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ADOPTING IMPROVED FARM TECHNOLOGY:

A STUDY OF SMALLHOLDER FARMERS IN EASTERN PROVINCE, ZAMBIA

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(GOVERNMENT OF THE REPUBLIC OF ZAMBIA)

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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and Sudhir Wanmali

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Contents

Foreword xxi

Just Faaland

Acknowledgments xxii

Rafael Celis, John T. Milimo, and Sudhir Wanmali

List of Contributors xxiv

1. Introduction 1

Rafael Celis and John T. Milimo

Part I. The Physical, Institutional, and Policy Environment

2. The Eastern Province of Zambia 7

John T. Milimo

3. Agricultural Policies in Zambia, 1975-85 21

Katongo Katongo

4. Policy Constraints on the Development of Agriculture and Small-Scale Enterprises in Rural Zambia 62

Lundondo Mumeka

5. Credit Policies and Agricultural Credit in Eastern Province 93

Moses Banda

6. Land Tenure and Agricultural Development in Eastern Province 129

John T. Milimo

7. The Institutional Setting in Eastern Province 138

Emmanuel C. W. Shula

8. Distribution of Businesses and Service Institutions in Eastern Province 158

Sudhir Wanmali

Part II. The Determinants and Effects of Technology Adoption

9. The Use of Improved Agricultural Technology in Eastern Province 173

Dayanatha Jha, Behjat Hojjati, and Stephen Vosti

10. Input Use and Productivity 202

Dayanatha Jha

11. The Effects of Adopting Technology on the Household Use of Labor 213

Rafael Celis and Cindy Holleman

12. The Effects of Technological Change on Food Consumption and Nutritional Status in Eastern Province 248

Catherine Siandwazi, Saroj Bhattarai, and Shubh K. Kumar

13. Household Expenditure Behavior and Household Revenue Determinants 268

Rafael Celis and Neal Bliven

Part III. Determinants of Other Factors Influencing Technology Adoption

14. Determinants of Service Use Among Rural Households in Eastern Province 311

Sudhir Wanmali and Jane He

15. Improving Agricultural Extension to Small Farms 348

Neal Bliven

Part IV. Conclusions

16. Conclusions and Policy Recommendations 389

Rafael Celis, John T. Milimo, and Sudhir Wanmali

References 397

Tables and Figures

Tables

Table 2.1	Population of towns in Eastern Province, Zambia, by gender, 1980	9
Table 2.2	Area, population, and population density of districts in Eastern Province, Zambia, by gender, 1980	10
Table 2.3	Educational status in Eastern Province and Zambia, 1980	12
Table 2.4	Educational status of heads of household in Eastern Province and Zambia, by gender, 1980	12
Table 2.5	Percentage of persons with access to safe drinking water in Eastern Province, Zambia, by district	13
Table 2.6	Employment status in Eastern Province, Zambia, by gender, 1980	14
Table 2.7	Major occupation of the working labor force in Eastern Province and Zambia, 1980	15
Table 2.8	Marketed production of major crops in Eastern Province, Zambia, 1978-86	16
Table 2.9	Share of Eastern Province in Zambia's marketed production, 1980-88	17
Table 2.10	Reserves and location of mining in Eastern Province, Zambia	18
Table 3.1	Economic indicators in Zambia, by sector, 1975-85	22
Table 3.2	Annual rates of growth of physical output, area, and yield in Zambia, selected periods, 1975-85	24
Table 3.3	Proportion of total crop area devoted to selected crops in Zambia, by province, 1975-85	27

Table 3.4	Guaranteed producer price index for selected import-substitute and export crops, Zambia, 1975-86	35
Table 3.5	Nominal protection coefficient of government producer prices and border prices in Zambia, by crop, 1975-85	36
Table 3.6	Budgetary expenses in nominal terms, Zambia, 1979-86	40
Table 3.7	Budgetary expenses in real terms, Zambia, 1979-86	41
Table 3.8	Loans disbursed for short-term production and long-term development in Zambia, by end use, 1980-85	44
Table 3.9	Number of farm units in Zambia, by type of farm and province, 1980	45
Table 3.10	Disbursement of loans to farmers in Zambia, by province, 1979-84	46
Table 3.11	Commercial bank advances and implicit credit subsidies transferred to the agricultural sector of Zambia, 1980-85	47
Table 3.12	Nominal and effective exchange rates, implicit export tax and tariff rates, and overall trade bias in Zambia, 1975-85	50
Table 3.13	Budget allocations to programs in the agricultural sector, Zambia, 1981-86	54
Table 3.14	Financial operations of the central government of Zambia, 1980-87	56
Table 3.15	Expenditures in nominal terms and ratio of personnel emoluments to recurrent departmental charges and of recurrent to capital expenditures, Zambia, 1979-86	58
Table 3.16	Expenditures in real terms and ratio of personnel emoluments to recurrent departmental charges and of recurrent to capital expenses, Zambia, 1979-86	59
Table 4.1	Contribution of the agricultural sector to the gross domestic product, Zambia, 1972-86	74
Table 4.2	Employment in the agricultural sector and the formal sector, Zambia, 1974-86	75

Table 4.3	Producer price of maize, Zambia, 1971-86	76
Table 4.4	Area cultivated with maize, Zambia, 1974-86	77
Table 4.5	Marketed production of maize in Zambia, by province, 1970-83	78
Table 4.6	Storage facilities of the National Agricultural Marketing Board, Zambia, by type of shed and province, December 1986	85
Table 5.1	Commercial banks in Zambia, by founding date and geographic distribution, 1988	95
Table 5.2	Sectoral financial institutions in Zambia, by sector	96
Table 5.3	Commercial bank loans to the agricultural sector of Zambia, 1961-85	97
Table 5.4	Nonbank financial institutions funding rural and agricultural development in Zambia, by date established and abolished, 1967-87	100
Table 5.5	Number and amount of agricultural loans requested and approved in Zambia, 1979-84	104
Table 5.6	Number and amount of agricultural loans requested and approved in Eastern Province, Zambia, 1979-84	105
Table 5.7	Amount of agricultural loans approved in Zambia, by type of term, 1979-84	107
Table 5.8	Number of agricultural loans approved in Zambia, by type of term, 1979-84	108
Table 5.9	Number of agricultural loans approved in Zambia, by end use, 1979-84	109
Table 5.10	Amount of agricultural loans approved in Eastern Province, Zambia, by type of term, 1979-84	110
Table 5.11	Number of agricultural loans approved in Eastern Province, Zambia, by type of term, 1979-84	111
Table 5.12	Number of agricultural loans approved in Eastern Province, Zambia, by end use, 1979-84	112
Table 5.13	Geographic location of farmers receiving agricultural credit in Eastern Province, Zambia, by bank, 1988	113

Table 5.14	Participation and recovery of funds in the Cooperative Credit Scheme in Eastern Province, Zambia, 1975-86	115
Table 5.15	Participation in and funds disbursed by the Cotton Credit Scheme in Eastern Province, Zambia, 1985-88	117
Table 5.16	Participation in and funds disbursed by the Soybeans Credit Scheme in Eastern Province, Zambia, 1985-88	118
Table 5.17	Funds disbursed and recovered by the Cotton Credit Scheme in Eastern Province, Zambia, 1985-87	119
Table 5.18	Funds disbursed and recovered by the Soybeans Credit Scheme in Eastern Province, Zambia, 1985-87	120
Table 5.19	Funds disbursed and recovered by the Agricultural Finance Company in Eastern Province, Zambia, 1970-81	122
Table 6.1	Patterns of acquiring the first four plots of land, Eastern Province, Zambia, 1989	131
Table 6.2	Original owner of plots bought or inherited, Eastern Province, Zambia, 1989	131
Table 6.3	Ethnic groups in Eastern Province, Zambia, by descent system	132
Table 7.1	Allocation of public responsibilities in Zambia, by institution	140
Table 7.2	Source of funding for selected projects in Eastern Province, Zambia	144
Table 8.1	Structure of services in Eastern Province, Zambia	159
Table 8.2	Number of establishments and persons employed in businesses and service institutions in Eastern Province, Zambia, by district	162
Table 8.3	Density of employment in businesses and service institutions in Eastern Province, Zambia, by district	163

Table 8.4	Time period in which businesses and service institutions were established in Eastern Province, Zambia, 1961-86	165
Table 8.5	Number of persons employed by businesses and service institutions in Eastern Province, Zambia, 1961-86	166
Table 8.6	Proportion of stocks picked up by shopkeepers or delivered by suppliers in Eastern Province, Zambia, by district	167
Table 8.7	Source of goods supplied to businesses in Eastern Province, Zambia	168
Table 8.8	Major source of goods supplied to businesses in Eastern Province, Zambia, by district	170
Table 9.1	Characteristics of agroecological zones in Eastern Province, Zambia	175
Table 9.2	Proportion of farmers adopting improved practices in Eastern Province, Zambia, by region and zone	177
Table 9.3	Fertilizer use in the plateau region of Eastern Province, Zambia, by zone	178
Table 9.4	Rates of application of fertilizers in Eastern Province, Zambia, by zone	180
Table 9.5	Mean yield of hybrid and local maize in the plateau region of Eastern Province, Zambia, 1982-87	182
Table 9.6	Area planted with maize in the plateau region of Eastern Province, Zambia, by zone	182
Table 9.7	Use and ownership of oxen in the plateau region of Eastern Province, Zambia, by zone	184
Table 9.8	Size of farms and adoption of technology in the plateau zone of Eastern Province, Zambia	186
Table 9.9	Simultaneity of adoption: Contingency table	188
Table 9.10	Variables included in the analysis of the determinants of adoption	190
Table 9.11	Probit maximum likelihood estimates of instrumental variables	191
Table 9.12	Probit maximum likelihood estimates of the adoption of fertilizer, hybrid maize, cultivation with oxen, and new crops	192

Table 9.13 Significant variables determining the adoption of technology in Eastern Province, Zambia 194

Table 10.1 Average enterprise budgets for local maize, hybrid maize, and groundnuts in Eastern Province, Zambia 203
Table 10.2 Average budget and returns to land and labor of enterprises in Eastern Province, Zambia 205
Table 10.3 Marginal productivity of labor, oxen, and fertilizer in Eastern Province, Zambia 209

Table 11.1 Average area cultivated and per capita labor of households in Eastern Province, Zambia, by technology package used 216
Table 11.2 Cultivation method and cropping technology adopted in Eastern Province, Zambia, by family composition 218
Table 11.3 Average annual hours worked per household by family laborers in Eastern Province, Zambia, by technology package adopted and activity 219
Table 11.4 Average annual hours worked per capita by family laborers in Eastern Province, Zambia, by technology package adopted and activity 221
Table 11.5 Average annual hours worked per capita by hired and exchange laborers in Eastern Province, Zambia, by technology package adopted and activity 223
Table 11.6 Allocation of activities to household and other laborers in Eastern Province, Zambia, by technology package adopted 225
Table 11.7 Allocation of household and other labor to activities in Eastern Province, Zambia, by technology package adopted 228
Table 11.8 Determinants of hours that males work per capita in households of Eastern Province, Zambia, by technology package adopted and activity 237

Table 11.9 Determinants of hours that females work per capita in households of Eastern Province, Zambia, by technology package adopted and activity 239
Table 11.10 Determinants of household use of hired and exchange labor in Eastern Province, Zambia 241

Table 12.1 Seasonal prevalence of undernutrition in children and adults in Eastern Province, Zambia, 1986 250
Table 12.2 Nutritional status of children under 10 in Eastern Province, Zambia, by ecological zone, level of adoption of hybrid maize, and month, 1986 251
Table 12.3 Nutritional status of children (January-February, 1986) in Eastern Province, Zambia, by gender of the head of household and hybrid maize adoption 254
Table 12.4 Daily per capita consumption of nutrients in high- and low-adoption areas of the plateau, Eastern Province, Zambia, by farm size, 1986 256
Table 12.5 Daily per capita consumption of nutrients in high- and low-adoption areas of the plateau, Eastern Province, Zambia, by season, 1986 258
Table 12.6 Food diversity in Eastern Province, Zambia, by month and regional level of technology adoption 260
Table 12.7 Average monthly number of episodes and duration of illness in Eastern Province, Zambia, by ecological region, hybrid maize adoption at area and household level, and age of individuals 262
Table 12.8 Source of water for drinking and sanitation in the plateau region of Eastern Province, Zambia, by use of hybrid maize 264

Table 13.1 Consumer expenditure behavior of sample households in Eastern Province, Zambia 270
Table 13.2 Average budget share for sample households in Eastern Province, Zambia, by quintile based upon per capita expenditure 272

Table 13.3 Marginal budget share for sample households in Eastern Province, Zambia, by quintile based upon per capita expenditure 273
Table 13.4 Regression results for determinants of the food share of total consumption expenditure of sample households in Eastern Province, Zambia 274
Table 13.5 Regression coefficients for determinants of the food share of total consumption expenditure of sample households in Eastern Province, Zambia, by type of food 276
Table 13.6 Regression coefficients for determinants of the food share of total consumption expenditure of sample households in Eastern Province, Zambia, by source of food 278
Table 13.7 Regression results for determinants of the cash purchase share of total consumption expenditure of sample households in Eastern Province, Zambia, by type of good 280
Table 13.8 Mean annual gross revenue of households in Eastern Province, Zambia, by locale and type of activity 285
Table 13.9 Mean share of annual gross revenue of households in Eastern Province, Zambia, by locale and type of activity 286
Table 13.10 Mean gross revenues generated per labor hour in Eastern Province, Zambia, by locale 288
Table 13.11 Regression results for the determinants of revenue generated per hour of crop-related activities of sample households in Eastern Province, Zambia 289
Table 13.12 Regression results for the determinants of revenue generated per hour of livestock-related activities (excluding cultivation using oxen) of sample households in Eastern Province, Zambia 291
Table 13.13 Regression results for the determinants of revenue generated per hour of wage employment of sample households in Eastern Province, Zambia 293

Table 13.14 Mean annual per capita consumer expenditure for food and nonfood items in Eastern Province, Zambia, by locale 299
Table 13.15 Mean share of annual per capita consumer expenditure for food and nonfood items in Eastern Province, Zambia, by locale 299
Table 13.16 Mean annual per capita consumer expenditure in Eastern Province, Zambia, by type and locale 300
Table 13.17 Mean share of annual per capita consumer expenditure in Eastern Province, Zambia, by type and locale 301
Table 13.18 Mean annual per capita consumer expenditure in Eastern Province, Zambia, by item and locale 302
Table 13.19 Mean share of annual per capita consumer expenditure in Eastern Province, Zambia, by item and locale 304

Table 14.1 Results of test for homogeneity of variances 315
Table 14.2 Reported distances by road compared with actual 316
Table 14.3 Pattern of service use in Eastern Province, Zambia, by type of service and mode of transportation 318
Table 14.4 Pattern of service use in Eastern Province, Zambia, by region and type of service 324
Table 14.5 Per capita consumer purchases in Eastern Province, Zambia, by type of service and region, 1985/86 325
Table 14.6 Pattern of service use in Eastern Province, Zambia, by farm size, 1985/86 326
Table 14.7 Per capita consumer purchases in Eastern Province, Zambia, by type of service and farm size, 1985/86 327
Table 14.8 Description of independent variables used in consumer purchase share regressions 329
Table 14.9 Average and marginal shares and elasticity of consumer purchases in Eastern Province, Zambia 330
Table 14.10 Regression coefficients for consumer purchase share equations in Eastern Province, Zambia, by type of service 331

Table 14.11 Elasticity and marginal consumer purchases with respect to distance in Eastern Province, Zambia 334
Table 14.12 Description of variables used in regressions for inputs and output in Eastern Province, Zambia 335
Table 14.13 Regression coefficients for purchases of inputs, rental of agricultural implements, and demand for loans equations in Eastern Province, Zambia 336
Table 14.14 Regression coefficients for output equation, Eastern Province, Zambia 338
Table 14.15 Elasticity and marginal factor purchases of services with respect to distance, Eastern Province, Zambia 339

Table 15.1 Regression results for the probability that a farmer will become a contact farmer 351
Table 15.2 Simulation results for the probability that a farmer will become a contact farmer in Kasendeka Branch (Lundazi Agricultural District) 352
Table 15.3 Regression results for the probability that a noncontact farmer will become aware in a timely fashion that a group of contact farmers is forming 354
Table 15.4 Simulation results for the probability that a noncontact farmer will become aware in a timely fashion that a group of contact farmers is forming in Kasendeka Branch (Lundazi Agricultural District) 355
Table 15.5 Regression results for the probability that a noncontact farmer will receive information on improved agricultural practices from any source 357
Table 15.6 Regression results for the probability that a noncontact farmer will have a contact farmer or a radio as the main source of information on improved agricultural practices 358

Table 15.7 Statistically significant regression results for the probability that a noncontact farmer will receive specific advice on agricultural operations, by source 362
Table 15.8 Regression results for the probability that a noncontact farmer will receive specific advice on agricultural operations 365
Table 15.9 Regression results for the probability that a noncontact farmer will consider an extension worker or contact farmer to be the best source of additional information on improved agricultural practices 368
Table 15.10 Regression results for the probability that a noncontact farmer will consider a source other than an extension worker, contact farmer, noncontact farmer, or village leader to be the best source of additional information on improved agricultural practices 369
Table 15.11 Regression results for the probability that a contact farmer will consider the recommendations of the last contact farmer meeting attended to be relevant to his or her type of farming 371
Table 15.12 Regression results for the probability that a contact farmer will be asked for advice by a noncontact farmer 372
Table 15.13 Regression results for the probability that a contact farmer will brief noncontact farmers about recommendations discussed at the last contact farmer meeting attended 373
Table 15.14 Regression results for the probability that a noncontact farmer with an opinion will consider a switch to training and visit to be an improvement 375
Table 15.15 Regression results for the probability that a contact farmer will adopt any recommendation discussed at a contact farmer meeting 377

Table 15.16 Regression results for the probability that a noncontact farmer with an opinion will think membership in a contact farmer group enhances the quantity or quality of crop production 380

Figures

Figure 2.1 Republic of Zambia, Eastern Province, survey locations 8

Figure 4.1 Prices indexes, Zambia, 1970-82 64
Figure 4.2 Purchasing power of primary commodity exports compared with manufactured imports, developing countries, 1970-82 65
Figure 4.3 Balance of trade, Zambia, 1970-82 66
Figure 4.4 External debt as a percentage of the gross domestic product, Zambia, 1973-80 69
Figure 4.5 Outstanding external debt as a percentage of the total value of exports, Zambia, 1970-82 70
Figure 4.6 Ratio of international reserves to disbursed debt, Zambia, 1970-82 71

Figure 11.1 Average monthly hours that male family laborers work in cropping activities in Eastern Province, Zambia, by type of cropping technology 230
Figure 11.2 Average monthly hours that female family laborers work in cropping activities in Eastern Province, Zambia, by type of cropping technology 231
Figure 11.3 Average monthly hours that male family laborers work in Eastern Province, Zambia, by type of cropping technology 232
Figure 11.4 Average monthly hours that female family laborers work in Eastern Province, Zambia, by type of cropping technology 233

Figure 11.5 Average monthly use of hired labor in households of Eastern Province, Zambia, by type of cropping technology 234
Figure 11.6 Average monthly use of exchange labor in households of Eastern Province, Zambia, by type of cropping technology 235

Figure 14.1 Average distance traveled to use services in Eastern Province, Zambia 319
Figure 14.2 Number of visits per household to use services in Eastern Province, Zambia 320
Figure 14.3 Average distance traveled per visit to use services in Eastern Province, Zambia, by agricultural branch 321
Figure 14.4 Number of visits per household to use services in Eastern Province, Zambia, by agricultural branch 322

Foreword

One of the major objectives of research conducted at the International Food Policy Research Institute is to determine the extent to which policies stimulate or constrain technological change in agriculture and their impact on the production and consumption patterns of low-income people in the Third World. A majority of the population in the Third World lives in rural areas where per capita productivity is the lowest in the economy and where agriculture and agriculture-related activities constitute the principal means of livelihood for that population. Thus, the linkages between agricultural and nonagricultural activities determine to a considerable extent the effectiveness of Third World policies for economic development.

