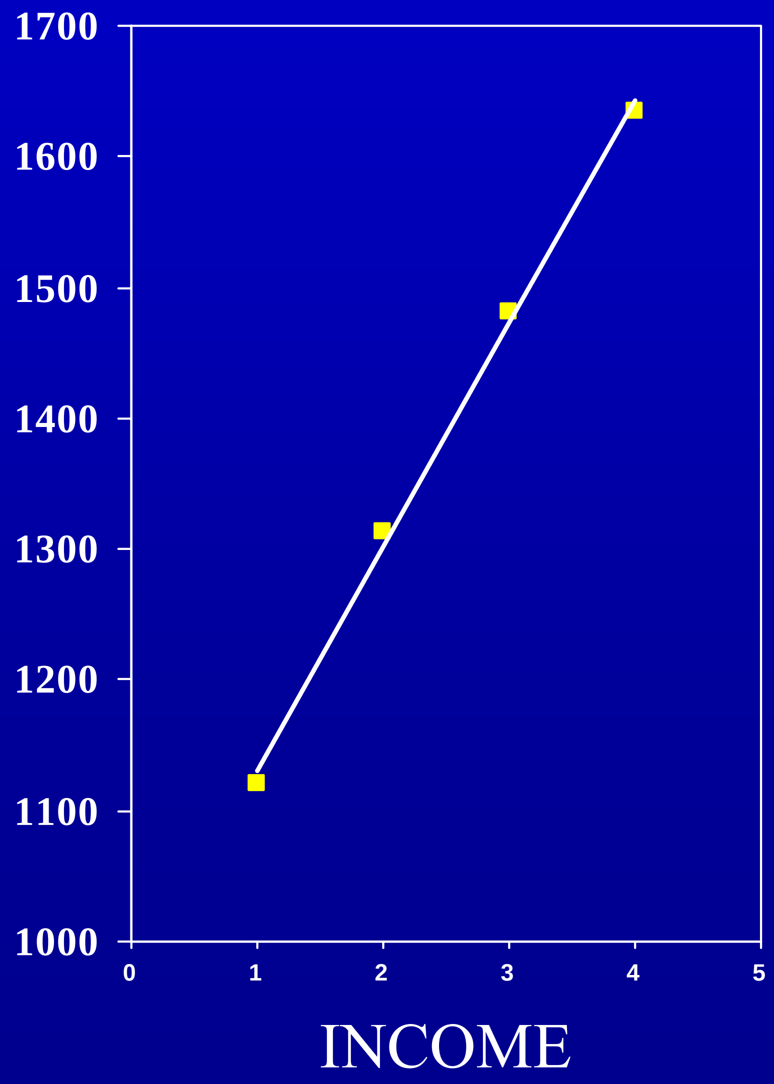
%Δ Price (x)

