

# Nutrition Economics

## Principles and Policy Applications

**Suresh C. Babu**

*International Food Policy Research Institute (IFPRI),  
Washington, DC, United States*

**Shailendra N. Gajanan**

*University of Pittsburgh, Bradford, PA, United States*

**J. Arne Hallam**

*Iowa State University, Ames, IA, United States*



ELSEVIER

AMSTERDAM • BOSTON • HEIDELBERG • LONDON  
NEW YORK • OXFORD • PARIS • SAN DIEGO  
SAN FRANCISCO • SINGAPORE • SYDNEY • TOKYO

Academic Press is an imprint of Elsevier



# Contents

Preface .....	xv
---------------	----

## **PART A INTRODUCTION**

---

<b>CHAPTER 1 Why Study the Economics of Nutrition? .....</b>	<b>3</b>
Organization of the Book Chapters.....	5

## **CHAPTER 2 Global Nutritional Challenges and Targets:**

<b>A Development and Policy Perspective .....</b>	<b>9</b>
---	----------

Global Nutrition Challenges.....	9
----------------------------------	---

Calorie-Deficient Diet .....	11
------------------------------	----

Micronutrient Deficiencies .....	11
----------------------------------	----

Stunting .....	12
----------------	----

Wasting .....	13
---------------	----

Overweight and Obesity .....	13
------------------------------	----

Exclusive Breast Feeding .....	14
--------------------------------	----

Lower Birth Weight.....	14
-------------------------	----

Malnutrition From a Development and Policy Perspective .....	14
--	----

How Can the Global Community Organize to Achieve	
--	--

the Global Nutrition Goals? .....	15
-----------------------------------	----

Global Nutrition Goals for 2025 .....	16
---------------------------------------	----

What Have We Learned and How Do We Move Forward? .....	17
--	----

Increasing Investments in Nutrition .....	18
---	----

The Role of Continued Documentation of Evidence .....	18
---	----

Increasing the Commitment to Nutrition .....	19
--	----

Monitoring and Tracking Nutrition Progress.....	19
---	----

Investing in Open Data Systems .....	19
--------------------------------------	----

Recent Global Initiatives .....	20
---------------------------------	----

Policy Process and Best Practices .....	20
---	----

Local Ownership and Leadership.....	21
-------------------------------------	----

The Role of Civil Society .....	21
---------------------------------	----

Multisectoral Approach .....	21
------------------------------	----

Emerging Challenges.....	22
--------------------------	----

Research Gaps .....	22
---------------------	----

Conclusions.....	23
------------------	----

Exercises .....	23
-----------------	----

<b>CHAPTER 3 A Conceptual Framework for Investing in Nutrition: Issues, Challenges, and Analytical Approaches .....</b>	<b>25</b>
Problems of Poverty, Hunger, and Malnutrition.....	26
Causes of Malnutrition: A Conceptual Framework.....	27
Rationale for Investing in Nutrition.....	30
Nutrition and Other Development Objectives .....	32
Nutrition Challenges and Their Economic Policy Analysis.....	34
Conclusions.....	36
Exercises .....	40
 <b>PART B ECONOMIC ANALYSIS OF NUTRITION</b>	
<b>CHAPTER 4 Microeconomic Nutrition Policy .....</b>	<b>43</b>
Introduction.....	43
The Household as the Decision-Making Unit.....	44
Household Equilibrium and Demand for Nutrients.....	45
Basic Concepts of Demand for Food .....	49
Income Elasticity of Demand.....	53
Derivation of Engel Curves From Income Consumption Lines.....	54
Deriving the Household Demand Curve for a Fiber-Rich Diet .....	55
Income and Substitution Effects .....	56
Demand for Nonfood Factors for Optimal Nutrition.....	57
Production of Nutrition With Food and Nonfood Inputs .....	58
Dynamics of Nutrition Choices.....	59
Cultural Factors Affecting Food Consumption and Nutrition.....	60
Conclusions.....	60
Exercises .....	61
<b>CHAPTER 5 Macroeconomic Aspects of Nutrition Policy .....</b>	<b>63</b>
Introduction.....	63
Conceptual Framework.....	63
Nutritional Impact of Macroeconomic Shocks and Policies .....	64
Elements of Macroeconomic Policy and Their Implications .....	66
How Do Macroeconomic Adjustment Policies Affect Nutritional Outcomes? .....	68
Analytical Methods for Studying the Impact of Macroeconomic Policies on Nutrition.....	68
Partial Equilibrium Analysis .....	68
General Equilibrium Modeling .....	69
Poverty Analysis Macroeconomics Simulator .....	72

Macro—Meso—Micro Policy Linkages in the Context of Nutrition .....	76
Conclusion .....	77
Exercises .....	77