The papers presented in this edited volume contribute to a better understanding of the nature and direction of these linkages. The focus is primarily, but not inclusively, on growth and equity in Zambian smallholder agriculture in the context of the increasing agricultural productivity resulting from technological change. The analysis centers on capacity of the regional and local economies to translate rapid agricultural growth into sustainable development and on the participation of the poor in that development.

In conducting this exercise, IFPRI has been privileged to collaborate with the Eastern Province Agricultural Development Project and the National Food and Nutrition Commission (both of the government of the Republic of Zambia) and with the Rural Development Studies Bureau of the University of Zambia. IFPRI is particularly grateful to Nicholas Mumba, then the permanent secretary of Eastern Province, to Alex Vamoer, executive director of the National Food and Nutrition Commission, and to Jacob Mwanza, then the vice-chancellor of the University of Zambia, for supporting this collaborative effort.

The research effort was funded by the Swiss Development Cooperation (SDC) of the Government of Switzerland. IFPRI is grateful to SDC for their generous support.

Just Faaland
Director General

Acknowledgments

We wish to express our deep gratitude to the Zambian government for the warm reception and encouragement that were and continue to be given to this research project. We thank the Right Honorable Kebby Musokotwane, who was prime minister in 1988, for noting the significance of this project as he declared the Livingstone workshop-cum-seminar open in December and the Honorable Rubben Kamanga, Member of the Central Committee and Chairman of the Rural Development Sub-Committee of the Central Committee of the United National Independence Party, for expressing his support of this research project. Rubben Kamanga gave his time and encouragement to the project without hesitation, and the project researchers are grateful to him.

We would like to thank Nicholas Mumba for his guidance both as the then-permanent secretary of Eastern Province and as the current permanent secretary of the Ministry of Agriculture. Our thanks are also due to the Department of Planning of the Ministry of Agriculture as well as to the Zambia National Commercial Bank, which participated, and continues to participate, in the deliberations of this project.

The four principal institutions involved in this project are the International Food Policy Research Institute, the Rural Development Studies Bureau of the University of Zambia, the National Food and Nutrition Commission, and the Eastern Province Agricultural Development Project.

This study would not have been completed without the devoted work of the individuals who collected and tabulated data in the field. We would particularly like to mention our gratitude to the late Emmanuel W. C. Shula, who spent two years in the field conducting, coordinating, and supervising the surveys and then oversaw the entry and tabulation of the data collected.

Together with Emmanuel Shula, the late Katongo Katongo was responsible for useful contributions to the understanding of the macro institutional environment within which the Eastern Province Study was eventually based. In some respects, this volume is a small tribute to their association with the study.

The editors of this volume are grateful to the 330 respondents who provided the primary data on which the majority of papers in this book are based, to the 20 enumerators who regularly collected data for the 13 monthly surveys and the opening and closing inventories, to the driver who transported the enumerators and researchers, and to the three data entry operators. They all contributed to the successful completion of this project.

This research project was made possible by a generous grant from the Swiss Development Cooperation, Government of Switzerland. We are grateful to them for their sustained interest in this work.

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1
Introduction

Rafael Celis and John T. Milimo

In late 1985, the International Food Policy Research Institute in collaboration with the Rural Development Studies Bureau of the University of Zambia, the National Food and Nutrition Commission, and the Eastern Province Agricultural Development Project embarked on a major research project in Eastern Province, Zambia. The study sought to obtain a better understanding of the public policies that govern the country's push to increase agricultural production and improve the participation of smallholder farmers in it. In particular, the study aimed to assess the impact that agricultural technology has on productivity, use and distribution of land, agricultural and rural employment both on and off farms, level and distribution of income, and nutritional status and welfare of the rural population. It also aimed to help the participating institutions improve their own research capabilities. This document presents the results of that project, which was the first major effort to collect primary data in Zambia.

RESEARCH METHODOLOGY

Eastern Province is one of the most developed agricultural regions of Zambia. The bulk of the fieldwork was carried out between November 1985 and December 1986. Additional surveys were conducted during the first half of 1987, and a land tenure survey was conducted in early 1989.

The basic research instrument was the field questionnaire. Separate questionnaires were designed for each major aspect of the study and administered to 330 respondents in 10 randomly selected locations. Information was collected on the production, employment, income, and expenditure characteristics of the households during a period of 12 months. Secondary data were also consulted on the physical, socioeconomic, and policy environment that affects the sample households.

SAMPLE FRAME

A sample of 330 households was drawn using sampling that was stratified, clustered, systematic, and ordered. Within each of nine agricultural districts, an administrative unit called a branch was chosen randomly; within each branch, households were listed, ordered, and systematically chosen according to four sampling variables: status of the farmer, use of hybrid maize seed, use of oxen, and gender of the head of household.[1] The four variables chosen covered the extension, technological, and cultural issues that are important in Eastern Province.

RESEARCH PERSONNEL AND INSTITUTIONS

The study was a collaborative venture between four institutions. The International Food Policy Research Institute conceived the project, procured funding from the Swiss government, and designed most of the questionnaires. The institute had already been involved in a similar but smaller collaborative research project with the National Food and Nutrition Commission and the Rural Development Studies Bureau during the early 1980s. The National Food and Nutrition Commission is a public institution operating under the Ministry of Health and charged with all aspects of nutritional issues in the country. Since 1972, the Rural Development Studies Bureau, a unit of the University of Zambia, has been conducting applied research on rural development in the country. Its clients and sponsors include government ministries, parastatals, bilateral aid agencies, and private companies. The Eastern Province Agricultural Development Project was sponsored by the World Bank and operated in Eastern Province between 1981 and 1988.

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[1] A branch covers a cluster of roughly 10 villages, each with approximately 25 households. A second branch was randomly added for one district to improve the coverage of the four key variables. The branches are Mphata (Mambwe Agricultural District), Nkhoka (Chama Agricultural District), Choweya (Lundazi Agricultural District), Kasendeka (Lundazi Agricultural District), Mtenthela (Chipata North Agricultural District), Makangila (Chipata South Agricultural District), Chipili (Chadiza Agricultural District), Sinda (Katete Agricultural District), Chiwizi (Petauke Agricultural District), and Kamwala (Nyimba Agricultural District).

One of its major activities was to promote the recently introduced training and visit system of agricultural extension.

The Rural Development Studies Bureau assigned one research fellow to work on the project full-time. He coordinated the project, supervised the enumerators and data entry operators, and lived in Chipata, the headquarters of Eastern Province, during the course of the fieldwork, which extended from November 1985 to July 1987. Research personnel from each of the three institutions regularly supervised their portions of the study in the field. The Eastern Province Agricultural Development Project, which was based in Chipata, provided office space for the project and played an integral part in the research itself. The research team was multidisciplinary, consisting of agricultural and other economists, nutritionists, a public administration specialist, geographers, and a social anthropologist.

The project hired 20 enumerators, 10 by the three institutions and 10 by the Eastern Province Agricultural Development Project. These individuals were located in the 10 research locations between November 1985 and December 1986, after which they moved to Chipata, where they completed the data entry.

In September 1987, soon after the field data were collected, the preliminary findings were discussed at a workshop held at Mfuwe Lodge in the South Luangwa National Park. More refined and detailed results were presented at a workshop held at Livingstone in late 1988. Both workshops were attended by government officials from Eastern Province as well as from Lusaka. A final, smaller workshop convened senior government policymakers and project researchers in Lusaka in November 1989 to present and discuss the policy implications, recommendations, and final research findings of the study. The papers presented at these workshops form the contents of this volume.

ORGANIZATION OF THE BOOK

This book is divided into four parts: the first describes and discusses the physical, institutional, and policy environment of Eastern Province; the second analyzes the determinants and effects of adoption of agricultural technologies; the third looks at issues of access to agricultural infrastructure; and the fourth brings the main findings together in a concluding chapter. The first part starts with an introductory chapter on the study area and its physical features, peoples, and major economic activities. The papers that follow analyze Zambia's national agricultural policies and their impact on smallholder

agricultural development, policy constraints and contradictions, and policies on pricing, marketing, subsidies, agricultural extension, credit, exchange rates, trade, and land tenure. The performance and effectiveness of the strategies related to these policies, especially those governing credit and land tenure, are also examined. This part ends with a chapter describing the public and private institutions operating in the province.

Following these papers, which form a background to the main analysis, the second and third parts present papers that discuss the results of the analyses of the primary data. The second part begins with a chapter on the adoption of agricultural technology, which is defined as inorganic fertilizers, hybrid maize seed, and animal draft power. These technologies affect a whole range of agricultural and nonagricultural activities and indicators, such as the use of land, inputs, and labor, agricultural productivity, allocation of labor, patterns of household income and expenditures, and nutritional status. The third part examines the patterns of access to a variety of service systems, including the training and visit system of agricultural extension.

The fourth part contains a concluding chapter that summarizes the results, policy implications, and policy recommendations presented in the previous chapters, and looks at possible future areas of research.

Part I
The Physical, Institutional, and Policy Environment

2
The Eastern Province of Zambia

John T. Milimo

Zambia's Eastern Province lies between longitudes 30°25′ and 34°00′ east and latitudes 10°30′ and 15°00′ south. It is bordered by the Republic of Malawi on the east and Mozambique on the south; the Luangwa River separates it from the rest of Zambia on the western and northwestern side. It encompasses 69,106 square kilometers of land (see Figure 2.1).

PHYSIOGRAPHY AND SOIL

The province has two distinct physiographic regions; the plateau, with an elevation of 900 to 1,500 meters, and the Luangwa Valley, with an elevation of 400 to 600 meters. The valley contains a mixture of alluvial soils that are medium in texture and suitable for crops such as rice, cotton, and drought-resistant sorghum and millet. The plateau soils are "well to moderately well-drained, of light to medium acidity, and with moderate natural fertility" (Fourth National Development Plan 1989, 619). These soils are generally suitable for maize, groundnuts, cotton, sunflower, tobacco, and soybeans. Between the plateau and the valley lies an escarpment with little human habitation. Annual rainfall ranges from 850 to 1,050 millimeters.

ADMINISTRATION

Chipata, the provincial headquarters, is situated some 25 kilometers from the Zambia-Malawi border. The province is divided into six administrative districts: Chadiza, Chama, Chipata, Katete, Lundazi, and Petauke. Each district is administered by a District Council, which is chaired by a district governor and served by an executive secretary. Like all provinces, Eastern Province is headed by a member of the ruling political party's Central Committee. That person is assisted by a provincial political secretary for political affairs and by a permanent secretary for administrative affairs.

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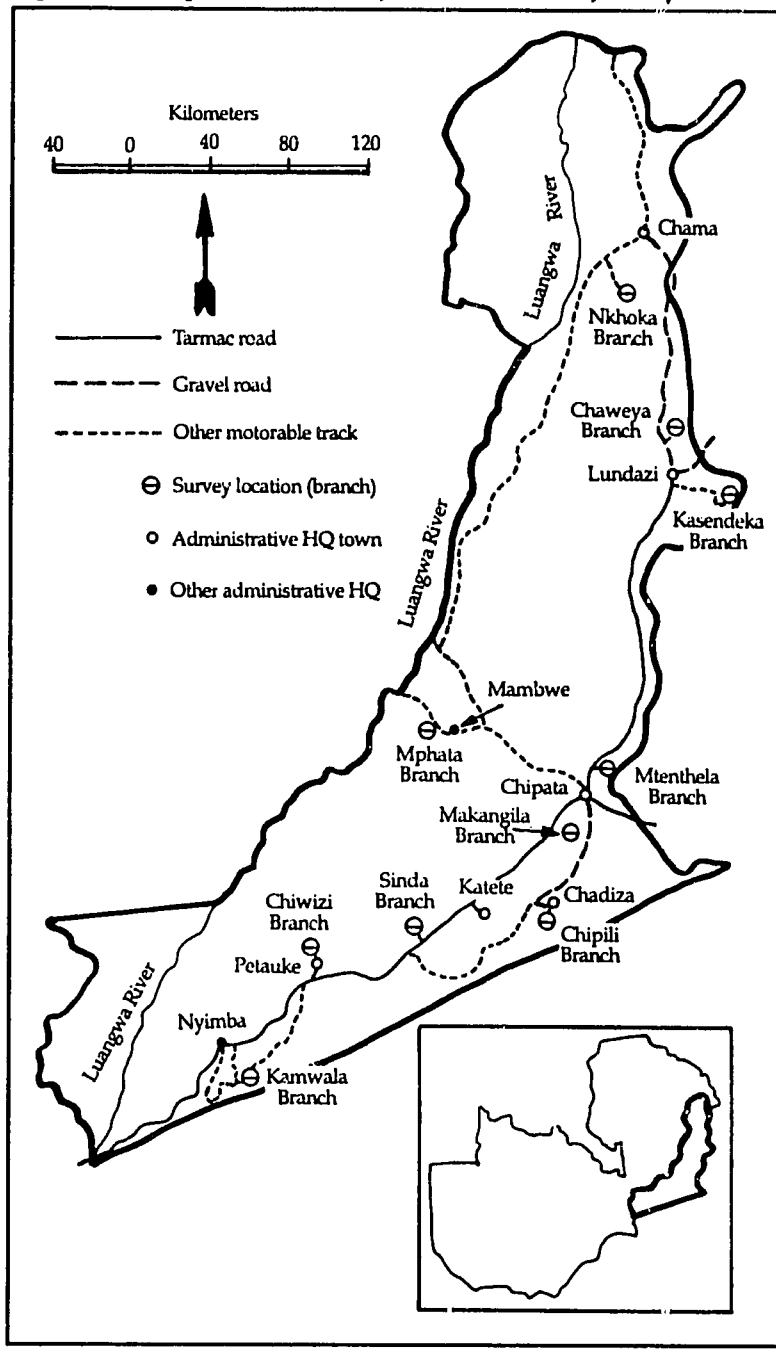
Figure 2.1—Republic of Zambia, Eastern Province, survey locations



POPULATION

According to the 1980 census of population the province held 650,902 persons, or 12 percent of Zambia's total population. Its population density, 9.4 persons per square kilometer, was higher than the nation's, 7.5 persons, but its growth rate was much lower (2 and 3 percent, respectively). Although population density is high, the province is largely rural; in 1980, only 10 percent of its population lived in urban areas compared with 40 percent of the nation's (see Tables 2.1 and 2.2).

Table 2.1—Population of towns in Eastern Province, Zambia, by gender, 1980

Town	Male	Female	Total
Chadiza	1,192	1,128	2,320
Chama	1,985	1,037	3,022
Chipata	16,180	16,110	32,291
Kacholola	1,018	1,153	2,171
Katete	3,169	3,335	6,504
Lundazi	2,044	2,039	4,083
Nyimba	720	701	1,421
Petauke	3,672	3,859	7,531
Total[a]	29,980	29,363	59,343

Source: Zambia, Central Statistical Office, *1980 census of population and housing, preliminary report* (Lusaka, Zambia: Government Printer, 1981), 12.

Note: Data on some towns, such as Sinda, were unavailable, so the total differs from that of the province's urban population of 63,100 persons.

Table 2.2—Area, population, and population density of districts in Eastern Province, Zambia, by gender, 1980

District	Area[a]	Population			Persons per Square Kilometer
		Male	Female	Total	
Chadiza	2,574	21,303	23,576	44,879	17.4
Chama	17,630	15,792	19,567	35,359	2.0
Chipata	11,986	97,435	107,303	204,738	17.1
Katete	3,989	44,236	49,972	94,208	23.6
Lundazi	14,241	53,114	61,539	114,653	8.2
Petauke	18,686	72,263	84,802	157,065	9.3
Total	69,106	304,143	346,759	650,902	9.4

Source: Compiled from information contained in Zambia, Central Statistical Office, *1980 census of population and housing*, vol. 1 (Lusaka, Zambia: Government Printer, 1985), 1, 5.

[a] Square kilometers.

In Eastern Province and Zambia as a whole, females outnumber males. For every 100 females, the province has 88 males and Zambia has 91. Within urban areas, however, the reverse is true, and males slightly outnumber females. In small towns of Eastern Province, 50.5 percent of the population is male, while 49.5 percent is female, and in urban areas of Zambia, the respective figures are 50.7 and 49.3 percent (Zambia, Central Statistical Office 1985a, 1:1). This suggests that men tend to migrate from rural to urban areas both within Eastern Province and within Zambia as a whole. They also migrate from Eastern Province to urban areas of other provinces with the country.

Corresponding to the low ratio of males to females, 38 percent of all households in the province are headed by women, the highest incidence in the country (Zambia, Central Statistical Office 1985a, 1:285). The national figure is only 28 percent. In rural areas of Eastern Province, the percentage of female-headed households is even higher: 39 percent (Zambia, Central Statistical Office 1985a, 1:286).

The average household is smaller in the province than in the

nation: 4.3 persons compared with 5.0 (Zambia, Central Statistical Office 1985a, 1:285). Nevertheless, the sample population represented in this study has even larger households than the national average: 6.0 persons. The province has the lowest life expectancy in the country. In 1980, males were expected to live 44.3 years and females, 45.5 years. The corresponding national figures are considerably higher: 50.4 years for males and 52.5 years for females (Zambia, Central Statistical Office 1980; 1985b, 57).

The population density in the plateau districts of Chadiza, Katete, and Chipata is higher than that in the valley and escarpment regions of Chama and parts of Lundazi and Petauke districts (Table 2.2). Population densities tend to be high in areas that have relatively well-developed socioeconomic infrastructure, especially roads. In Eastern Province, the infrastructure is better developed on the plateau than in the valley. As much as 25 percent of the province's total population lives within 7.5 kilometers of the main roads that connect Lusaka to Chipata, Chipata to Lundazi, and Chipata to the border with Malawi.