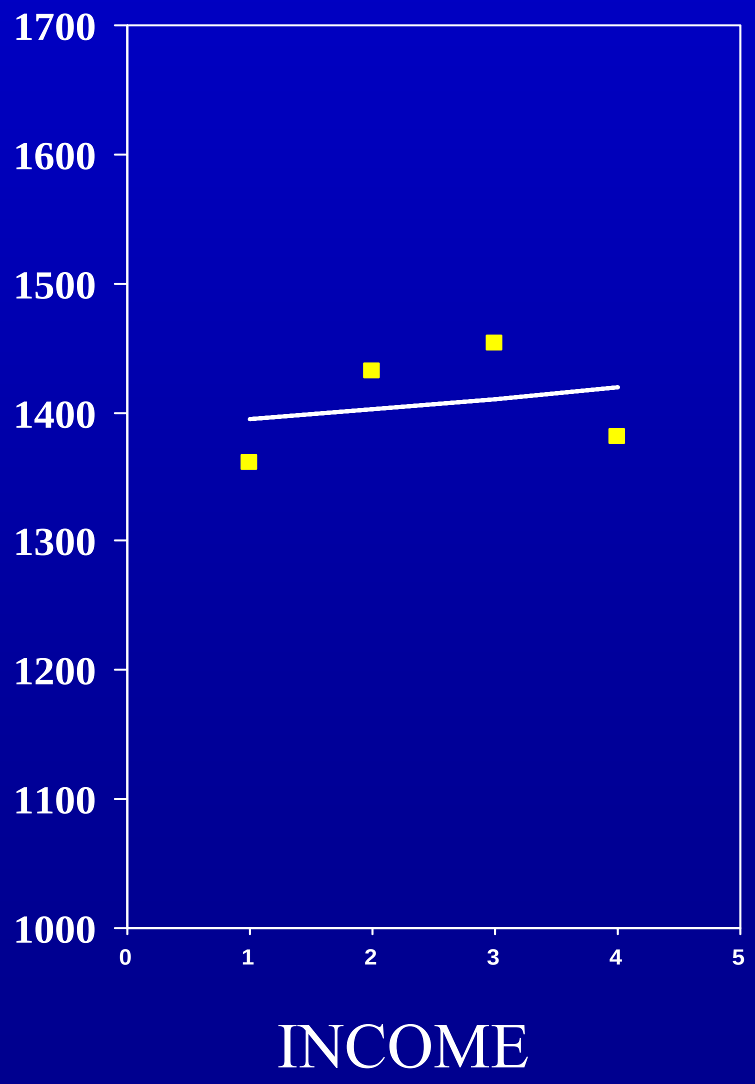
CROSS-PRICE ELASTICITY

%Δ Quantity (y)

%Δ Price (x)

Energy Availability/Intake For Rural Philippines By Income Group





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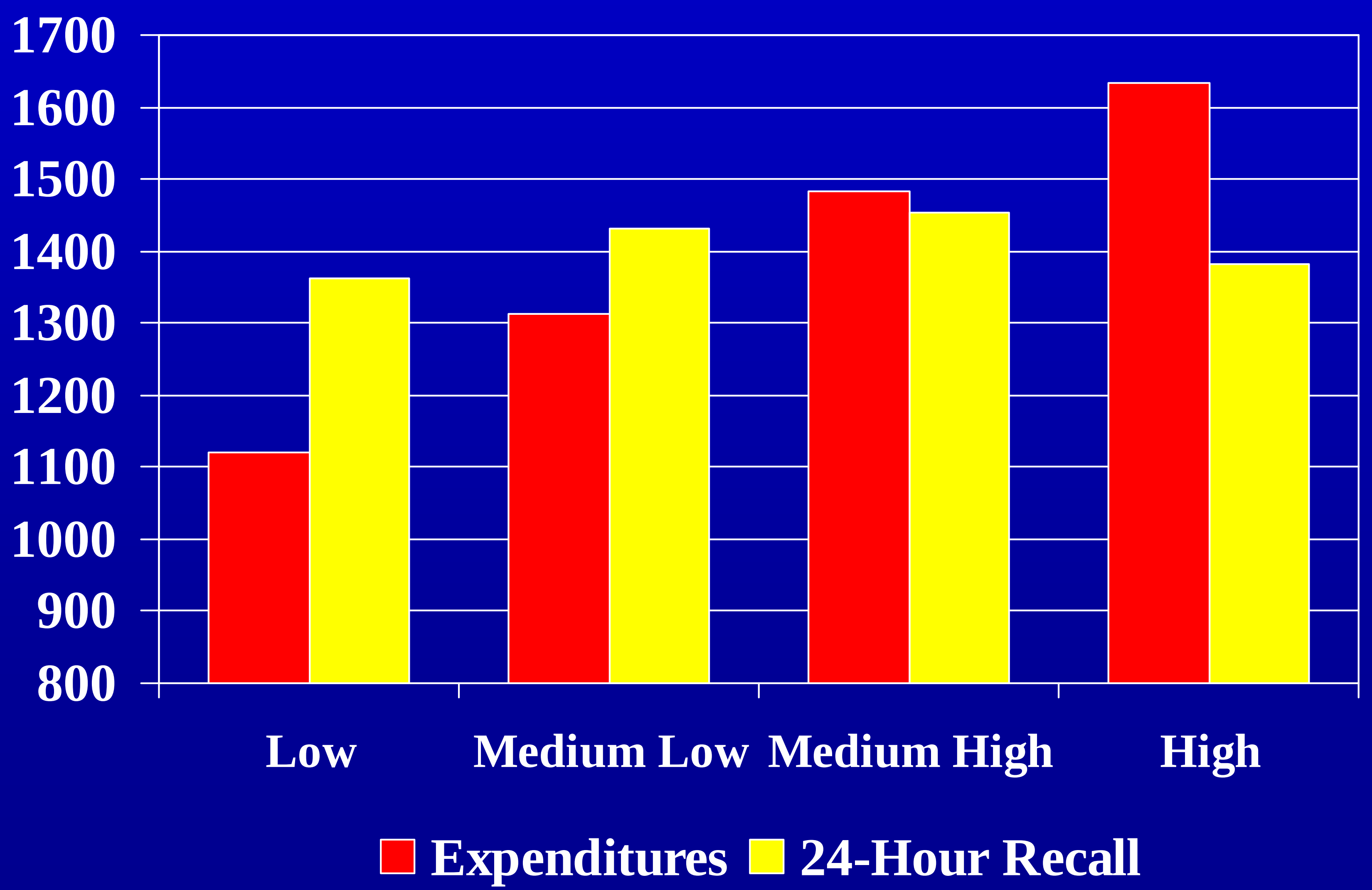