## PART C ECONOMICS OF NUTRIENT DEMAND

---

<b>CHAPTER 6 Consumer Theory and Estimation of Demand for Food .....</b>	<b>81</b>
Derivation of Consumer Demand Functions .....	82
Block Additivity .....	88
Direct Additivity .....	88
Testing for Separability .....	89
Aggregating Consumer Demand for Policy Analysis.....	90
Duality, Indirect Utility, and Cost Minimization .....	91
Cost Minimization and Hicksian Demand Functions.....	93
Introduction to Empirical Demand Systems .....	93
Linear Expenditure System (LES) .....	94
Indirect Addilog Model (IAD) .....	96
Rotterdam Model .....	97
Transcendental Logarithmic Demand System .....	98
Generalized Addilog Demand System .....	98
Almost Ideal Demand System.....	99
Food Demand Studies in Developing and Developed Countries .....	101
Empirical Implementation in STATA.....	109
Calculating Elasticities .....	112
Conclusions.....	113
Exercises .....	114
<b>CHAPTER 7 Demand for Nutrients and Policy Implications .....</b>	<b>117</b>
Introduction.....	117
Studies on Nutrient Demand .....	117
Recent Studies From Asia .....	118
The United States .....	123
Estimation of Nutrition Elasticities.....	125
Food Price – Nutrient Elasticities.....	127
Nutrient Expenditure (Income) Elasticities.....	127
A Note on Limitations in Deriving Nutrition Elasticities .....	127
Can Subsidies Improve Nutrition? .....	128
Implementation in STATA.....	131
Example 1: The Effect of a Subsidy .....	132
Example 2: Based on Jensen-Miller (2011).....	135

Example 3: Based on Kaushal and Muchomba (2015) .....	137
Example 4: Based on Chang et al. (2015) .....	139
Conclusions.....	141
Exercises .....	142
 <b>PART D DETERMINANTS OF NUTRITIONAL STATUS AND CAUSAL ANALYSIS</b>	
<b>CHAPTER 8 Socioeconomic Determinants of Nutrition: Application of Quantile Regression .....</b>	<b>145</b>
Introduction.....	145
Safe Water, Sanitation, Mothers' Education, Children's Diets, and Nutrition.....	145
Are Nutritional Outcomes Age-Specific?.....	149
Double Burden and Socioeconomic Determinants in Indonesian Households.....	149
Policy Issues for Reducing Under-Nutrition: An Example .....	150
Generating Analytical Results for Policy Discussions .....	151
Quantile Estimation Using STATA .....	152
Conclusions.....	159
Exercises .....	159
<b>CHAPTER 9 Intra-Household Allocation and Gender Bias in Nutrition: Application of Heckman Two-Step Procedure .....</b>	<b>161</b>
Introduction.....	161
Economics of Intra-Household Behavior.....	163
Models of Intra-Household Decision-Making .....	165
Are Girls Eating More? A Review of Selected Studies .....	168
Policy Applications of Studies on Intra-Household Resource Allocation .....	170
Generating Analytical Results.....	172
Implementation in STATA.....	173
Conclusions.....	180
Exercises .....	180
<b>CHAPTER 10 Economics of Child Care, Water, Sanitation, Hygiene, and Health: The Application of the Blinder—Oaxaca Decomposition Method .....</b>	<b>183</b>
Introduction.....	183
Conceptual Approach .....	184

What Do We Know: Policy Lessons?.....	185
Child Malnutrition and Rights to Water and Sanitation.....	187
The Asian Enigma .....	189
Child Care, Fertility, and Malnutrition .....	190
Health Care and Nutrition .....	192
Ecohealth Approaches: Maharashtra, India, Cameroon, and Lebanon .....	193
Panagaria—Gillespie Debates and Policy Considerations .....	193
Analytical Methods.....	194
Implementation in STATA.....	197
Conclusions.....	201
Exercises .....	201

## **PART E PROGRAM EVALUATION AND ANALYSIS OF NUTRITION POLICIES**

---

### **CHAPTER 11 Methods of Program Evaluation: An Analytical Review and Implementation Strategies .....** 205

Introduction.....	205
Analytical Methods.....	206
Randomization .....	207
Implementation in STATA: Test Scores and Free Lunch.....	208
Instrumental Variables Estimator.....	209
Implementation in STATA: IV Estimation, Test Scores, and Free Lunch.....	211
The Difference-in-Difference Estimator .....	213
Example: Test Scores and Free Lunch .....	214
Implementation in STATA.....	215
Regression Discontinuity Design .....	216
Propensity Score Matching and Pipeline Comparisons.....	217
Implementation in STATA.....	219
Example .....	220
The Deaton—Imbens Debate .....	226
Conclusions.....	230
Exercises .....	230