TRANSPORTATION

Eastern Province has 1,876 kilometers of roads, the longest of which is the Great East Road linking the province to Lusaka. Classified as a grade 1 tarmac road, it begins in Chipata and continues to Mwami at the Zambia-Malawi border post. Chipata is also linked to Lundazi, a district headquarters, by a tarmac road that needs much repair.

Most other roads are made of gravel and are unclassified. One connects Chipata to Chadiza; another links Chipata to Lundazi and Chama and then joins the Great North Road near Isoka in Northern Province; and yet another links Chipata to South Luangwa National Park via Mambwe.

EDUCATION

Eastern Province has one of the lowest educational levels in Zambia, and women in the province have less education than men (see Tables 2.3 and 2.4). Although the average female head of household in Zambia is better educated than her counterpart in Eastern Province, she remains less educated than men, either in the province or in the nation as a whole. Male heads of household in the province have more education than female heads of household overall. Moreover, many

Table 2.3—Educational status in Eastern Province and Zambia, 1980

Educational Status	Eastern Province	Zambia
	(percent)	
None	54.1	37.5
Primary education (1-7 years)	43.7	42.7
Secondary education	6.6	16.3
College or university	0.1	0.3
Not indicated	3.9	3.2
Total	100.0	100.0

Source: Compiled from information contained in Zambia, Central Statistical Office, *1980 census of population and housing*, vol. 2 (Lusaka, Zambia: Government Printer, 1985), 246, 255.

Table 2.4—Educational status of heads of household in Eastern Province and Zambia, by gender, 1980

Educational Status	Eastern Province		Zambia,
	Females	Males	Females
		(percent)	
None	70.0	45.4	58.8
Primary education (1-7 years)	22.5	42.1	30.9
Secondary education	2.4	9.2	6.4
College or university	0.0	0.1	0.1
Not indicated	5.1	3.2	3.8
Total	100.0	100.0	100.0

Source: Computed from information contained in Zambia, Central Statistical Office, *1980 census of population and housing, major findings and conclusions*, vol. 2 (Lusaka, Zambia: Government Printer, 1985b), 246, 255.

women in the province have no education at all; almost three out of four have not attended school, compared with slightly more than two out of four in the nation.

HEALTH

The province has 10 hospitals (2 general and 8 district), 84 health centers (81 in rural areas and 3 in towns), 1 leprosarium, and 16 mobile health clinics. The province has 1 trained nurse for every 1,200 persons and 1 doctor for every 21,070 persons (Fourth National Development Plan 1989, 627). The health services emphasize primary health care. By 1988, nearly 440 community health workers had been trained to help run the primary health care program. According to the 1990 census, the province has 1 community health worker for every to 1,925 persons. In addition, 331 registered traditional healers treat ailments as they have been doing for generations. Their efforts supplement those of the modern health sector.

A major problem that compounds health issues is the scarcity of safe and clean drinking water. The Fourth National Development Plan reported that "more than 50 percent of rural population have no access to safe and clean water" (Fourth National Development Plan 1989, 625). In Chadiza District, this figure is a mere 17 percent of the population (see Table 2.5).

Table 2.5—Percentage of persons with access to safe drinking water in Eastern Province, Zambia, by district

District	Percentage
Chadiza	17.0
Chipata	63.0
Katete	44.0
Lundazi	30.0
Petauke	56.0

Source: Fourth National Development Plan, *The Fourth National Development Plan* (Lusaka, Zambia: Government Printer, 1989), 625.

ECONOMIC ACTIVITIES

According to the 1980 census, the province's labor force consists of 218,768 persons, 45 percent of whom are actually working. Persons categorized as unemployed include housewives, students, the sick, and the disabled. Since housewives are considered part of the inactive labor force, it is not surprising that 68 percent of the women in Eastern Province fall in this category.

The majority of men and women are self-employed (61 percent), while only slightly over one-quarter are formally employed (26 percent; see Table 2.6). One would, perhaps, have expected more women than men to be self-employed since women are more involved in small-scale economic enterprises than men (Milimo and Fisseha 1985, 52). This is not the case, however, since only 57 percent of women, compared with 63 percent of men, are self-employed. The difference between the expectation and the reality may have a statistical cause. The Central Statistical Office does not include housewives as part of the active labor force, while Milimo and Fisseha (1985) do if they are involved in a business. The largest occupational category by far, in both Eastern Province and Zambia as a whole, employs persons in agriculture, forestry, fishing, hunting, and production (74 and 41 percent, respectively; see Table 2.7). This is the only category in which Eastern Province employs a higher percentage of workers than the nation.

Table 2.6—Employment status in Eastern Province, Zambia, by gender, 1980

Employment Status	Male	Female	Total
		(percent)	
Employer	0.7	0.2	0.5
Employee	31.7	11.6	25.8
Self-employed	62.6	56.8	60.9
Not stated	5.0	31.4	12.8

Source: Compiled from information contained in Zambia, Central Statistical Office, *1980 census of population and housing*, vol. 2 (Lusaka, Zambia: Government Printer, 1985), 61, 70.

Table 2.7—Major occupation of the working labor force in Eastern Province and Zambia, 1980

Occupation	Eastern Province	Zambia
	(percent)	
Professionals, technicians, and related occupations	4.9	8.2
Administrators and managers	0.6	1.3
Clerical and related staff	1.7	4.5
Salespersons	2.3	8.3
Service workers	5.0	9.6
Workers in agriculture, forestry, fishing, hunting, and production	73.8	40.7
Transportation workers, equipment operators, and laborers	7.9	19.8
Unclassified workers	0.4	1.6
Unstated occupations	3.4	6.0
Total	100.0	100.0

Source: Compiled from information contained in Zambia, Central Statistical Office, *1980 census of population and housing*, vol. 2 (Lusaka, Zambia, 1985), 181, 190.

AGRICULTURE

Agriculture, forestry, and fishing involve almost three-quarters of the province's labor force. A total of 1.3 million hectares are under cultivation in the province, and this is only 35 percent of the total amount of arable land. Thus more than 2.5 million hectares of arable land are not in use.

The province's main agricultural products are maize, groundnuts, cottonseed, tobacco, sunflower seed, and livestock. Eastern Province is the largest producer of groundnuts, one of the three largest producers of maize, the staple cereal of Zambia, and the fourth largest producer of livestock in the country (see Table 2.8 for the production of major crops from 1978 to 1987). The province increased its production of maize, groundnuts, and cottonseed and contributed an impressive amount of the nation's production of pigs, sheep, goats, sunflower, and maize between 1978 and 1986 (see Table 2.9).

Table 2.8—Marketed production of major crops in Eastern Province, Zambia, 1978-86

Year	Maize	Groundnuts	Cottonseed
		(tons)	
1978	69,447	1,672	2,838
1979	46,563	2,241	3,432
1980	66,577	1,455	3,750
1981	106,581	912	1,855
1982	114,610	741	1,485
1983	143,857	940	2,625
1984	166,671	1,046	4,769
1985	176,775	6,194	n.a.
1986	224,339	8,178	n.a.

Source: Fourth National Development Plan, *The Fourth National Development Plan* (Lusaka, Zambia: Government Printer, 1989), 621 and following.

n.a. Not available.

INDUSTRY

Food processing constitutes one of the major industries in the province, which has two large milling plants owned by the Eastern Province Cooperative Union: E. C. Milling in Chipata processes maize, and the Oil Processing Plant at Katete processes groundnuts and sunflower. The Oil Processing Plant is supposed to produce all the cooking oil required by the province, but has never been able to do so because machines are constantly breaking down and the supply of oil seed, mainly sunflower, is inadequate to meet the demand for edible oils. Other privately owned hammer mills scattered throughout the province supplement the efforts of the Chipata-based E. C. Milling, which is unable to meet the demand for processed maize.

Table 2.9—Share of Eastern Province in Zambia's marketed production, 1980-88

Crop	Percentage
Maize	22.3
Cottonseed	14.3
Tobacco	10.9
Paddy rice	6.1
Sunflower	23.4
Cattle[a]	9.8
Sheep and goats[b]	31.0
Pigs[b]	61.5

Source: For crops, Fourth National Development Plan, *The Fourth National Development Plan* (Lusaka, Zambia: Government Printer, 1989), 569; and for livestock, Development Research Center of Zambia, *An assessment of the status of the livestock sector and its role in the development of Zambia's agriculture* (Lusaka, Zambia: DRC, 1988), 8, 14, 16.

[a] 1983-87.

[b] 1984-86.

Luangwa Industries Limited, the country's only bicycle manufacturing plant, is another fairly large economic venture. Other industries operate in the informal sector of the economy. Some plants produce farm implements, such as hoes, axes, plowshares, plows, wheelbarrows, and scotch carts. Other plants use the abundant, high-quality forest products to manufacture furniture, mats, and baskets. These plants operate on a small-scale basis and sell their products in provincial markets.

MINING

Although Zambia as a whole is well known for its mining industry, little mining takes place in Eastern Province. Only small quantities of minerals have been discovered there, and less than 1 percent of the labor force is devoted to mining. In Zambia as a whole, 6 percent of the work force is involved in mining, compared with 22 percent in Copperbelt Province, whose main industry is mining. Table 2.10 shows the types of minerals found in Eastern Province and the stage of mining operations reached.

Table 2.10—Reserves and location of mining in Eastern Province, Zambia

Type of Mineral	Location	District	Reserves	Comments
			(tons)	
Phosphate	Chilembwe	Petauke	1,600	Ready for mining
Agricultural lime	Hofmeyer	Petauke	50,000	Ready for mining
Graphite	Kaumba	Chama	4,000	Ready for mining
Aquamarine	Lundazi	Lundazi	n.a.	Mining in progress
Aquamarine	Msoro	Chipata	n.a.	Deposits known
Tourmaline	Nyimba	Petauke	n.a.	Mining in progress
Barite	Chasefu	Lundazi	400	None
Gold	Sasare	Petauke	11,780	None

Source: Fourth National Development Plan, *The Fourth National Development Plan* (Lusaka, Zambia: Government Printer, 1989), 170 and following.

TRADE

Agricultural products provide the bulk of goods traded within the province and between the provinces and the rest of the country. Most of the agricultural products marketed by Eastern Province are sold within the province itself. Surplus maize and groundnuts are sold to other provinces, and in 1989 maize was sold to Malawi.

Most of the business community is of Asian origin, and Asians dominate the trade in goods other than farm products. They own most of the shops in Chipata. The National Imports and Exports Company also has shops in Chipata and most of the district headquarters. It plans to open five more business premises in the province during the 1989-93 period of the National Development Plan.

TOURISM

Endowed with one of Africa's richest concentrations of wildlife, the province has a great potential to develop tourism. Although wildlife is found in the Luangwa Valley, which covers parts of Northern, Central, and Eastern provinces, the South Luangwa National Park can be reached mainly through Eastern Province, where a gravel road connects Chipata with the park headquarters at Mfuwe. Many tourists fly to Mfuwe from Lusaka's modern airport.

A number of tourist lodges, some privately owned and others belonging to a parastatal, operate in the park and together have more than 170 beds. The current development plan has earmarked the Chipata-Mfuwe road for tarmac surfacing, which should make the game park more accessible. The large-scale Luangwa Integrated Resource Development Project is seeking to involve the community in efforts to conserve wildlife. This project allows the local community to determine quotas for various types of animals that the Department of Wildlife decides to cull in a given year. Once fully operational, the project will make game meat available to the local population, thus curbing small-time poaching of game.

Apart from the South Luangwa National Park, Eastern Province has no other major tourist attractions. Hotel accommodations for ordinary travelers are often limited, and the few motels that exist in the provincial and some of the district headquarters are frequently occupied by permanent residents.

As can be seen from the description above, Eastern Province is agriculturally one of the more developed provinces of Zambia. It is

argued that for the realization of this potential, certain policy interventions will be necessary. It is one of the objectives of the analysis that is contained in the subsequent chapters to indicate the nature of these interventions and, further, to also indicate its policy implications for economic development of Eastern Province.

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3
Agricultural Policies in Zambia, 1975-85

Katongo Katongo

The analysis of agricultural policies in Zambia is mainly concerned with whether policies increase income, particularly among poor farming households, make basic foods more accessible, and generate foreign exchange. It examines whether policies establish a trade-off between agricultural exports and import substitutes and whether they maintain a balance between the production of crops for food and for cash. To address these concerns, policy analysts examine policies related to pricing, marketing, subsidies, credit, trade, exchange rates, land tenure, and research and extension. They also examine how public and private institutions market inputs and other factors, transform products, and deliver essential services to different types of producers and whether their approaches are successful.

This paper takes a qualitative, analytical approach rather than a rigorous quantitative approach to analyzing these issues. It does not examine in detail how various policies complement or conflict with one another nor their total impact. Nevertheless, it does address these issues in broad terms, using data compiled from secondary sources published by government and private agencies. Although the adequacy and accuracy of such data are limited, their usefulness is not.

PERFORMANCE OF THE AGRICULTURAL SECTOR

The agricultural sector performed poorly between 1975 and 1985. The production of agriculture, forestry, and fisheries remained stable, averaging 15 percent of the country's total gross domestic product. The large-scale commercial subsector contributed an average of 38 percent, while the subsistence subsector contributed 62 percent of the agricultural gross domestic product between 1975 and 1983. The rural labor force grew at an annual rate of 2 percent. The subsistence sector absorbed 97 percent of the labor force, while the commercial sector employed the remaining 3 percent (see Table 3.1). The subsistence sector not only contributed a large share of the agricultural gross domestic product, but employed much of the rural labor force.

The average amount of food produced annually increased 2 percent per capita between 1975 and 1985, while cereal imports rose from 93,000 metric tons in 1984 to 247,000 metric tons in 1985 (World

Table 3.1—Economic indicators in Zambia, by sector, 1975-85

Year	Agricultural GDP as a Percent of Total GDP[a]	Contribution		Labor Force		
		Commercial Sector	Subsistence Sector	Rural	Commercial Sector	Subsistence Sector
		(percent)		(number)	(percent)	
1975	12.9	35.9	64.1	942,400	3.8	96.2
1976	n.a.	n.a.	n.a.	957,800	3.3	96.7
1977	16.4	38.1	61.9	983,900	3.0	97.0
1978	16.1	37.1	62.9	1,003,500	3.0	97.0
1979	14.9	35.4	64.6	1,034,000	3.0	97.0
1980	14.2	36.9	63.1	1,049,000	3.0	97.0
1981	15.9	40.2	59.8	1,072,400	3.3	96.7
1982	13.7	37.6	62.4	1,087,700	3.1	96.9
1983	14.2	44.4	55.6	1,127,600	3.1	96.9
1984	14.5	n.a.	n.a.	n.a.	n.a.	n.a.
1985	14.5	n.a.	n.a.	n.a.	n.a.	n.a.
Average	14.7	38.2	61.8	n.a.	3.2	96.8

Source: Computed from various statistical bulletins of Zambia's Central Statistical Office; Cooperative Savings Scheme, Projections of labor force, 1969-84 (Lusaka, Zambia, 1976); and Zambia, Central Statistical Office, *Monthly digest of statistics* (Lusaka, Zambia, October/December 1982).

[a] GDP, gross domestic product.

n.a. Not available.

Bank 1987). This apparent contradiction between the increase in the average index of food production and the increase in imports of both commercial and noncommercial food may be the result of annual variations in agricultural production. For example, agricultural output was low in the base year period of 1975 due to a drought.

Table 3.2 presents the rate at which output, area, and yield grew for selected crops between 1975 and 1986. Based on data from annual statistical bulletins, this information shows the impact that various policy instruments have on efficiency, growth, and distribution and the changing composition of crops at the national and provincial level.

In output, area, and yield, beans were the dominant food crop between 1975 and 1980. Between 1981 and 1986, however, beans declined in all categories of growth except yield, which grew at a dramatic rate of 78 percent.

The expansion of area was the main source of growth in physical output, with the exception of wheat. The area devoted to beans, cotton, sorghum, soybeans, rice, and sunflower expanded the most. Only cotton and, to a lesser extent, sorghum and rice registered a positive growth in yield between 1975 and 1986. Except for wheat, the yield of food crops grew slowly or declined.

The output of nonfood crops grew faster than that of food crops, with the exception of beans and rice, which occupy a small proportion of the total cultivated area in all regions. Moreover, the yield of major import substitutes, such as sunflower, groundnuts, and soybeans, declined. This complicates efforts to determine an optimal or even an acceptable trade-off between allocating land to domestic food crops and to import-substitute and export crops. For both types of crops, however, output grew because the amount of area cultivated expanded, not because yield increased.

The pattern of agricultural growth shifted significantly over the years (see Table 3.3). As the amount of land allocated to maize decreased, the area allocated to groundnuts increased. The same relationship exists between maize and sunflower, particularly in Central, Southern, and Luapula provinces. In Southern Province, the amount of land allocated to sunflower and groundnuts increased dramatically, from about 4 percent each in 1979 to 11 and 13 percent, respectively, in 1980. This increase led to a substantial decline in the amount of land allocated to major food crops. Land allocated to maize declined from 75 to 69 percent, while land allocated to sorghum declined from 12 to 2 percent. In Eastern Province, land allocated to groundnuts also increased dramatically (from 9 to 23 percent), while

Table 3.2—Annual rates of growth of physical output, area, and yield in Zambia, selected periods, 1975-86

Indicator	1975-80	1981-86	1975-86
		(standard units)	
Physical output			
Food crops			
Beans	0.900	-0.220	0.340
Wheat	0.280	-0.370	0.010
Sorghum	0.240	0.003	0.190
Rice	0.220	0.120	0.180
Maize	0.110	-0.050	0.040
Groundnuts	0.440	-0.190	0.060
Nonfood crops			
Cotton	0.370	0.200	0.210
Sunflower	0.140	-0.090	0.100
Soybeans	0.090	0.080	0.190
Virginia tobacco	0.040[a]	0.040	...
		(hectares)	
Area			
Food crops			
Beans	1.260	-0.490	0.780
Wheat	0.280	-0.480	-0.070
Sorghum	0.340	-0.003	0.170
Rice	0.220	0.100	0.170
Maize	0.160	...	0.090
Groundnuts	0.420	-0.230	0.090
Nonfood crops			
Cotton	0.170	0.080	0.130
Sunflower	0.220	-0.090	0.110
Soybeans	0.120	0.140	0.220
Virginia tobacco	0.070[a]	-0.100	-0.020

(continued)

Table 3.2—Continued

Indicator	1975-80	1981-86	1975-86
	(standard units per hectare)		
Physical yield			
Food crops			
Beans	-0.360	0.780	-0.050
Wheat	...	0.110	0.080
Sorghum	-0.100	0.010	0.020
Rice	...	0.020	0.010
Maize	-0.0500	-0.050	-0.050
Groundnuts	0.0200	0.040	-0.030
Nonfood crops			
Cotton	0.190	0.120	0.080
Sunflower	-0.080	0.003	-0.010
Soybeans	-0.030	-0.060	-0.030
Virginia tobacco	-0.040[a]	0.140	0.020

Source: Computed from various statistical bulletins of Zambia's Central Statistical Office, Lusaka, Zambia.