FOOD DEMAND PATTERNS

An understanding of what factors drive food consumption decisions implies very different food-based approaches to solving vitamin A and iron deficiencies

FOOD EXPENDITURES FOR A RURAL PHILIPPINE POPULATION (pesos/week)

Food Category	*Poorest 20%*	*Richest 20%*
Rice	2.30	9.91
Corn	9.56	4.36
Meat, Fish	7.21	23.64
Vegetables	2.70	3.78
Fruits, Snacks	0.87	10.51
Other Foods	3.55	8.44
TOTAL	26.19	60.64

ENERGY INTAKES FOR A RURAL PHILIPPINE POPULATION
(calories per adult equivalent per day)

Food Category	*Poorest 20%*	*Richest 20%*
Rice and Corn	1771	1798
All Other Foods	337	777
TOTAL	2108	2575

PHILIPPINE POPULATION (international units per day per adult equivalent)

Food Category	*Poorest 20%*	*Richest 20%*
Rice	0	0
Corn	10	2
Meat, Fish	1010	1733
Vegetables	3481	4047
Fruits, Snacks	121	124
Other Foods	169	294
TOTAL	4972	6200
Percent of RDA	106	138

IRON INTAKES FOR A RURAL PHILIPPINE POPULATION (milligrams per day per adult equivalent)

Food Category	*Poorest 20%*	*Richest 20%*
Rice	0.53	2.14
Corn	2.31	0.97
Other Staples	0.68	1.24
Meat, Fish	1.17	3.66
Vegetables	1.16	1.35
Other Foods	0.80	0.91
TOTAL	6.64	10.27
Percent of RDA	66	103

VITAMIN A INTAKES BY SURVEY ROUND FOR A RURAL PHILIPPINE POPULATION

Survey Round	*Adequacy Ratio*	*Percent Below 80% of RDA*
1	**1.95**	**39**
2	**1.24**	**59**
3	**1.03**	**72**
4	**0.71**	**72**
TOTAL	**1.23**	**60**

IRON INTAKES BY INCOME GROUP FOR A RURAL PHILIPPINE POPULATION

Income Group	Iron Adequacy Ratios		
	Pre-schoolers	Mothers	Fathers
1	0.65	0.53	1.10
2	0.78	0.57	1.24
3	0.77	0.62	1.34
4	0.86	0.66	1.47
5	1.07	0.76	1.67
TOTAL	0.81	0.63	1.37

CALORIES

- Consumers are aware of intake fluctuations
- Low income and price elasticities

IRON

- Low price elasticity due to diverse sources
- High income elasticity
- Adequacy out of reach due to low incomes
- Fortification or supplementation required