### **CHAPTER 12 Nutritional Implications of Social Protection: Application of Panel Data Method .....** 231

Placing Social Protection Programs in a Larger Development Context.....	232
A Conceptual Framework for Evaluating Social Protection	
Programs for Nutritional Outcomes .....	233
Designing and Implementing Social Protection: What Is the Best Approach? ....	236

What Does the Current Literature Show?.....	238
Safety Net in Ethiopia: Policy Lessons .....	239
Brazil's Bolsa Familia: Cash Transfers Are Not Enough .....	240
Nutria-Cookies, Child Labor, and Safety Net Programs in India .....	240
Bangladesh Social Protection With a Behavioral Change Component .....	241
Safety Nets and Nutrition in India .....	242
The Great Recession and the Social Safety Net in the United States.....	244
Analytical Methods.....	245
Empirical Example in STATA.....	247
Conclusions.....	254
Exercises .....	255

## **CHAPTER 13 Economics of School Nutrition: An Application of Regression Discontinuity.....** 257

Introduction.....	257
What Do We Know From Existing Literature?.....	258
Lessons From the Evaluations of the International Agencies .....	260
How Many Kids Are Fed in Schools? .....	260
The Bottom Line .....	260
The Importance of School Feeding Programs .....	261
The Challenges With School Feeding Programs .....	261
School Feeding Programs in the United States .....	263
Do School Breakfast Programs Work? .....	264
School Feeding Programs Global Evolution.....	265
Analytical Results: Application of Regression Discontinuity .....	266
Implementation in STATA.....	269
Conclusions.....	276
Exercises .....	277

## **PART F ECONOMICS OF TRIPLE BURDEN: UNDER-NUTRITION, OVER-NUTRITION, MICRONUTRIENT DEFICIENCIES**

---

### **CHAPTER 14 Economic Analysis of Obesity and Impact on Quality of Life:**

<b>Application of Nonparametric Methods .....</b>	<b>281</b>
Introduction.....	281
The Economic Effects of Obesity on Human Capital .....	283
Health Costs of Obesity.....	285
Causes of Obesity in America.....	286
How Safe Are the Safety Nets in the United States? .....	286

Income Effects and Childhood Obesity .....	290
Obesity in Suburbia .....	290
Urban Sprawl, Remoteness, and the Built Environment.....	291
Can Higher Gas Prices Reduce Obesity?.....	292
Urban Sprawl and the Walmart Effect.....	292
The Built Environment: Obesity, Parks, and Recreation .....	292
The Built Environment: Junk Foods, Vending Machines, Video Games, and Grades.....	293
Food Deserts .....	294
Fast-Food and Obesity.....	295
Policy Challenges: Will Fat-Taxes or Soda-Taxes Work?.....	296
Peer Effects, Social Networks, Dating, and Obesity .....	298
Obesity in Other Developed Countries .....	300
Canada .....	300
Obesity in the OECD.....	300
Obesity in Latin America: Colombia, Brazil, Guatemala, and Mexico.....	301
Other Obese Groups .....	302
Policy: Should We Worry About Obesity?.....	302
Does Public Opinion Sway Policy? .....	303
Policy Angle From Behavioral Economics.....	303
The Moral Hazard Problem and Policy Headaches.....	304
Can Nutrition Labeling, Packaging, Advertising, Law, and Education Help? ....	305
Public Policy Angle 1: Food Advertisement and Promotion .....	306
Policy Angle 2: USDA Dietary Guidelines .....	306
Policy Angle 3: Will Soda-Taxes Work? .....	307
Policy Angle 4: Family Issues and Mother's Role .....	307
Policy Angle 5: Early Screening, Maternal Role, and Breast Feeding.....	308
Nonparametric Regression in STATA: Testing Obesity and Food Insecurity .....	308
Conclusions.....	310
Exercises .....	311

## **PART G SPECIAL TOPICS IN NUTRITION POLICY**

---

<b>CHAPTER 15 Agriculture, Nutrition, Health: How to Bring Multiple Sectors to Work on Nutritional Goals .....</b>	<b>315</b>
Introduction.....	315
Conceptual Framework.....	316
Dietary Diversity .....	319
Bio-Fortification .....	320
Nutrition Value Chains.....	322

Connecting the Sectors Through Multi-Sector Programming .....	322
Conclusions.....	325
Exercises .....	325
<b>CHAPTER 16 Designing a Decentralized Food System to Meet Nutrition Needs: An Optimization Approach .....</b>	<b>327</b>
A Practical Tool for Designing Decentralized Food Nutrition Interventions.....	330
Application of the Model to the Food System in Malawi.....	332
The Optimization Procedure .....	333
Conclusions.....	341
Exercises .....	342
<b>PART H CONCLUSION</b>	
<b>CHAPTER 17 Future Directions for Nutrition Policy Making and Implementation .....</b>	<b>345</b>
References.....	353
Index .....	379