Note: The growth rates were calculated as follows:

$$Q_t = Q_o e^{rt}, \qquad (1)$$

where Q_t is physical output in the current year; Q_o is physical output in a past year; e is a constant; r is the growth rate; and t is the number of years that have elapsed.

Taking logarithms of both sides of equation (1) produces

$$LnQ_t = LnQ_o + rt. \qquad (2)$$

Rearranging equation (2), one obtains

$$rt = Ln\cdot Q_t - LNQ_o. \qquad (3)$$

Dividing both sides by t, one obtains

$$r = (LNQ_t - LNQ_o)/t. \qquad (4)$$

[a] 1977-80.

land allocated to maize declined from 76 to 67 percent and land allocated to sorghum declined from 5 to less than 1 percent. The cultivation of cottonseed also increased markedly over the years, particularly in Central, Southern, and Copperbelt provinces.

Despite a uniform pricing regime, Zambia does not have a uniform pattern of production. This reflects regional differences in the soil, climate, and level and availability of support services and infrastructure. Furthermore, traditional food crops are produced in provinces with relatively poor agricultural infrastructure and services. In these so-called disadvantaged provinces, the supply of basic foodstuffs, although adequate at the national level, is often unreliable. Although Eastern Province was the only area to increase the allocation of land to maize during the period under review (from 79 percent in 1975 to 84 percent in 1985), the disadvantaged provinces devoted a significant proportion of their total land to food crops. The national average was just over 79 percent, while Western Province devoted 95 percent, Northwestern Province, 91 percent, and Luapula Province, 89 percent of their land to food crops. Although these provinces apparently increased the amount of land allocated to traditional crops, the increase probably reflected improvements in the methods of collecting and reporting data rather than substantial increases in the production of the crops themselves.

Finally, despite the government incentives and technological advances in production, Zambia's pricing policies do not recognize comparative advantage nor support equitable regional growth and income distribution. Agricultural policies should, for example, complement industrial policies in order to enhance the market opportunities of comparatively advantageous traditional crops. Agricultural policies operate through the pricing system, have an impact on the decisionmaking environment of producers and consumers, and are designed for, and intended to have an impact on, the institutions that implement them.

Zambia's policies and policy instruments have the following objectives: (a) achieve self-sufficiency in the production of staple food crops; (b) increase the production of traditional and nontraditional agricultural exports and therefore diversify the economic base and eliminate the nation's dependence on copper; (c) produce more import substitutes of agricultural products and inputs; (d) improve employment and provide equitable, higher incomes for rural households, improve nutritional levels, and minimize migration from rural to urban areas; and (e) increase the contribution of the agricultural sector to the total gross domestic product.

Table 3.3—Proportion of total crop area devoted to selected crops in Zambia, by province, 1975-85

Province and Crop[a]	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
						(percent)					
Central											
Maize	76.20	85.50	84.20	72.40	50.60	69.10	69.90	77.10	79.80	70.20	72.00
Sunflower	11.40	6.60	7.90	10.80	18.50	11.10	12.40	8.90	5.70	8.30	7.50
Cottonseed	9.80	1.60	1.20	2.70	14.70	9.50	7.30	7.30	8.70	15.60	12.30
Groundnuts	1.70	3.90	5.70	2.70	6.10	6.30	5.50	2.00	2.40	1.70	3.70
Wheat	0.40	0.70	0.50	0.30	0.10	0.10	0.10	0.60	...	...	...
Soybeans	0.40	0.10	0.20	6.50	6.10	1.00	1.70	2.20	1.50	1.90	1.80
Sorghum	...	...	...	...	...	...	...	...	...	...	...
Virginia tobacco	...	1.10	1.80	2.70	1.30	1.00	0.40	0.40	0.50	0.30	...
Beans	...	...	0.20	2.20	0.50	1.40	1.80	0.60	0.30	0.40	0.80
Rice	...	...	...	...	0.02	0.03	...	...	0.02	0.01	0.02
Millet	...	...	...	...	...	...	...	0.70	0.30	0.60	...
Lusaka											
Maize	...	...	...	80.90	74.30	59.30	58.30	61.20	75.70	67.90	57.10
Wheat	...	...	...	5.10	3.60	5.10	2.50	3.50	...	...	...
Sunflower	...	...	...	4.70	8.70	20.10	4.30	10.50	8.50	10.31	2.40
Virginia tobacco	...	...	...	3.40	1.90	2.40	0.60	0.40	...	...	...
Soybeans	...	...	...	2.50	7.20	0.60	1.40	2.30	3.20	9.80	7.40
Beans	...	...	...	2.30	2.20	2.10	0.40	1.10	1.50	1.00	1.10
Groundnuts	...	...	...	0.60	1.10	3.00	4.40	0.81	1.50	0.90	1.10
Sorghum	0.50	1.20	0.20	25.80	14.30	7.00	3.30	14.80	...	...	...

(continued)

Table 3.3—Continued

Province and Crop[a]	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Southern						(percent)					
Maize	88.60	82.50	78.50	75.40	75.20	68.70	71.50	74.40	69.60	61.20	66.60
Sorghum	4.70	2.20	1.80	6.40	12.30	1.90	2.00	2.10	2.90	3.70	3.80
Sunflower	4.10	4.40	3.80	3.10	3.60	10.60	9.20	9.70	9.90	13.00	13.80
Groundnuts	1.20	9.60	13.70	12.90	3.90	13.00	9.90	5.10	3.60	4.40	4.00
Cottonseed	0.80	0.80	0.90	0.70	2.80	2.90	4.70	7.20	11.20	13.30	8.60
Soybeans	0.40	0.40	0.40	0.30	0.20	0.30	0.70	0.60	1.70	1.60	0.90
Wheat	0.04	0.10	0.02	0.10	0.50	0.10	0.30	0.40	0.40	...	...
Virginia tobacco	...	...	0.70	0.60	0.80	1.50	0.50	0.40	0.70	0.60	0.40
Beans	...	...	0.20	0.50	1.00	1.90	1.40	...	0.30	0.20	0.02
Rice	...	...	...	...	...	0.01	0.10	...	0.02	0.01	...
Millet	...	...	...	...	...	...	...	...	0.40	1.60	1.90
Northern											
Maize	91.00	76.40	76.30	42.30	28.80	12.90	13.50	60.70	60.20	69.70	67.20
Groundnuts	3.80	11.20	10.00	18.80	29.40	5.80	5.10	3.50	3.40	6.20	3.80
Rice	3.50	4.70	5.90	4.60	2.30	0.70	0.80	6.20	5.20	5.80	7.10
Sunflower	1.50	1.20	1.80	...	0.10	0.40	0.10	1.00	0.70	1.40	0.60
Cottonseed	0.20	0.10	0.10	...	...	0.02	0.03	0.20	0.10	0.30	0.30
Wheat	0.02	...	...	0.10	0.02	0.30	0.30	1.30	...	...	...
Beans	6.50	5.90	15.00	24.80	80.00	80.00	25.80	18.90	5.90	7.10	...
Sorghum	...	...	0.10	19.10	14.60	0.02	0.10	0.20	0.10	0.40	0.10
Virginia tobacco	...	...	...	0.10	...	0.02	0.01	0.02	0.02	0.03	0.01
Soybeans	...	...	...	...	...	0.01	...	1.1	0.10	0.20	0.90
Millet	...	...	...	...	...	...	...	...	11.30	10.20	12.90

Eastern											
Maize	78.90	59.10	73.70	73.70	76.40	66.60	65.10	85.50	81.50	81.00	83.80
Groundnuts	12.20	31.00	23.80	22.30	9.30	23.10	19.90	4.60	6.90	5.60	4.80
Sorghum	5.60	5.50	...	1.10	5.40	0.60	1.60	0.10	0.50	0.70	0.50
Sunflower	1.50	0.90	0.40	0.10	0.80	4.80	7.70	5.90	8.20	7.80	7.10
Cotton	1.40	1.70	1.50	1.40	4.90	3.10	2.10	1.60	1.10	2.60	2.40
Rice	0.50	0.30	0.20	0.30	0.60	0.50	0.50	0.50	0.60	0.60	0.60
Soybeans	0.1	0.02	0.01	0.01	0.10	0.20	0.20	0.20	0.20	0.20	0.30
Beans	...	0.60	0.40	0.80	2.20	1.50	2.50	0.60	0.50	0.50	0.30
Virginia tobacco	...	...	...	0.40	0.40	0.30	0.50	0.40	0.20	0.20	0.10
Millet	...	...	...	...	...	...	...	...	0.20	0.70	...
Copperbelt											
Maize	82.70	56.10	56.50	36.90	68.70	25.70	37.20	29.90	57.2	58.3	63.3
Sunflower	12.20	6.40	3.10	1.40	0.50	...	37.20	29.90	2.8	3.9	2.4
Groundnuts	3.30	25.20	19.50	2.50	1.40	0.09	3.60	3.00	3.9	2.5	4.3
Beans	1.20	0.70	...	1.10	...	0.40	3.20	4.40	1.6	0.5	1.0
Soybeans	0.70	0.10	0.50	0.10	...	0.70	1.00	6.90	9.5	8.1	9.1
Sorghum	...	11.40	18.50	56.60	28.20	70.90	17.50	24.20	23.0	24.1	18.9
Cottonseed	...	...	1.50	0.70	1.00	0.20	0.07	0.40	1.5	1.2	0.6
Wheat	...	...	0.30	...	...	...	0.30	1.00	...	0.9	...
Virginia tobacco	...	...	...	0.90	0.30	0.10	0.10	0.20	0.5	0.1	0.1
Rice	...	...	...	...	0.10	...	...	0.10	0.1	0.4	0.2
Millet	...	...	...	...	...	...	...	...	...	0.1	0.4

(continued)

Table 3.3—Continued

Province and Crop[a]	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
						(percent)					
Luapula											
Maize	66.80	71.20	57.80	22.70	61.30	23.60	30.60	74.60	70.70	62.50	66.20
Rice	18.70	13.30	15.60	0.40	5.10	1.40	0.60	7.20	6.40	8.10	6.60
Groundnuts	8.60	12.70	22.20	67.00	2.90	62.10	52.30	7.50	11.20	8.10	6.70
Beans	4.40	0.80	1.60	6.60	29.10	12.60	16.40	5.70	6.40	4.70	4.10
Sunflower	1.50	2.00	3.00	0.30	1.50	0.20	0.10	4.60	3.10	4.00	2.40
Millet	...	...	...	...	...	...	...	...	1.70	10.30	11.50
Cottonseed	...	...	...	...	...	...	0.02	0.50	0.40	0.30	1.10
Soybeans	...	...	...	...	0.10	...	...	...	0.10	0.30	1.10
Sorghum	...	...	...	...	...	...	...	...	...	1.80	0.40
Northwestern											
Maize	84.40	76.30	72.40	41.70	30.20	43.00	45.00	58.30	53.20	53.50	58.40
Rice	8.30	6.00	4.10	1.70	0.90	0.40	0.30	2.80	3.60	4.80	4.30
Groundnuts	4.50	13.30	18.10	19.00	18.90	15.80	12.20	2.40	3.30	4.30	3.50
Sunflower	2.80	2.80	3.60	0.30	1.10	0.20	0.60	3.20	1.30	2.80	1.20
Sorghum	...	...	...	37.30	21.50	36.20	41.00	25.10	20.50	25.50	13.80
Beans	...	1.70	1.80	...	27.50	4.50	1.10	3.20	6.50	7.00	5.30
Millet	...	...	...	...	...	...	...	...	11.40	1.80	11.60

Western											
Maize	92.60	84.60	77.10	74.00	75.40	85.30	65.80	74.00	58.10	50.10	56.40
Sorghum	3.70	2.70	3.20	14.60	18.10	4.10	13.40	8.40	4.60	13.00	7.80
Rice	2.30	2.20	2.80	3.30	1.20	3.10	2.70	11.70	4.50	8.70	10.10
Groundnuts	0.70	10.30	14.80	4.80	3.60	4.30	11.20	4.00	0.90	1.10	3.60
Sunflower	0.60	0.30	1.50	2.50	0.50	1.80	0.10	0.60	0.30	0.40	0.30
Wheat	0.10	...	...	...	...	0.02	0.03	...	...	...	...
Beans	...	0.50	0.10	0.70	0.60	6.00	...	4.70	0.80	0.10	...
Virginia tobacco	...	...	...	0.70	0.60	0.60	0.50	0.70	0.30	0.10	0.20
Cottonseed	...	...	...	...	0.10	0.20	0.20	0.60	0.20	0.60	0.60
Soybeans	...	...	...	...	...	...	...	0.20	...	0.10	0.20
Millet	...	...	...	...	...	...	...	...	26.50	25.10	20.70
Zambia as a whole											
Maize	81.60	76.70	78.00	70.60	64.40	49.70	50.70	75.50	77.20	72.70	74.80
Sunflower	6.00	4.00	3.50	2.90	4.90	5.20	7.90	8.10	6.80	8.30	8.10
Groundnuts	4.30	13.90	14.90	16.30	8.40	12.30	10.90	3.70	4.40	4.20	4.10
Cottonseed	4.20	1.20	1.20	1.20	4.70	2.80	2.60	4.00	4.70	7.50	5.90
Millet	2.90	3.00	0.80	5.90	10.60	5.40	4.90	3.60	2.30	3.10	3.20
Rice	0.50	0.50	0.40	0.40	0.60	0.50	0.50	1.00	1.00	1.30	1.40
Soybeans	0.30	0.20	0.20	0.20	0.40	0.10	0.40	0.90	0.70	1.40	1.30
Virginia tobacco	0.10	0.40	0.40	1.60	4.90	23.30	21.60	2.40	2.50	1.10	1.10
Sorghum	...	...	0.50	0.70	0.90	0.40	0.40	0.40	0.30	0.30	0.20
Wheat	...	...	...	...	...	...	...	...	...	0.10	0.10

(continued)

Table 3.3—Continued

Source: Computed from various agricultural statistical bulletins of Zambia's Central Statistical Office, Lusaka, Zambia.

Note: The growth rates were calculated as follows:

$$Q_t = Q_o e^{rt}, \qquad (1)$$

where Q_t is physical output in the current year; Q_o is physical output in a past year; r is the growth rate; e is a constant; and t is the number of years that have elapsed.

Taking logarithms of both sides of equation (1) produces

$$LnQ_t = LnQ_o + rt. \qquad (2)$$

Rearranging equation (2), one obtains

$$rt = LnQ_t - LNQ_o. \qquad (3)$$

Dividing both sides by t, one obtains

$$r = (LNQ_t - LNQ_o)/t. \qquad (4)$$

[a] Crops are listed in order of importance for 1975, except in Lusaka Province, where they are listed in the order for 1978.

The strategies for achieving these policy objectives are as follows: (a) intensify the use of abundant resources, particularly land and labor, by deemphasizing the use of imported machinery and other inputs that require substantial capital and foreign exchange; (b) promote and expand market-oriented production, particularly by supporting small-scale commercial farmers; (c) streamline the provision of credit to producers wishing to buy imported agricultural inputs; (d) develop and disseminate appropriate technology and labor-intensive packages for crop production as well as reduce substantially the incidence of livestock and plant diseases, particularly in the subsistence subsectors; and (e) reduce significantly the cost of production, especially of export commodities in the commercial farming sector, and thus increase international competitiveness.

The government plays an important role in efforts to achieve these objectives and implement these strategies. It invests directly in the agricultural sector, allocates portions of the central budget to agriculture, is whole or part owner of parastatal companies that promote a given crop or crops and market an agricultural product, provides credit and other inputs to farmers, mobilizes foreign investments, and sets policies and implements policy instruments. The government influences the pace of agricultural growth and the composition and volume of trade in Zambia.

SECTORAL PRICING POLICIES

The government uses a system of price controls to influence the pattern and composition of production and the distribution and consumption of most agricultural commodities. Prices are uniform, determined by a set of criteria, and raised annually. These floor prices do not take into account geographic differences nor seasonal fluctuations in supply and demand. The government recently set floor prices for all commodities except maize and wheat, whose price is both a floor and a ceiling price. The producers of commodities other than maize and wheat negotiate prices with buyers, and these prices may be equal to or greater than floor prices. This partial liberalization of commodity markets in effect raises the price of wheat and other commodities above the price mandated by the government by allowing producers to sell their product to nongovernmental and private commodity traders.

Consumer prices, particularly for maize and wheat flour, are set below producer prices. This creates huge subsidies that are a major

component of the government's budget for the agricultural sector. The producer price of maize and wheat is based on 100 percent of the cost of production plus allowances for management. The floor price of soybeans, cotton, and sunflower is based on, among other factors, oil content and supply cross-price elasticities (Fosu 1987). The floor price of traditional export and import-substitute crops is based on the parity price of imports and exports (see Table 3.4). That of other food crops, such as millet and sorghum, is based on the cost of production and nutrient value compared with those of maize, which is estimated to be 90 percent. Floor pricing seeks to ensure that producers receive an "adequate" price. Therefore, the following factors determine the price of agricultural commodities: (a) cost of production; (b) political acceptability; (c) profitability; (d) fairness to producers and consumers; (e) nutrient content; and (f) export and import parity. The government significantly controls the structure of agricultural commodity prices that producers receive and consumers pay. These prices profoundly influence, in turn, the direction, pace, composition, and volume of agricultural output and trade.

Some of these criteria may, in fact, have little or no bearing on how the government determines producer prices. The dramatic shifts in how land is allocated to food crops in general and to maize and oil seed crops such as sunflower and groundnuts in particular, suggest that relative prices, represented by high cross-price elasticities, were sometimes ignored in the years between 1975 and 1986. Determining producer prices for traditional food crops by comparing their nutrient content with that of maize suggests that relative prices were perhaps less important than other considerations.

Although parity pricing is supposed to be one factor determining producer prices, this is not evident from the data analysis. To examine the effect that pricing policies have on agricultural commodities, crops were grouped as import substitutes and export crops, and nominal protection coefficients were calculated. The border price from 1975 to 1985 was calculated and converted to domestic currency at the official exchange rate (see Table 3.5). This approach excludes the effects of trade and exchange rate policies and defines the border price as the price that farmers could have received if border pricing had been the main criteria for determining the producer price. A nominal protection coefficient less than 100 percent means that producers were implicitly taxed, while a nominal protection coefficient greater than 100 percent means that producers were implicitly subsidized.