VITAMIN A

- Low income elasticity because intakes are highly-correlated with vegetables
- High price elasticity due to diet concentration
- Nutrition education effective
- Fortification or supplementation may still be required – depends on the conversion rate between betacarotene and retinol

EFFECT OF DIETARY QUALITY ON CHILDRENS' HEIGHTS FOR VIETNAM

	COEFFICIENT (T-Statistic)		
Sample Description	Animal and Fish	Non-Staple Plant	Staples
All Children 0-20	6.1 (5.5)	2.4 (3.5)	0.5 (2.6)
Children 0-6	2.9 (1.8)	2.3 (2.3)	0.4 (1.6)
Children 7-13	9.2 (5.0)	2.8 (2.4)	0.3 (1.2)
Children 14-20	6.3 (3.0)	0.0 (0.0)	0.4 (1.3)

EFFECT OF DIETARY QUALITY ON BLOOD HEMOGLOBIN IN BANGLADESH

	Preschool Children	Adult Females
Cereals	-.0002(-1.8)	-.0000(-0.5)
Non-Staple Plants	-0004(1.2)	-.0000(-0.1)
Animal and Fish	.0020(2.8)	0.0011(2.5)
All Foods	-.0001(-0.7)	-.0000(-0.3)

PER CAPITA ENERGY INTAKES IN SATURIA

	Income Level			
	Low	Medium	High	Total
Total	2137	2319	2418	2296
Cereals	1826	1925	1973	1910
Non-staple Plants	274	343	374	332
Animal and Fish	37	52	71	54

TAKA TO PURCHASE 100 CALORIES IN SATURIA

	Income Level			
	Low	Medium	High	Total
Total	0.51	0.58	0.64	0.58
Cereals	0.29	0.30	0.30	0.30
Non-staple Plants	1.31	1.40	1.48	1.41
Animal and Fish	5.54	5.75	5.58	5.62

FOOD BUDGET SHARES FOR SATURIA

	Income Level			
	Low	Medium	High	Total
Total	100	100	100	100
Cereals	49	43	38	43
Non-staple Plants	33	36	36	35
Animal and Fish	18	21	26	22

INTRAHOUSEHOLD CALORIE INTAKES FOR SATURIA

	Income Level			
	Low	Medium	High	Total
Total Calorie				
Girls, Age2-5	1093	1097	1099	1095
Boys, Age2-5	1077	1165	1252	1168
Women, Age20-55	2134	2328	2369	2282
Men, Age20-55	3019	3032	3112	3058
Animal and Fish				
Girls, Age2-5	21	22	40	26
Boys, Age2-5	30	45	58	45
Women, Age20-55	31	43	61	46
Men, Age20-55	65	70	98	79

PREVALENCE OF ANEMIA IN SATURIA

PRESCHOOL CHILDREN Income Tercile	Boys	Girls	All
Low	40	43	41
Medium	32	37	34
High	26	26	26
ALL	33	37	35

PREVALENCE OF ANEMIA IN SATURIA

ADULT WOMEN				
Income Tercile	Non-Preg Non-Lact.	Lact.	Preg.	All
Low	50	39	75	47
Medium	47	59	92	51
High	48	42	92	49
ALL	48	47	86	49

Calculation of Bioavailable Iron

- Fe(bio) = 0.140 FeMFP + [5 +26.804 log{(EF+100)/100}] X CT [FeTOT – 0.4 FeMFP]/100

- EF = (M + F + P) + AA
- CT = 10 exp [-0.22869 log (PHYTATE)+0.1295]

Effect of Additional Trace Minerals On Blood Hemoglobin

- Fe(bio) = f[dietary intake]
- Hb = g[Fe(bio), iron supplements]

- Doubling the iron in rice through biofortification has 30% the effect of iron supplements in raising blood hemoglobin

Effect of Additional Trace Minerals On Blood Hemoglobin

- Iron supplements are **50 times as expensive** to deliver per person treated
- To get an equal effect as bio-fortification through meat/fish consumption, poor Bangladeshi households would have to spend **$35 extra per person per year** on meat/fish.