From 1975 to 1985, some crops were taxed; the degree of taxation was -35 percent for groundnuts, -24 percent for soybeans, -21 percent

Table 3.4—Guaranteed producer price index for selected import-substitute and export crops, Zambia, 1975-86

Year	Import Substitutes						Exports		
	Maize[a]	Sunflower[b]	Soybeans[a]	Paddy Rice[c]	Wheat[d]	Shelled Groundnuts[c]	Cotton-Seed[d]	Virginia Tobacco[d]	Sorghum[a]
				(1975=100)					
1975	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1976	126.0	119.0	128.8	120.0	100.0	147.1	133.3	115.8	100.0
1977	126.0	119.0	128.8	120.0	100.0	147.1	133.3	130.4	100.0
1978	136.0	148.8	162.9	120.0	125.0	168.2	153.3	148.6	100.0
1979	180.0	163.1	189.4	133.3	125.0	188.2	153.3	174.5	100.0
1980	234.0	195.2	242.4	150.0	125.0	205.9	153.3	181.2	100.0
1981	270.0	209.5	275.0	155.0	162.5	251.2	153.3	189.4	150.0
1982	320.0	247.0	319.8	233.3	200.0	282.4	156.7	277.1	150.0
1983	366.0	256.0	343.2	333.3	223.4	323.5	173.3	306.1	266.7
1984	490.0	256.0	397.7	333.3	265.6	420.6	193.3	323.3	310.8
1985	566.0	331.9	461.4	333.3	282.5	539.2	223.3	398.5	448.3
1986	1,100.0	499.4	849.2	463.1	527.5	772.6	323.3	609.5	870.8

Source: Doris J. Jansen, "Zambia: A comparative study of the political economy of agricultural pricing policies," University of Zambia, Lusaka, Zambia, September 1987, Mimeo.

[a] Kwacha per 90 kilograms.

[b] Kwacha per 50 kilograms.

[c] Kwacha per 80 kilograms.

[d] Kwacha per kilogram.

Table 3.5—Nominal protection coefficient of government producer prices and border prices in Zambia, by crop, 1975-85

Year	Maize[a]			Shelled Groundnuts[b]			Sunflower[c]			Soybeans[a]		
	P_g	P_b	NPC	P_g	P_b	NPC	P_g	P_b	NPC	P_g	P_b	NPC
1975	5.0	6.8	73.5	17.0	25.0	65.9	8.4	13.7	61.3	13.2	23.3	56.7
1976	6.3	7.5	84.0	25.0	40.9	61.1	10.0	8.9	112.4	17.0	22.6	75.2
1977	6.3	8.0	78.8	25.0	35.7	70.0	10.0	13.1	76.3	17.0	29.5	57.6
1978	6.8	8.0	85.0	28.6	42.3	67.6	12.5	14.2	88.0	21.5	32.9	65.3
1979	9.0	12.8	70.3	32.0	45.7	70.0	13.7	13.6	100.7	25.0	31.2	80.1
1980	11.7	15.0	78.0	35.0	91.5	38.3	16.4	12.0	136.7	32.0	33.4	95.8
1981	13.5	20.5	65.9	92.7	61.3	69.7	17.6	11.7	150.4	36.3	34.1	106.5
1982	16.0	20.0	80.0	48.0	76.1	63.1	20.8	11.1	187.4	42.2	32.2	101.0
1983	18.3	21.8	83.9	55.0	90.8	60.6	21.5	15.5	140.6	45.3	43.4	104.6
1984	24.5	27.9	87.8	71.5	107.3	66.6	21.5	26.6	80.8	52.5	57.8	90.8
1985	28.3	37.2	76.1	131.4	163.0	80.6	27.9	34.7	80.4	60.9	68.2	89.3
Averages												
1975-80			78.3			62.2			95.9			71.8
1981-85			78.7			68.1			127.9			98.4
1975-85			78.5			64.7			103.1			75.8

(continued)

Table 3.5—Continued

Year	Paddy Rice[b]			Wheat[a]			Cottonseed[d]			Virginia Tobacco[d]		
	P_g	P_b	NPC	P_g	P_b	NPC	P_g	P_b	NPC	P_g	P_b	NPC
1975	12.0	...	...	16.0	13.1	122.1	0.3	0.4	75.0	0.8	0.8	100.0
1976	14.4	11.8	122.0	16.0	12.7	126.0	0.4	0.5	80.0	1.0	1.0	100.0
1977	14.4	13.4	107.5	16.0	17.8	87.9	0.4	0.6	66.7	1.0	1.1	90.9
1978	14.4	16.5	87.3	20.0	16.5	121.2	0.5	0.6	83.3	1.3	1.3	100.0
1979	16.0	15.4	103.9	20.0	18.4	108.7	0.5	0.6	83.3	1.5	1.5	100.0
1980	18.0	14.4	125.0	20.0	19.2	104.2	0.5	0.6	125.0	1.6	1.5	113.3
1981	18.6	17.1	108.8	26.0	25.4	102.4	0.5	0.4	100.0	1.7	1.6	106.3
1982	28.0	19.1	146.6	32.0	24.2	132.2	0.5	0.5	100.0	2.4	1.8	133.3
1983	40.0	14.2	281.7	35.8	36.9	97.0	0.5	0.6	83.3	2.6	1.9	136.8
1984	40.0	27.7	144.4	42.5	44.9	94.7	0.6	1.0	60.0	2.8	2.2	127.3
1985	40.0	36.1	110.8	45.2	44.9	100.7	0.7	1.2	58.3	3.5	3.0	116.7
Averages												
1975-80			109.1			111.7			85.6			100.7
1981-85			158.5			105.4			80.3			124.1
1975-85			133.8			108.8			83.2			111.3

Source: Doris J. Jansen, "Zambia: A comparative study of the political economy of agricultural pricing policies," University of Zambia, Lusaka, Zambia, September 1987, Mimeo.

Note: The nominal protection coefficient (NPC) is $1 + (P_g - r\,P_b)/rP_w$, where P_g is the government producer price, P_b is the border price, P_w is the world price, and r is the nominal exchange rate.

[a] Kwacha per 90 kilograms. [b] Kwacha per 80 kilograms. [c] Kwacha per 50 kilograms. [d] Kwacha per kilogram.

for maize, and -17 percent for cottonseed. On the other hand, some crops were protected: the degree of subsidization was 34 percent for rice, 11 percent for Virginia tobacco, 9 percent for wheat, and 3 percent for sunflower. Adjusting for overvaluation of currency, the level of taxation averaged -68 percent for groundnuts, -60 percent for maize, -58 percent for soybeans, -45 percent for sunflower, -42 percent for wheat and Virginia tobacco, and -35 percent for rice (Jansen 1987).

The government provides additional incentives to farmers and potential investors in the agricultural sector. Farmers receive (a) a bonus in foreign exchange of US$0.50 for each bag they produce above 5,000 bags of maize, 1,000 bags of soybeans, and 2,000 bags of wheat sold to official marketing organizations; (b) a development allowance of 10 percent of the total expenditure in any given year for planting tea, coffee, bananas, and citrus fruits; (c) a reduced tax rate of 15 percent on income earned from agriculture; (d) a two-year period in which to write off farm machinery and equipment; (e) a five-year tax holiday on dividends derived from farm income; (f) an exemption from paying duties on imported machinery and equipment for agriculture; (g) a withdrawal of the selective employment tax; and (h) a retention of 50 percent of the foreign exchange earned on agricultural exports.

These incentives benefit commercial farmers, who contribute relatively little to the agricultural gross domestic product. Small-scale farmers would benefit more if they were encouraged to develop more productive cooperatives that could then be grouped into informal farmers associations and if the US$0.50 foreign exchange bonus could be applied to marketing groups. Applying the bonus to these groups might, however, benefit commercial farmers who form joint marketing ventures more easily than small-scale farmers can. Exporting agencies could also pay a premium to small-scale farmers who do not directly export their own product. Originating from the 50 percent retention of foreign exchange, such a premium would stimulate production.

MARKETING AND SUBSIDY POLICIES

Until recently, when the government partially liberalized the marketing system, the National Agricultural Marketing Board enjoyed a statutory monopoly over the marketing of all agricultural commodities. The Board now purchases maize from provincial cooperative unions in provinces with a surplus, imports and sells maize to cooperative unions in provinces with a deficit, maintains national

strategic reserves, and imports fertilizers. The provincial cooperative unions purchase produce directly from farmers, market it to other provinces, and supply maize directly to provincial milling companies. Although designed to serve their members, provincial cooperative unions now purchase crops from nonmembers as well.

The partial liberalization of the marketing system also allows private commodity merchants to purchase agricultural commodities directly from producers at prices at or above the government-determined floor price. Provincial cooperative unions are thus the buyers of last resort. The marketing policy adjustments also seek to make the marketing organization more efficient and provide incentives to producers.

Subsidies, both to consumers and to producers, rose as a percentage of the Ministry of Agriculture's budget from 6 percent in 1981 to 70 percent in 1986 (see Tables 3.6 and 3.7). The government recognizes that this share is too high and is committed to reducing its subsidies to the agricultural sector. Subsidies comprised 66 percent of the agricultural budget in 1981 and 58 percent in 1986, an annual decline of 2 percent. Moreover, agricultural subsidies dropped from 20 percent of the agricultural gross domestic product in 1981 to 16 percent in 1985, an annual decline of 1 percent.

The rate at which government subsidies to particular sectors rises or declines is sensitive to a number of factors, including the policy of maintaining uniform prices. Uniform prices, particularly of maize, encourages production in areas located far from consumption centers and increases the cost of transportation and handling (Jansen 1987). The level of government subsidy should perhaps also include implicit subsidies on credit, such as nominal interest rates that are lower than the rate of inflation and investments in research and extension. The source of the subsidized commodity is also a factor, that is, whether a commodity is produced domestically or is imported, how the price of the import compares with that of the domestic product, and how far the production center lies from the consumption center. The level at which agricultural products and inputs are subsidized depends on the commodity produced, while the extent of subsidy support depends on the type of inputs and level of management used by each type of producer.

Although subsidies transfer resources from lenders and taxpayers to borrowers and consumers, they also work against the objective of equity. In 1982, the average rate of subsidy per bag of fertilizer equaled 60 percent of the cost of production, storage, and handling.

Table 3.6—Budgetary expenses in nominal terms, Zambia, 1979-86

Year	Recurrent	Capital	Subsidies	MAWD Budget	Government Budget	MAWD as a Percent of Government Budget	Subsidies as a Percent of MAWD Budget
				(K1,000)			
1979	119,211.3	15,317.6	17,939.4	152,468.3	956,410.7	16	12
1980	225,001.5	20,767.0	14,854.2	260,632.7	1,657,566.6	16	6
1981	131,115.5	18,085.9	10,037.1	159,238.5	1,388,007.6	11	6
1982	190,225.4	25,438.9	21,226.6	236,920.9	1,643,237.2	14	9
1983	84,697.8	31,862.8	16,912.0	133,472.6	1,476,361.4	9	13
1984	73,110.7	28,538.4	21,113.1	122,762.2	1,484,625.7	8	17
1985	47,140.1	46,551.0	171,670.6	265,361.7	2,184,332.8	12	65
1986	74,122.6	159,332.0	548,145.4	781,600.0	5,260,997.1	15	70
Annual growth rate (percent)	6	29	43	20	21	...	...

Source: Compiled from various financial reports of the government of the Republic of Zambia, 1979-86.

Note: MAWD is the Ministry of Agriculture and Water Development. These figures do not include resource flows to the Ministry of Co-operatives and Ministry of Lands and Natural Resources or from other sectors, including the private sector.

Table 3.7—Budgetary expenses in real terms, Zambia, 1979-86

Year	Recurrent	Capital	Subsidies	MAWD Budget	Government Budget	MAWD as a Percent of Government Budget	Subsidies as a Percent of MAWD Budget
				(K1,000)			
1979	131,001.4	16,832.5	19,713.6	167,547.6	1,051,000.8	16	12
1980	225,001.5	20,767.0	14,854.2	1,657,566.6	1,657,566.6	16	6
1981	111,398.0	15,366.1	8,527.7	1,179,785.5	1,179,785.5	11	6
1982	160,663.4	21,485.5	17,927.9	1,387,869.3	1,387,869.3	14	9
1983	64,262.4	24,175.1	12,831.5	1,120,152.8	1,120,152.8	9	13
1984	48,481.9	18,924.6	14,000.7	984,499.8	984,499.8	8	17
1985	25,087.9	24,774.3	91,362.8	1,162,497.5	1,162,497.5	12	65
1986	25,143.4	54,047.5	185,938.1	1,784,598.8	1,784,598.8	15	70
Annual growth rate (percent)	-21	15	28	6	7	...	...

Source: Compiled from various financial reports of the government of the Republic of Zambia, 1979-86.

Note: MAWD is the Ministry of Agriculture and Water Development. These figures do not include resource flows to the Ministry of Co-operatives and Ministry of Lands and Natural Resources or from other sectors, including the private sector.

During that same year, 90 percent of all fertilizer was distributed to the so-called traditional line-of-rail provinces, including Eastern Province. This left the rest of the provinces only 10 percent of all fertilizer (World Bank 1984).

Market performance is influenced by the existing pricing policy, which does not change during the year. The lack of a premium to cover the cost of storing and managing inventory discourages producers and private millers or processors from storing the product. It also encourages producers to sell their produce immediately after the harvest, which means that the government must finance large crop purchases over a short period and mobilize reliable and adequate transportation and storage facilities to handle the product. Even after 1985, transportation rates still accounted for the distances to be covered and the quantity to be transported, but not the quality of the road surfaces. The absence of premiums to store and manage inventory continues to discourage the participation of private traders.

After liberalization, private commodity merchants did begin to market products whose processing facilities lay outside the domain of parastatals, such as wheat, soybeans, and groundnuts, and commodities whose consumer price was not controlled by the government. It is not clear how many producers receive the US$0.50 bonus or how much the government pays in lieu of this incentive. It is clear, however, that the bonus does not encourage producers to sell their produce to private merchants because it only covers products delivered to official marketing entities. The government does not have the staff or the financial resources to authenticate deliveries to private merchants.

To improve equity and increase output, producer subsidies must take into account differences in the level of demand for production inputs among various categories of farmers and products. Given shortfalls in the supply of inputs, the government will have to balance the demands of different categories of producers and their expected contribution to the overall growth of the agricultural sector. This balance should reflect the government's national objectives for the agricultural sector.

CREDIT POLICIES

The relatively poor performance of the agricultural sector has been attributed partly to its inadequate financial base. The overall financial requirements of the agricultural sector are, however, unknown.

The government is involved in financial credit markets to a great

degree. This involvement includes the whole or partial ownership of commercial banks, pension funds, and insurance concerns, all of which exercise significant direct and indirect control over allocating resources to the agricultural sector. The government also maintains a policy of differentiated interest rates, which places the interest on loans to the agricultural sector at 1 percentage point above the prime lending rate compared with 3 percentage points on loans to other sectors.

Since interest rates on loans to the agricultural sector are low, the rates of return on investments are probably lower in agriculture than in other sectors. It appears, however, that if the policies and practices governing land tenure were changed and capital gains were included in the rate of return, investments in the agricultural sector would realize rates of return comparable to those realized in other sectors.

The government also imposes a ceiling on interest rates, which reduces the amount of credit that financial institutions can effectively and profitably lend to the agricultural sector. Financial institutions cannot charge a premium to cover the additional costs and risks associated with loans to nontraditional borrowers. Consequently, financial institutions in effect raise interest rates by charging commitment fees, registration fees, and other types of fees.

Although the government allows loans to be secured with different rates of maturity, the ceilings placed on interest rates are binding on all loan portfolios. The result is that a stable, but small amount of loans is delivered to the agricultural sector; between 1980 and 1984, approximately 50 percent of the revealed demand was satisfied (Zambia, Ministry of Agriculture and Water 1986b) The excess demand for credit was stimulated in part by the low interest rate. Furthermore, the total disbursement of loans from 1980 to 1984 shifted progressively from loans for long-term development to loans for short-term, seasonal production (see Table 3.8); this distribution improved marginally in 1985.

Commercial farmers and politicians create the demand for low interest rates. Commercial farmers are concerned that the cost of borrowing is high, while the price they receive for their product is low. Politicians are concerned that high interest rates keep small-scale farmers (who form the bulk of the rural population; see Table 3.9) from participating in the credit market. If interest rates were high, agricultural output would suffer because small farmers would not be able to acquire and apply improved inputs, and income distribution in rural areas would become even more skewed.

Only 4 percent of the estimated 600,000 rural households had access to formal credit in 1984 (Zambia, Ministry of Agriculture and

Table 3.8—Loans disbursed for short-term production and long-term development in Zambia, by end use, 1980-85

End Use	1980	1981	1982	1983	1984	1985
			(percent)			
Crop inputs						
Production	88	95	98	98	98	91
Development	12	5	2	2	2	9
Livestock						
Production	56	73	58	50	52	44
Development	44	27	42	50	48	56
Machinery						
Production	31	28	89	79	60	50
Development	69	72	11	21	40	50
Land						
Production	18	42	28	23	66	58
Development	82	58	72	77	34	42
Construction and improvements						
Production	23	28	87	67	97	56
Development	77	72	13	33	3	44
Other						
Production	85	98	98	98	90	99
Development	15	2	2	2	10	1
Total						
Production	73	80	87	86	93	85
Development	27	20	13	14	7	15

Source: Zambia, Ministry of Agriculture and Water Development, Planning Division, Survey of agricultural loans issued by commercial banks and other financial institutions during 1979/80-1983/84 financial years, Lusaka, Zambia, July 1986.

Water 1986b). Moreover, credit was highly concentrated in a few provinces (see Table 3.10). More than 90 percent of all loans went to Central, Lusaka, Southern, and Eastern provinces, which have the highest concentration of commercial farmers. The loans disbursed to small-scale farmers tend to be small, and the cost of procuring a loan

Table 3.9—Number of farm units in Zambia, by type of farm and province, 1980

Province	Commercial			Subsistence	Total
	Large-scale	Medium-scale	Small-scale		
Southern	320	8,000	49,000	7,500	62,720
Central	300	7,630	21,400	18,400	47,730
Lusaka	90	1,910	4,300	13,400	19,700
Copperbelt	...	490	2,000	17,900	20,399
Eastern	20	3,100	27,000	80,900	111,920
Western	...	...	5,450	85,400	90,350
Northwestern	...	80	2,900	53,600	56,580
Luapula	...	50	2,050	73,600	75,700
Northern	...	90	7,400	111,900	119,390
Total	730	21,350	122,400	462,600	607,080

Source: Zambia, Ministry of Agriculture and Water Development, *Food strategy study*. Main report. Annex on socio-regional framework (Lusaka, Zambia: MAWD, 1981).

Note: Small-scale commercial units are less than 10 hectares, medium-scale units are between 10 and 40 hectares, and large-scale units are more than 40 hectares.

generally depends on its size and maturity. Thus the small loans typical of small-scale farmers tend to be eliminated because the overhead cost of administering them is high. The distribution of loans both within and among provinces is as skewed as the access to credit.

The credit that commercial banks extend to agriculture and to the economy in general declined in real terms, but increased in nominal terms between 1980 and 1985 (see Table 3.11). Subsidies form an increasingly large share of total credit and are becoming increasingly important to the agricultural sector. The subsidized dimension of agricultural credit continues to grow as the spread between the nominal interest rate and the ever-rising inflation rate continues to widen. Between 1980 and 1985 policies governing how credit is allocated among sectors remained unchanged.

Internal financing in Zambia ranges from 42 to 70 percent (Zambia, Ministry of Agriculture and Water Development 1983b). To

Table 3.10—Disbursement of loans to farmers in Zambia, by province, 1979-84

Province	1979/80	1980/81	1981/82	1982/83	1983/84
			(percent)		
Central	30.73	22.02	9.02	15.27	10.85
Copperbelt	4.40	3.22	5.16	4.01	3.78
Eastern	7.34	8.60	4.38	4.83	14.34
Luapula	0.62	0.72	0.85	0.77	0.63
Lusaka	22.92	28.87	46.90	45.93	41.46
Northern	2.53	2.16	2.73	3.09	1.41
Northwestern	0.79	0.77	0.93	0.46	0.45
Southern	30.13	33.10	29.29	23.56	25.99
Western	0.51	0.56	0.75	2.07	1.10
Total	100.00	100.00	100.00	100.00	100.00

Source: Zambia, Ministry of Agriculture and Water Development, Planning Division, Survey of agricultural loans issued by commercial banks and other financial institutions during 1979/80-1983/84 financial years, Lusaka, Zambia, July 1986.

be adequate, institutional credit to agriculture should constitute 40 percent of the total cost of production, giving an internal financing ratio of 60 percent. The government's policy of keeping interest rates substantially below the rate of inflation discourages additional financing from being reinvested in agriculture. That is, the rate of reinvestment in agriculture is low because the financial recoveries from agricultural lending and additions to the portfolio of agricultural lending are low. Producers have no incentive to use their own resources to finance production.

High internal financing ratios of approximately 70 percent reflect, perhaps, the lack of available funds to satisfy the demand for loans and the tendency of institutions that supply inputs to favor clients who pay with cash over those who pay with local purchase orders. Also, since only 4 percent of the rural population has access to credit, the agricultural sector is undercredited. Low interest rates and concentrated

Table 3.11—Commercial bank advances and implicit credit subsidies transferred to the agricultural sector of Zambia, 1980-85

Economic Indicator	1980	1981	1982	1983	1984	1985	Annual Growth Rate
			(thousands of 1980 kwacha)				
Average annual balance	119,858.0	77,186.0	109,684.0	116,146.0	105,435.0	71,055.0	-8.0
Commercial bank advances							
To the agricultural sector	23,924.0	61,543.9	55,712.7	43,807.4	48,115.6	47,722.5	11.0
Total	354,296.0	455,838.2	406,673.6	371,744.5	408,903.9	347,875.7	-0.3
Gross domestic product							
Total	3,063,600.0	3,185,923.2	3,115,511.2	3,113,328.3	3,187,459.5	3,369,930.8	2.0
Agricultural	435,300.0	470,518.0	425,710.0	450,455.0	475,597.0	492,390.0	2.0
Credit subsidies transferred to the agricultural sector	1,989.0	1,678.0	3,585.0	4,733.0	2,795.0	6,211.0	19.0
Ratios			(percent)				
Total average balance to the agricultural gross domestic product	0.005	0.004	0.010	0.010	0.010	0.010	n.a.
Total bank advances to the the agricultural sector	0.250	0.160	0.260	0.260	0.220	0.140	n.a.
Credit subsidies to the agricultural gross domestic product	0.010	0.020	0.020	0.010	0.020	0.010	n.a.
Bank advances to the total gross domestic product	0.120	0.140	0.130	0.120	0.130	0.100	n.a.

Source: Basic data were collected from various statistical bulletins of Zambia's Central Statistical Office and financial reports of the government of the Republic of Zambia by the Bank of Zambia, 1981-86.

Note: The figures have been deflated by a gross domestic product deflator. The average annual balance includes credit and grants to parastatal companies and loans from commercial banks and other financial institutions. The credit subsidies transferred to agriculture were estimated by multiplying the annual balance by -i, where i is (is - r)/1 + r, where r is the annual rate of inflation and is is the average nominal rate of interest for agricultural credit.

credit appear to have benefited mainly commercial farmers. Equally important, the prevailing interest rates do not make annual crop credit more available to successful farmers. The growth of output for selected crops was apparently due to an expansion of the area sown rather than an increase in productivity.

On the whole, credit plays a minimal role in helping farmers adopt higher-yielding techniques in production. It does, however, play a role in sustaining commercial farmers at their existing level of production. Nonetheless, within a given group of farmers producing a given crop, individuals seem to increase their productivity in proportion to the credit they receive. The significance of credit as a means of stimulating technical change remains to be established empirically.

EXCHANGE RATE AND TRADE POLICIES

Trade and exchange rate policies have a profound impact on agriculture and rural development in Zambia. In fact, they seem to have more influence, especially on the movement of capital within and between sectors, than policies directed at specific sectors.

From October 1985 to May 1987, the exchange rate was determined through a weekly auction system. During that time, 5 percent of the total amount of foreign exchange available for auctioning went to the agricultural sector. This share was low because liquidity within the agricultural sector was low and the financial resources of small-scale farmers were severely constrained. The bulk of the foreign exchange available to the agricultural sector was used to acquire spare parts and rehabilitate existing machinery and equipment. The exchange rates that emerged may not have reflected a scarcity of foreign exchange, but they did have a profound impact on the agricultural sector.

When the kwacha was devalued in 1982, the cost of production rose 116 percent, the direct costs of agricultural inputs in kwacha grew, the agricultural sector was highly dependent on inputs from import-intensive sectors within the economy, and prices rose in general. The impact that devaluation had on the price and comparative advantage of various commodities depended on the producer's level of technology and management. The ratio of the border price to the domestic cost of production for 1986 without auction was as follows: for rice, 1.28:2.69; for maize, 1.54:2.28; for soybeans, 1.02:1.51; for cotton, 3.98:5.78; and for wheat, 1.03:1.39. Since all the ratios were greater than 1.0, Zambia had a comparative advantage in producing rather than

importing these crops (Zambia, Ministry of Agriculture and Water Development 1986a). Commodities, such as maize and cotton, that are produced primarily by small-scale farmers have the highest ratios and offer the greatest opportunities for increasing production for domestic use and for export.

Since May 1987, when the auction system was discontinued, the kwacha has been pegged at K 8.00 to US$1.00. The business community and scholars argue that the kwacha is overvalued, although the amount of overvaluation is not certain. Exchange rates higher than K 20.00 to US$1.00 are not uncommon on the unofficial foreign exchange market.

A system of import quotas and foreign exchange allocations made through the Foreign Exchange Management Committee replaced the auction system. Through this arrangement, the government exercises quantitative restrictions that limit aggregate imports and regulate the structure of imports and exports. Although this system influences the flow of foreign exchange to various sectors, it has not influenced the end use of foreign exchange. Administrative constraints keep it from closely monitoring the nature and composition of imports. The government's criteria for budgeting and allocating foreign exchange reflect, however, what is socially desirable and beneficial.

Import substitutes and export commodities are important to examining the impact of trade and exchange rate policies (see Table 3.12 for the methodology of this examination and the classification of commodities). The level of direct export subsidies grew from 3 percent in 1977 to 75 percent in 1985. Over the 10-year period, exports received an average direct export subsidy of approximately 9 percent in nominal terms. If a real "equilibrium" exchange rate were used, the rate of export subsidies would be lower.

The government continues to restrict imports, and the tariff rates reported here do not account for scarcity premiums that occur when the supply of foreign exchange falls short of the demand, which is the main reason for quantitative restrictions. Between 1975 and 1985, the domestic price of import substitutes was higher than the foreign price by an average of 85 percent. This changed between 1983 and 1985, when the domestic price of import substitutes was lower than the foreign price by about 41 percent. Based on the figures for overall trade bias presented in Table 3.12, trade policies in Zambia from 1976 to 1985 favored producers of import substitutes over producers of exports; this trend remains fairly stable (for the methodology used, see Bautista 1987). The picture improved marginally in 1982/83, when the kwacha was devalued 20 percent.

Table 3.12—Nominal and effective exchange rates, implicit export tax and tariff rates, and overall trade bias in Zambia, 1975-85

Year	Nominal Exchange Rate	Effective Exchange Rate EERx	Effective Exchange Rate EERm	Implicit Export Tax Rate (Tx)	Implicit Tariff Rate (Tm)	Overall Trade Bias (OTB)
1975	0.643	0.788	0.785	0.226	0.220	1.004
1976	0.713	0.813	1.038	0.140	0.456	0.783
1977	0.790	0.765	0.818	-0.032	0.035	0.935
1978	0.800	0.840	0.892	0.050	0.115	0.942
1979	0.793	0.808	0.926	0.110	0.168	0.873
1980	0.789	0.885	1.084	0.122	0.374	0.816
1981	0.860	0.855	1.066	-0.006	0.240	0.802
1982	0.928	0.940	1.354	0.013	0.460	0.694
1983	1.251	0.913	1.228	-0.270	-0.018	0.743
1984	1.940	0.855	0.996	-0.559	-0.487	0.858
1985	3.159	0.780	0.912	-0.752	-0.710	0.855

Source: Calculated by the author.

Note: The overall trade bias (OTB) is calculated as: OTB = $[P_x / P_m] / [P^*_x / P^*_m]$, where $P_x = (1 - t_x)r$; $P_m = (1 - t_m)r$; $P^*_x = EER_x \cdot P^*_x$; and $P^*_m = EER_m \cdot P^*_m$. Hence OTB = $[(1 - t_x) / (1 - t_m)] = [EER_x / EER_m]$, where t_x and t_m are implicit export tax and import tariff rates, r is the average nominal exchange rate, EERx and EERm are the effective exchange rates for exports and imports, respectively. If OTB is less than 1, there is evidence of an antitrade bias where the policies favor the production of import substitutes over that of export commodities. If OTB is greater than 1, there is evidence of a trade bias where the policies favor exports over imports. Finally, if OTB equals 1, neither is being encouraged. EERx includes maize, groundnuts, cotton, and Virginia tobacco, while EERm includes maize, sunflower, soybeans, rice, and wheat. Maize appears both as an import substitute and as an export because it switched positions over the years. These calculations assume the absence of import restrictions.

By revising producer prices upward each year, the government may have compensated for the currency overvaluation. However, even though the revised producer prices may approximate border prices in nominal terms, the annual revisions may leave farmers worse-off in real terms (World Bank 1986). Based on the official exchange rate, the incentives given to cereal producers in Zambia increased 46 percent between 1971 and 1983, which means that domestic prices increased significantly more than border prices. When border prices are calculated taking into account real appreciation, incentives only increased 25 percent. The incentives given to export crops over the same period decreased 7 percent in nominal terms, but 20 percent in real terms (World Bank 1986). Thus exchange rate policies have different effects on different commodity groups.

LAND TENURE POLICIES

A dual land tenure system exists in Zambia. Under one system, the president holds the title to state land and delegates authority over it to the commissioner of lands. Rental of state land is set at a nominal average of K 0.80 per hectare per annum. The lease is for a maximum period of 99 years. Land in Zambia has no market value, and the compensation of holding a lease is limited to the value of improvements not exhausted. Therefore, the value of land consists of the cost of investments in infrastructure and improvements. Land has an informal market value, however, and changes hands at a rate much higher than the rate mandated by the government. Under the system of customary land tenure, traditional chiefs govern the use of land under their jurisdiction.

Several studies on land tenure in Zambia have suggested that the traditional land tenure system should be gradually converted into statutory leaseholds. This could be done by establishing differential rents that reflect comparative values based on the potential use of the land, which would make long-term credit more accessible to leaseholders (World Bank 1984). Although the absence of tenure under the traditional system does not give producers secure opportunities to obtain credit and invest in development, the investments in infrastructure, services, and markets that the government and private individuals undertake are more important than the provision of secure credit if they increase the value of undeveloped land (Fosu 1987).

RESEARCH AND EXTENSION SERVICES

In the past, research and extension activities concentrated principally on the needs of commercial farmers, and a committee of experts determined the policies and priorities of national plans to develop the agricultural sector. Recently, however, adaptive research planning teams shifted the emphasis to addressing the constraints of small-scale farmers. These teams were created to ensure that research and extension would complement each other. Moreover, research activities were reorganized into agroecological zones. The country is now divided into three zones served by three main research stations, which are, in turn, supported by a network of provincial and district-based extension stations. Accompanying this reorganization, research was reoriented to managing acid soil, increasing soil productivity, integrating agroforestry and livestock activities into farming systems, and integrating biological control of crop diseases. The approach now focuses on conserving soil moisture; developing early maturing, drought tolerant, and prolific crops; and relating soil, plants, and water to one another with the aim of achieving optimal results by applying water in a timely fashion.

The research program continues to improve varieties suited to the conditions of each region and farming system and to examine issues related to problems after the harvest. Under the new institutional arrangement, joint research priorities are planned between the adaptive research planning teams and the research and extension staff, and a certain amount of decentralization is allowed at the level of the agroecological zone. The government recognizes that policies and targets will only succeed if they are rooted firmly in the local environment. In the long run, this reform seeks to promote research and extension that takes into account and addresses effectively the constraints on farmers. In the short run, improved adaptive trials address the most relevant needs of farmers.

The training and visit system of extension is designed to improve the performance of extension services. Although this system has more contact with small-scale farmers than previous ones, it still communicates a message based on the conditions and experiences of commercial farmers. In the past, research focused on adapting the standard recommended practices to suit the local conditions of the commercial farming community. Because the training and visit system uses extension workers more effectively than previous systems, it is adopted by many countries such as Zambia where the ratio of extension worker to farmer is greater than 1:600. On the other hand, the training

and visit system addresses standard problems and consequently proposes standard solutions, which may not be equally appropriate for commercial and small-scale subsistence farmers or for diverse agroecological regions. Perhaps most important, the extension system requires increased and consistent funding to be effective.

RESOURCE ALLOCATION TO SECTORS

For the most part, analysis of how resources are allocated seeks to reform the system of public expenditures and make resource allocation to the agricultural sector more efficient. How revenue is collected generally receives little attention, even though Zambia's agricultural sector is taxed less than other sectors. To review the priorities that govern how public monies are spent on agriculture and to examine changes in the pattern over the years would require a functional classification of public expenditures in the sector. Unfortunately, the data needed to accomplish this are not available.

The data that are available indicate that the recurrent and capital expenditures of the Ministry of Agriculture and Water Development grew 21 percent in nominal terms and only 7 percent in real terms between 1979 and 1986 (Tables 3.6 and 3.7). The share of the agricultural sector, including subsidies, in the total national budget averaged 13 percent per year during the same period (see Table 3.13). When subsidies are excluded, the average share of agriculture was less than 6 percent, meaning that more than 50 percent of the budget represented subsidies. The subsidy component of the Ministry of Agriculture and Water Development's budget increased from 6 percent in 1981 to 70 percent in 1986. At the national level, subsidies increased their share of the public budget from 26 percent in 1980 to 58 percent in 1987 (see Table 3.14). Within the agricultural sector, the share of subsidies declined from 66 percent in 1981 to 58 percent in 1986. This reflects both a deliberate government policy to reduce subsidies and a general economic crisis in the country.

Despite its growth at an annual rate of 20 percent in nominal terms and 6 percent in real terms, the ministry's budget has significant internal imbalances. First, an imbalance exists between personnel emoluments--that is, salaries, wages, and bonuses--and recurrent departmental charges--that is, operating costs for materials and services. The ratio of recurrent departmental charges to personnel emoluments declined from 1.00:1.05 in 1979 to 1.00:0.34 in 1986 (see Tables 3.15 and 3.16). This significantly affects the ministry's ability

Table 3.13—Budget allocations to programs in the agricultural sector, Zambia, 1981-86

Program	1981	1982	1983	1984	1985	1986[a]
			(K1,000)			
Administration	1,578.5	2,039.9	3,193.0	3,033.5	4,067.3	5,985.6
Area development	3,929.2	7,556.8	6,337.4	21,852.2	19,225.0	59,273.8
Crop and livestock production	5,336.3	8,398.7	15,278.1	4,980.0	9,478.0	28,097.0
Agricultural extension, land use, and information services	10,556.8	16,303.5	23,207.8	24,349.1	25,257.9	44,077.3
Agricultural research	2,590.5	5,117.4	4,079.7	4,613.8	5,393.5	9,607.3
Veterinary services	5,516.5	8,122.2	9,721.4	8,263.4	14,529.0	20,192.6
Agricultural education	3,208.0	4,678.6	2,922.4	4,630.3	7,551.7	13,543.3
Input supply and marketing	5,284.1	10,014.1	17,649.7	21,049.2	18,769.8	37,968.2
Agricultural credit	9,100.0	9,200.0	696.0	250.0	3,500.0	6,500.0
Forestry development	8,078.7	20,558.9	7,274.9	4,492.2	7,692.5	12,539.3
Fisheries development	1,537.7	1,841.1	2,879.6	2,865.7	3,394.0	4,169.6

Total	56,716.3	93,831.2	93,239.8	100,379.8	118,858.7	241,954.0
Agricultural subsidies	108,786.7	153,429.1	81,116.4	90,143.3	150,077.0	332,077.0
Agricultural programs and subsidies	165,503.0	247,260.3	174,356.2	190,523.1	268,935.7	574,031.0
National budget	1,388,607.6	1,643,237.2	1,476,361.4	1,484,625.7	2,181,650.2	5,260,997.1
			(percent)			
Agriculture as a percent of the national budget						
With subsidies	11.9	15.1	11.8	12.8	12.3	10.9
Without subsidies	4.1	5.7	6.3	6.8	5.5	4.6
Agriculture as a percent of the agricultural						
Budget	65.7	62.1	46.5	47.3	55.8	57.9
Gross domestic product	19.6	31.2	13.7	12.6	16.4	...

Source: Compiled from various financial reports of the government of the Republic of Zambia, 1981-86.
Note: The agricultural sector comprises agriculture, forestry, and fisheries.
[a] Preliminary figures.