INDICES OF REAL PRICES OF SELECTED FOODS

YEAR	RICE PADDY	WHEAT	SOR-GHUM
1973-75	1.00	1.00	1.00
1976-78	0.75	0.63	0.63
1979-81	0.74	0.60	0.60
1982-84	0.76	0.69	0.58
1985-87	0.72	0.60	0.60
1988-90	0.71	0.61	0.58
1991-93	0.60	0.55	0.55
1994-96	0.59	0.57	0.61

INDICES OF REAL PRICES OF SELECTED FOODS

YEAR	LENTILS	CHICK-PEAS	COW-PEAS
1973-75	1.00	1.00	1.00
1976-78	0.94	0.74	0.66
1979-81	1.33	1.07	0.99
1982-84	1.18	1.15	0.87
1985-87	1.25	1.14	0.61
1988-90	1.39	1.26	1.25
1991-93	1.27	1.01	1.12
1994-96	1.41	1.20	1.22

INDICES OF REAL PRICES OF SELECTED FOODS

YEAR	SPINACH	TOMA-TOES	PUMP-KIN	ONIONS
1973-75	1.00	1.00	1.00	1.00
1976-78	1.04	1.02	0.90	0.87
1979-81	0.81	1.20	0.81	1.36
1982-84	0.67	1.23	1.23	0.95
1985-87	0.94	1.82	1.12	1.13
1988-90	1.30	3.13	1.51	1.25
1991-93	1.10	2.18	1.71	1.46
1994-96	1.23	2.68	1.96	1.32

INDICES OF REAL PRICES OF SELECTED FOODS

YEAR	CHICKEN	EGGS	COW MILK
1973-75	1.00	1.00	1.00
1976-78	1.20	1.09	0.96
1979-81	1.24	1.13	1.08
1982-84	1.24	1.24	1.07
1985-87	1.43	1.36	1.13
1988-90	1.42	1.35	1.26
1991-93	1.55	1.28	1.08
1994-96	1.56	1.26	1.05

INDICES OF REAL PRICES OF SELECTED FOODS

YEAR	RUHI FISH	HILSA FISH
1973-75	1.00	1.00
1976-78	1.33	1.35
1979-81	1.41	1.39
1982-84	1.44	1.15
1985-87	1.86	1.38
1988-90	1.93	1.41
1991-93	2.21	1.54
1994-96	2.27	1.60

CONCLUSION

MORE OF THE SAME

- Higher rural incomes
- Strong linkages with non-farm economy
- Energy intakes protected and increased
- All things being equal, helped to improve dietary quality

CONCLUSION

STATUS QUO IS NEVER SATISFACTORY

- Pressures on prices of non-staple foods to rise
- Better understand the importance of dietary quality for human health
- Breeding for improved nutrient quality of rice can make a crucial contribution

RELATIVE COSTS OF BIOFORTIFICATION

- **Conventional Iron Fortification:**
  - $0.10 per person per year
  - 1.25 billion people in South Asia
  - to reach 40% of this population each year costs $50 million, $500 million each decade

RELATIVE COSTS OF BIOFORTIFICATION

- **Vitamin A Supplementation:**
  - $0.50 per person
  - treat 100 million children and women in South Asia (1 in every12.5 persons)
  - $50 million each year, $500 million over a decade

Costs of Plant Breeding

- $10 million over ten years to develop and test (say) a high-iron rice and for varieties to be adopted in a limited number of countries
- **Fixed**, **one-time** investment at a **central** location
- Iron and zinc content are highly correlated so other trace minerals may be added at little extra cost

"NICHE" for Plant Breeding

- Inexpensive, cost-effective, sustainable, long-term delivery of nutrients to the poor
- **Improves plant nutrition** and so can raise agricultural productivity and farm incomes
- Cannot deliver the **level of nutrients in a single "dose"** that supplements and fortification can deliver
- **Not a substitute** for improved dietary quality

Biofortification Reduces Prevalence For Those Less Iron Deficient & Maintains Status