Table 3.14—Financial operations of the central government of Zambia, 1980-87

Financial Operation	1980	1981	1982	1983	1984	1985	1986	1987
				(K million)				
Total revenues and grants	791.4	834.1	869.1	1,069.1	1,114.8	1,579.5	3,206.4	4,371.1
Tax revenue	684.5	727.8	744.4	940.9	975.1	2,651.6	3,725.7	
Minerals	41.7	1.0	0.0	53.4	94.5	129.5	405.4	475.2
Imports	98.1	108.3	111.0	83.3	122.3	288.1	820.9	1,334.6
Domestic goods	273.4	310.7	337.0	425.5	420.8	447.0	580.4	781.3
Income	271.3	307.8	296.4	378.7	337.5	474.1	844.9	1,134.6
Nontax revenue	83.2	83.8	96.1	75.2	117.1	207.9	383.9	554.1
External grants	23.7	22.5	28.6	53.0	22.6	32.9	170.9	91.3
Total expenditures and net lending	1,581.1	1,292.4	1,544.2	1,379.4	1,439.4	2,084.4	5,108.9	5,537.4
Current expenditures	1,022.6	1,152.3	1,233.7	1,184.1	1,262.3	1,829.4	4,135.5	4,884.5
Personnel emoluments	250.9	354.6	378.9	403.0	451.0	536.3	661.1	1,014.7
Recurrent departmental charges	147.7	153.2	240.4	202.6	219.5	310.7	567.9	1,086.8
Subsidies	206.4	109.1	154.1	82.2	90.5	188.4	569.9	677.4
Construction and statutory expenses	337.1	444.2	317.5	358.5	364.7	615.2	1,996.8	1,684.1
Interest payments	126.8	117.6	149.6	184.3	164.1	336.1	1,125.1	738.4
Domestic	64.2	70.5	74.4	147.5	120.0	266.0	671.0	617.8
External	62.6	47.1	75.2	36.8	44.1	70.1	454.1	120.6
Other payments	210.3	326.6	167.9	174.2	200.6	279.1	871.7	945.7
Transfers and pensions	80.5	91.2	142.8	137.8	136.6	178.8	339.8	421.5
Capital expenditures and net lending	558.5	140.1	310.5	195.3	176.9	255.0	973.4	652.9
Capital outlays	121.3	130.4	198.5	153.9	150.4	180.6	511.4	560.5
Net lending	437.2	9.7	112.0	41.4	26.5	74.4	462.0	92.4

Overall deficit (financing requirements)	789.7	458.3	675.1	310.3	324.4	504.9	1,902.5	1,166.3
External (net)	264.0	247.4	111.6	100.8	40.6	62.5	282.7	(56.6)
Domestic nonbank (net)	41.7	42.0	38.9	81.0	21.5	37.6	49.4	40.9
Bank borrowing	484.0	168.9	524.6	128.5	262.3	404.8	1,570.4	1,182.0
Ratios				(percent)				
Total revenue and grants to total expenditures	50	65	56	78	77	76	63	79
Domestic revenue to total expenditures	49	63	54	74	76	74	59	77
Domestic revenue to gross domestic product	25	23	23	24	22	22	23	24
Capital expenditures to total expenditures	35	11	20	14	12	12	19	12
Capital expenditures to gross domestic product	18	4	9	5	4	4	8	4
Overall deficit to gross domestic product	-26	-13	-19	-7	-7	-7	-15	-6
Bank borrowing to gross domestic product	16	5	15	3	5	6	12	7
Bank borrowing to overall deficit	61	37	78	41	81	80	83	101
External financing to total financing	33	54	17	32	13	12	15	-5
Subsidies to total financing (overall deficit)	26	24	23	27	28	37	30	58
Subsidies to current expenditures	20	9	13	7	7	10	14	14
Subsidies to bank borrowing	43	65	29	64	35	47	36	57

Source: Compiled from national accounts statements of the government of the Republic of Zambia, 1979-86.

Table 3.15—Expenditures in nominal terms and ratio of personnel emoluments to recurrent departmental charges and of recurrent to capital expenditures, Zambia, 1979-86

Year	Personnel Emoluments	Recurrent Departmental Charges	Ratio of Recurrent Departmental Charges to Personnel Emoluments	Ratio of Capital to Recurrent Expenditures
	(K1,000)			
1979	8,405.3	8,819.0	1.05	0.13
1980	8,899.2	10,897.9	1.23	0.09
1981	10,313.0	11,874.0	1.15	0.14
1982	15,466.3	20,830.3	1.35	0.13
1983	15,733.9	23,472.3	1.49	0.38
1984	33,335.8	7,439.1	0.22	0.39
1985	35,975.2	10,343.1	0.03	0.99
1986	56,342.3	18,896.1	0.34	2.15

Source: Compiled from various financial reports of the government of the Republic of Zambia, 1979-86.

Table 3.16—Expenditures in real terms and ratio of personnel emoluments to recurrent departmental charges and of recurrent to capital expenditures, Zambia, 1979-86

Year	Personnel Emoluments	Recurrent Departmental Charges	Ratio of Recurrent Departmental Charges to Personnel Emoluments	Ratio of Capital to Recurrent Expenditures
	(K1,000)			
1979	9,236.6	9,691.2	1.05	0.13
1980	8,899.2	10,897.9	1.23	0.09
1981	8,762.1	10,088.3	1.15	0.14
1982	13,062.7	17,593.2	1.35	0.13
1983	11,937.7	17,809.0	1.49	0.38
1984	22,105.0	4,933.1	0.22	0.39
1985	19,145.9	5,504.6	0.03	0.99
1986	19,112.0	6,409.8	0.34	2.15

Source: Compiled from financial reports of the government of the Republic of Zambia, 1979-86.

to deliver essential services to farmers. Second, an imbalance exists between current and capital outlays. Although current expenditures declined in both nominal and real terms, as shown in Tables 3.7 and 13, capital expenditures continued to grow. The ratio of capital to current expenditures thus increased from 1.00:0.13 in 1979 to 1.00:2.15 in 1986. Since the incremental recurrent cost required by 1 kwacha of capital expenditure is approximately 11 percent (and the real annual growth rate in capital expenditure was about 15 percent between 1979 and 1986), a real growth rate in recurrent expenditures of about 4 percent was needed over the same period (Jansen 1986).

Other issues are important to understanding the implications of the level and pattern of investment in greater depth. First, the current and capital expenditures on human capital formation, livestock programs, forestry programs, and agricultural research in capital formation should be disaggregated and compared with investment expenditures on noncapital formation, such as administration and planning. Second, the tax policies that affect agriculture should be analyzed to see (a) whether the current method of collecting revenue distorts incentives and supports inefficient patterns of agriculture; (b) whether alternative methods of collecting revenue could collect the same amount of revenue while distorting relative prices less; and (c) whether additional revenue could be collected without having a negative impact on poor farming households (Norton 1988).

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4
Policy Constraints on the Development of Agriculture and Small-Scale Enterprises in Rural Zambia

Lundondo Mumeka

This paper assesses Zambia's macroeconomic policies during the 16 years from 1970 to 1986. First, it discusses comprehensive and aggressive policies to develop agriculture. Such policies are the only viable means for diversifying the country's copper-dependent economy and promoting balanced growth and equity. Second, it examines the government's policies to industrialize and promote the development of small-scale enterprises (particularly privately owned enterprises) in rural areas. Third, it analyzes the new paradigms for allocating resources that were developed by the post-Mulungushi industrialization policies. Fourth, it stresses the importance of rural, small-scale enterprises in supporting agriculture and thus promoting economic growth.

THE STRUCTURAL ORIGIN OF POLICY DEFICIENCIES

Policy deficiencies in Zambia can be traced to endogenous and exogenous factors. Both factors are essential to analyzing the policy options chosen by the government.

Endogenous Factors

The copper industry occupies a pivotal position in Zambia's economy and influences the direction of Zambia's general economic policy. The overall growth of the Zambian economy depends on the buoyancy of the revenue generated by the copper industry. Except for two periods, from 1975 to 1980 and from 1984 to 1985, the copper industry contributed between 24 and 46 percent of Zambia's gross domestic product in the 22 years between 1964 and 1986. The copper industry thus exerts a great deal of influence on the government's fiscal policy, and the government budget is highly sensitive to changes in both the production and price of copper.

The copper industry also provides the framework within which domestic savings and capital formation take place. It is the country's

major source of foreign exchange earnings and generates over 90 percent of Zambia's earnings from exports of merchandise. The mining industry continues to be the largest employer of wage labor, despite the decline in its share of employment from 18 percent in 1976 to 16 percent in 1986.[1]

Exogenous Factors

From 1964 to 1974, Zambia experienced relatively high economic growth and stability followed by serious convulsions in the world economy. Most of these were triggered by fluctuations in the real price of oil, which quadrupled in 1973-74, fell one-sixth between 1974 and 1978, and then increased 80 percent during 1979-80.[2] The high cost of oil imports meant that the imported capital and intermediate goods required to produce domestic goods and services had to be forgone.

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[1] The following statistics describe the share that mining and quarrying held in Zambia's total employment in the formal sector between 1976 and 1986.

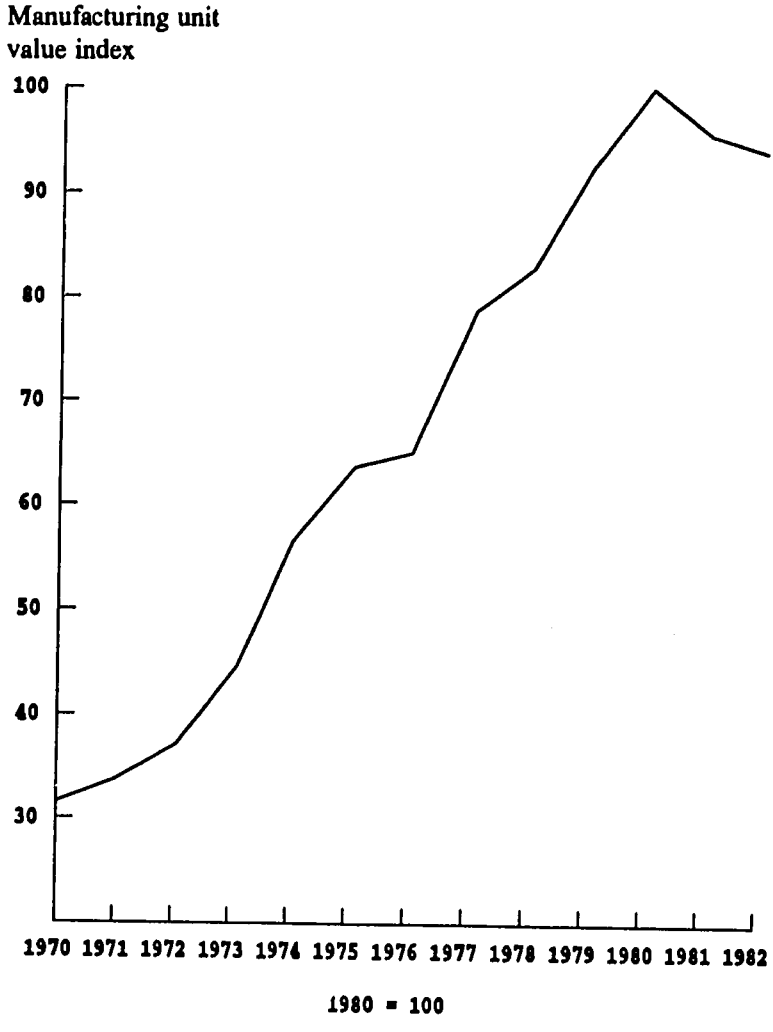
1976	1978	1979	1980	1981	1982	1983	1984	1985	1986
				(percent)					
17.5	17.0	16.3	16.5	16.2	16.2	15.9	16.0	15.9	15.8

Source: Zambia, Central Statistical Office, Monthly digest of statistics (Lusaka, Zambia, 1987).

[2] Other factors also caused convulsions in the world economy (commonly referred to as external shocks). First, inflation hit double digits in 1973, receded slightly, and once again soared into double digits late in the decade. Although Zambia's exports initially profited from the upsurge in global inflation, the benefits were short-lived. By 1974, the profits earned from the high price of raw materials were consumed by the skyrocketing price of oil and oil products. Second, global economic growth took a downswing accentuated by the steep recessions of 1974-75 and 1980-82. At the same time, the problem of stagflation in industrialized countries caused import prices to rise precipitously and export markets and prices to decline by the same magnitude. Third, interest rates soared to an unprecedented height, which caused the cost of borrowing money (especially from private banks) and of servicing foreign debts to rise substantially. The combination of these shocks gave Zambia a Hobson's choice of going deeply into debt or suffering economic collapse.

As the price of oil rose, so did the dollar value of imported merchandise (manufactured goods). As Figure 4.1 illustrates, the year-to-year movements of the unit value index of manufactured goods began to rise steeply in 1970 and reached a peak of 100 percent in 1980.

Figure 4.1—Price indices, Zambia, 1970-82

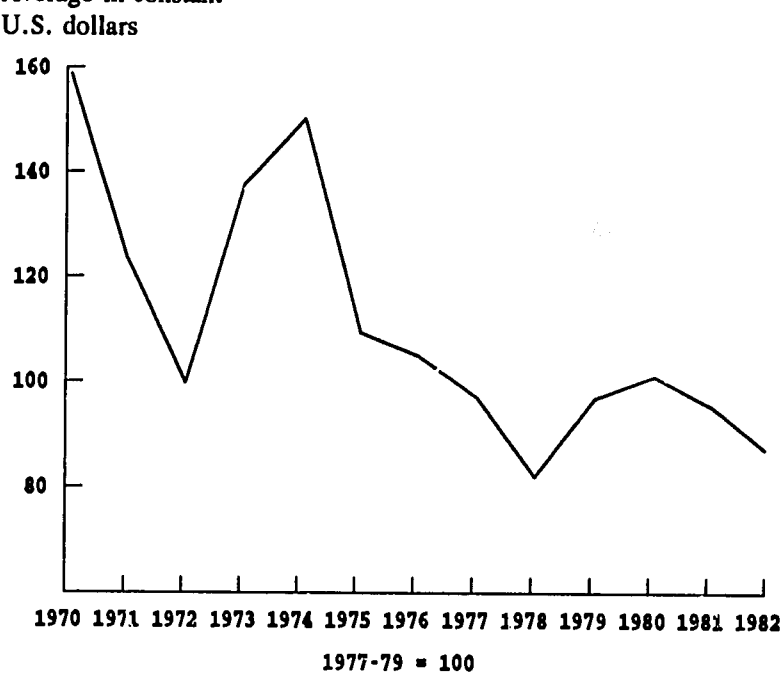


Source: World Bank, *Commodity trade and price trends, 1985* (Washington, D.C.: World Bank, 1985).

While the price of oil and imported merchandise increased, so did the value of the dollar. This strongly depressed the dollar price of exports, especially of primary products such as metals and minerals, which are Zambia's main source of international liquidity (see Figure 4.2). The purchasing power of these products averaged 60 percent in 1970, plummeted to 15 percent in 1975, and declined to average a negative 5 percent in 1982 (1977-79 = 100; see World Bank 1985).

The situation was aggravated by sporadic, sharp recessions between the second quarter of 1974 and the fourth quarter of 1982. These recessions hit industrialized countries, producing a general slowdown in economic growth and high rates of unemployment. Beginning in 1979, these factors caused a large and rapid growth in Zambia's trade deficit and a sharp deterioration in its terms of trade (see Figure 4.3).

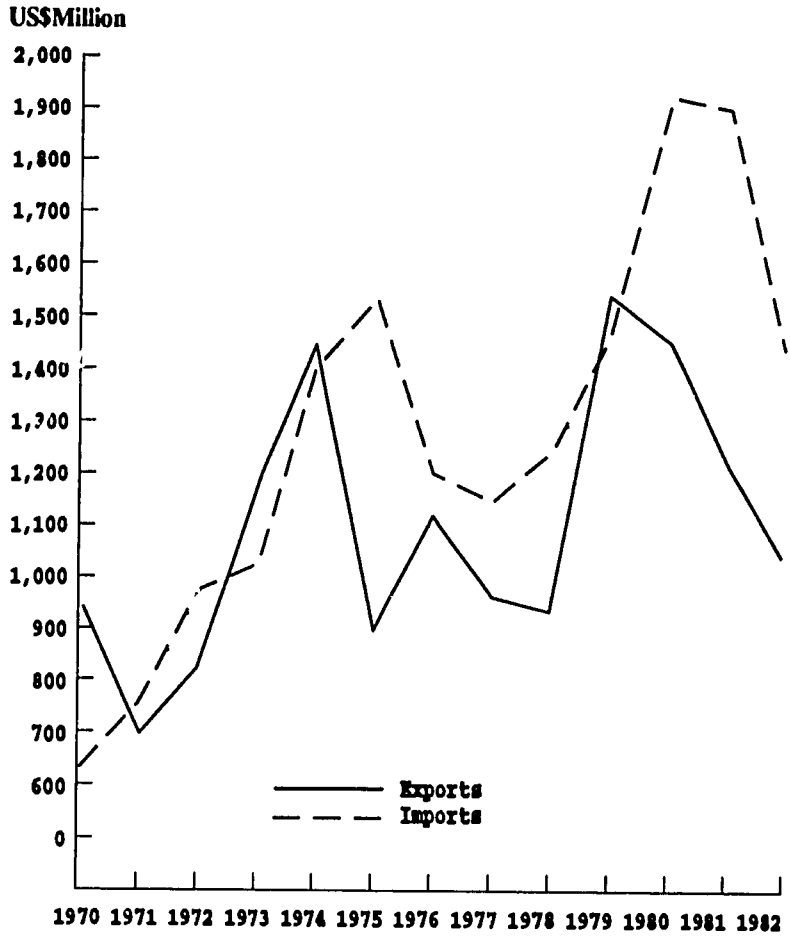
Figure 4.2—Purchasing power of primary commodity exports compared with manufactured imports, developing countries, 1970-82



Source: Calculated from World Bank, *Commodity trade and price trends, 1985* (Washington, D.C.: World Bank, 1985).

Note: The primary commodities are metals and minerals.

Figure 4.3--Balance of trade, Zambia, 1970-82



Source: Calculated from International Monetary Fund, *Direction of trade statistics yearbook, 1970-1983* (Washington, D.C.: IMF, 1970-83).

The world price of copper slumped, and so did the Zambian economy. The average price of copper dropped 40 percent in one year, from an average of US$0.93 per pound in 1974 to US$0.56 in 1975. It recovered temporarily in 1979 and 1980, reaching almost US$1.00 per pound as world stocks fell drastically. Since then, the trend has

remained downward, averaging less than the 1974 peak even in current terms. The collapse of copper prices had an adverse multiplier effect. Drastically reduced export earnings generated a foreign exchange crisis, particularly after 1980, and had a severe, adverse impact on the manufacturing sector. Foreign exchange shortages now constitute the most critical constraint to industrial growth and diversification. By 1984 many firms were operating at a low 30 percent of capacity.

The government budget was under severe pressure between 1975 and 1982. The mining industry's contribution to government revenue dropped from 53 percent in 1974 to 0 percent in 1977, 1978, and 1979, only 6 percent in 1980, and then 0 percent again in 1981 and 1982. As a result of decreased output and greatly reduced profitability in almost all industries, few taxes were collected from mining companies. The inflow of both customs and excise duties was similarly affected.

The continued erosion of Zambia's terms of trade led to a huge reduction in national income (exports account for 50 percent of Zambia's gross national product; see Zambia, Central Statistical Office 1984). The economic growth of the 1960s and most of the 1970s came to an abrupt halt, and per capita growth was reversed (World Bank 1981, 154). By 1985 per capita income stood at $390, prompting the World Bank to reclassify Zambia from a low-middle-income to a low-income country.

The overall macroeconomic environment ultimately forced the government to use external financing to sustain the necessary level of recurrent expenditures and imports. This drained export earnings.[3] The extent to which the country's real resources were diverted to

[3] The following data show the extent and effect of Zambia's external indebtedness for the period 1980-86.

Ratio	1980	1981	1982	1983	1984	1985	1986
				(percent)			
Debt to exports	199.8	307.3	337.8	369.0	396.9	527.1	326.1
Debt to gross national product	90.3	92.1	100.2	120.2	152.0	185.9	356.5
Debt service to exports	17.3	25.1	16.3	12.2	11.9	11.2	7.6
				(months)			
International reserves to imports	1.2	0.9	1.2	1.3	0.6	2.2	0.4

Source: Mumeka (1987).

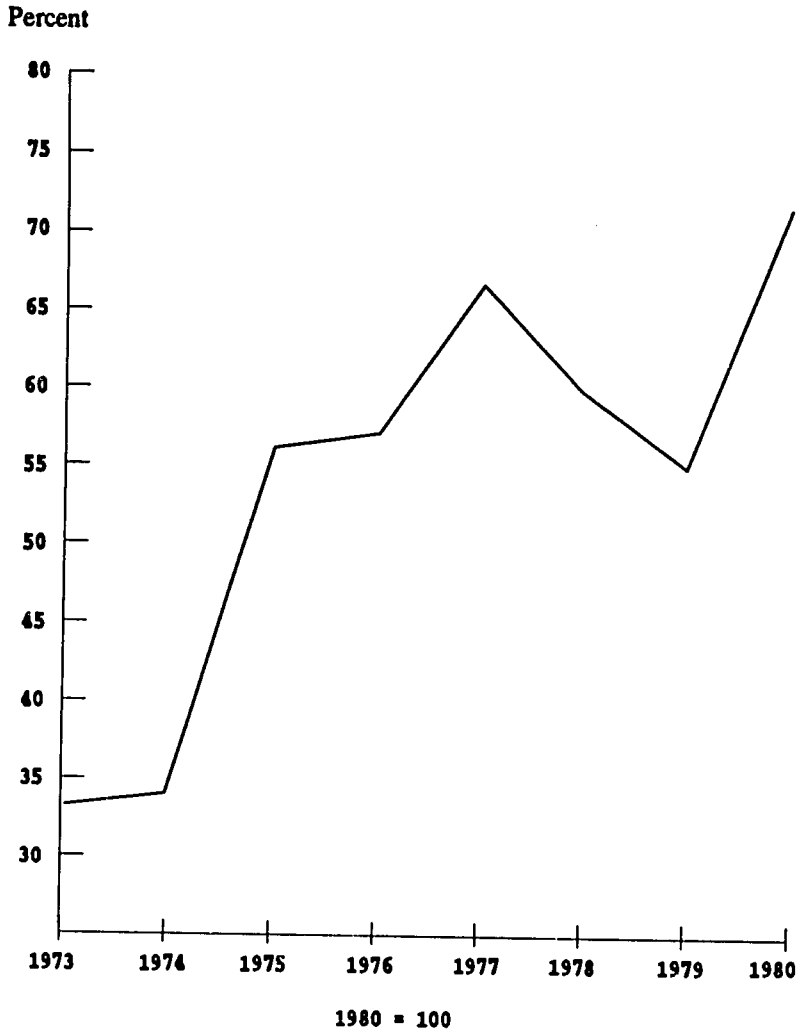
servicing the external debt between 1973 and 1980 is shown in Figure 4.4. Scaled in relation to exported goods and services, the outstanding external debt (including undisbursed debt) rose from 87 percent at the end of 1970 to over 303 percent at the end of 1982 (see Figure 4.5). Also, as illustrated in Figure 4.6, the cost of paying interest and amortization, plus weak export earnings, forced Zambia to use foreign reserves to service the external debt. The country's international reserves as a percentage of disbursed external debt plummeted from nearly 97 percent in 1970 to about 7 percent in 1982. This reduced the country's safety margin of international reserves (that is, its capacity to import goods and services) to critically low levels of less than three months during the period from 1975 to 1986. As of March 31, 1986, Zambia's external debt totaled US$4.6 billion, including US$430 million in short-term commercial arrears.

This scenario depicts how dependence on the copper industry makes the Zambian economy highly vulnerable to the vagaries of external factors. It also underlines the necessity of diversifying the country's economy away from the copper industry and toward agriculture.

MACROECONOMIC POLICIES AND AGRICULTURAL DEVELOPMENT

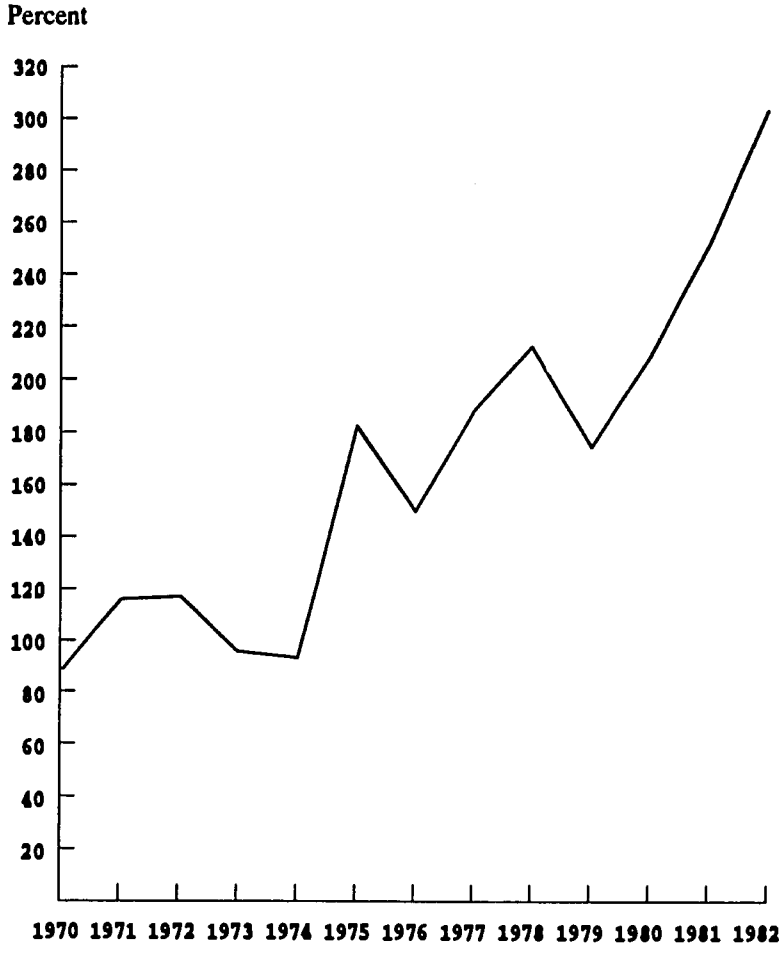
There is a general consensus in Zambia that agriculture could play an overwhelming role in development. This consensus is reflected in Zambia's postindependence economic policies, which purportedly discourage discrimination against the agricultural sector. The reasons for this approach are easy to find. First, the largest segment of Zambia's population and the majority of the poor depend on agriculture for their livelihood. Second, increased agricultural production is critically important because the population is growing rapidly, especially in urban areas. Third, agriculture is a viable policy instrument for attacking poverty and hunger on a broad front. Thus Zambia could use agricultural development to redress the urban-rural bias in income distribution, given the right policy mix (see, for example, Kaunda 1967, 1982; and International Labour Organisation 1969). Growth in the agricultural sector would encourage production to be more labor-intensive. This policy has merit, since the goods demanded by the majority of Zambians (food, clothing, and housing) are produced in relatively labor-intensive industries.

Figure 4.4—External debt as a percentage of the gross domestic product, Zambia, 1973-80



Source: World Bank, *World tables*, various issues (Washington, D.C.: World Bank, various years); and World Bank, *World debt tables: External debt of developing countries*, various issues (Washington, D.C.:World Bank, various years).

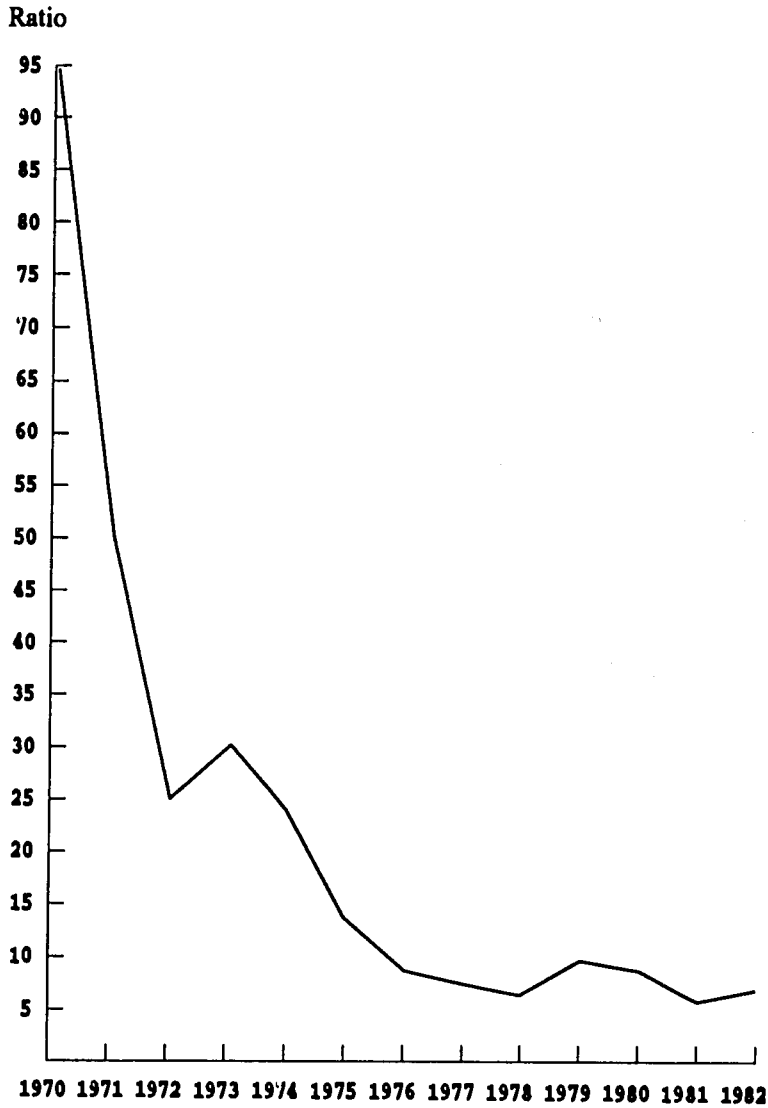
Figure 4.5—Outstanding external debt as a percentage of the total value of exports, Zambia, 1970-82



Source: Calculated from World Bank, *World debt tables: External debt of developing countries, 1970-83* (Washington, D.C.: World Bank, various issues).

Note: Includes undisbursed debt.

Figure 4.6—Ratio of international reserves to disbursed debt, Zambia, 1970-82



Source: Calculated from World Bank, *World debt tables: External debt of developing countries, 1970-83* (Washington, D.C.: World Bank, 1970-83).

Further, agriculture has a long-term future because Zambia has vast tracts of land that is excellent for agricultural development. The agricultural sector could expand its production not only of food, but also of raw materials. This is especially important because Zambia imports most of the raw materials it uses for industrial production.

From 1970 to 1985 government policies to develop agriculture and food production revealed constant and sustained biases against agriculture and for nonagricultural and urban-based industries. The government allocated more resources to develop nonagricultural sectors than to develop the agricultural sector, which was neglected throughout the second and third national development plans (1972-83).

Between 1974 and 1985 the central government allocated only 7 percent of its financial resources and 5 percent of the total value of imported capital goods to productive activities in the agricultural sector. From 1973 to 1981 agriculture received only 10 percent of the total value of imported inputs (see Zambia, Central Statistical Office 1974-82a).

Consequently, the government did not achieve self-sufficiency in the production of food. From 1970 to 1981 the total value of food imports amounted to K 445.7 million. Between 1979 and 1984 Zambia imported under commercial and concessional terms 132,602 tons and 4,663,153 bags of foodgrains (each bag weighs 90 kilograms; see Mumeka 1987; Zambia, National Agricultural Marketing Board 1979-84).

The high cost of food imports, together with widespread food shortages, increased the cost of living, wages, and the cost of production. It also exacerbated the acute shortage of foreign exchange and limited the country's ability to import much-needed capital goods and spare parts.[4]

Zambia has considerable potential for agricultural development. It has an estimated 45 million hectares of arable land, but only 4.5 million hectares, or 10 percent, were cultivated during the 1984/85 season. Zambia's climate and topography vary widely, which allows a

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[4] Food imports were valued at K 24.9 million in 1973, or 7 percent of total commodity imports, and prices continued to rise. Between 1974 and 1981 the value of imported food averaged 9 percent of the value of all imported goods. In 1982 it stood at K 49.4 million, or 5 percent of total commodity imports, which were valued at K 930.0 million. See Zambia, Central Statistical Office (1974-86b).

wide range of crops to be grown.[5] Despite its potential, agricultural growth is retarded by inappropriate policies. The vast majority of utilized land is cultivated with rainfed maize, which contributes over 70 percent of the total value of agricultural products marketed. Zambia also has the potential to irrigate 12 million hectares, but in 1982 only 16,000 hectares, or about 0.13 percent of the country's irrigation potential, were developed (for details on irrigation potential in Sub-Saharan Africa, see Food and Agriculture Organization of the United Nations 1985).

Policies intended to develop the agricultural sector are inconsistent and tend to favor recurrent over capital expenditures. From 1970 to 1982, for example, 65 percent of total expenditures were allocated to subsidies. The same was true with recurrent and capital expenditures on agricultural research from 1980 to 1985. In 1980 recurrent expenditures received K 1.9 million, or 58 percent of the K 3.3 million allocated. This increased to K 3.1 million, or 76 percent of the K 4.1 million allocated, in 1983. The amount allocated to capital expenditures was K 1.4 million (42 percent) and K 1.0 million (24 percent) of total allocations in 1980 and 1983, respectively.

Although government development policies and programs constantly stress that agricultural growth is a first priority, the results for the period from 1972 to 1986 were extremely disappointing. Agriculture's overall contribution to the gross domestic product never exceeded 16 percent, and between 1974 and 1986 its share of the country's employment never exceeded 10 percent (see Tables 4.1 and 4.2). The agricultural sector will have to account for at least 30 percent of the gross domestic product by the year 2000 if agriculture is to replace copper as the driving force in the economy.[6]

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[5] Zambia has three main seasons: a cool and dry period from April to August, a hot and dry season from August to November, and a warm and wet season from November to April, which is the main planting and growing season.

[6] Some progress was made during 1983-85. The agricultural value added grew an average of 8 percent a year, and enough maize was produced to make the country self-sufficient in 1985 and enough to record a surplus in 1986.

Table 4.1—Contribution of the agricultural sector to the gross domestic product, Zambia, 1972-86

Year	Gross Domestic Product	Agricultural Sector	Share of the Agricultural Sector in the Gross Domestic Product
	(Kmillion)		(percent)
1972	1,334.7	171.7	12.9
1973	1,616.0	186.3	11.5
1974	1,913.6	199.4	10.4
1975	1,603.0	206.4	12.9
1976	1,962.5	273.3	13.9
1977	1,986.4	321.5	16.2
1978	2,250.7	357.8	15.9
1979	2,660.4	397.2	14.9
1980	3,063.6	435.3	14.2
1981	3,485.4	553.8	15.9
1982	3,595.3	492.2	13.7
1983	4,181.2	593.7	14.2
1984	4,931.1	717.2	14.5
1985	7,048.6	916.1	13.0
1986	12,097.9	1,304.6	10.8

Source: Zambia, Central Statistical Office, *Monthly digest of statistics*, various issues.

AGRICULTURAL PRODUCTION AND FOOD POLICY

Since 1980 the primary focus of agricultural production and food policy has been to achieve self-sufficiency in the production of maize. Maize is the country's staple food and thus a commodity of strategic importance to maintaining political stability. The general policy is to acquire national self-sufficiency and build adequate national reserves of

Table 4.2—Employment in the agricultural sector and the formal sector, Zambia, 1974-86

Year	All Sectors	Agricultural Sector	Agricultural Sector as a Percent of All Sectors
	(thousands)		(percent)
1974	384.9	33.6	8.7
1975	393.5	36.1	9.2
1976	368.8	32.5	8.8
1977	370.5	30.8	8.3
1978	367.0	31.6	8.6
1979	373.9	31.9	8.5
1980	379.3	32.6	8.6
1981	373.7	36.4	9.7
1982	367.5	35.2	9.6
1983	363.8	35.4	9.7
1984	365.2	35.6	9.7
1985	351.5	35.1	10.0
1986	360.5	34.8	9.7

Source: Zambia, Central Statistical Office, *Monthly digest of statistics*, various issues.

maize.[7] The immediate goal is to increase both the number of farmers, particularly small-scale farmers, who grow maize and the area under cultivation. This effort was complemented by the creation of a system of incentives for maize growers and a streamlined marketing system, which began to increase the price of maize in 1975/76 (see Table 4.3).

[7] Copperbelt and Lusaka provinces have Zambia's largest urban centers and highest concentration of population. By the 1980 census, the Copperbelt's population stood at 1,146,185 persons, or 51 percent of the nation's urban population of 2,258,519. Lusaka's population was 538,469 persons, or 24 percent of the total urban population. From 1969 to 1980, the average annual growth rate was 4 percent for Copperbelt and 9 percent for Lusaka (see Zambia, Central Statistical Office 1986b, vol. 22, no. 1-4, Table 3).

Table 4.3—Producer price of maize, Zambia, 1971-86

Year	Price[a]	Percentage Change
1971	4.00	...
1972	4.30	7.5
1973	4.30	...
1974	5.00	16.3
1975	.6.30	26.0
1976	6.30	...
1977	6.30	...
1978	9.00	42.9
1979	9.00	...
1980	11.70	30.0
1981	13.50	15.4
1982	16.00	18.5
1983	18.30	14.4
1984	24.50	33.9
1985	28.32	19.7
1986	55.00	87.6

Source: Bank of Zambia, *Report and statement of accounts for the year ended 31st December* (Lusaka, Zambia: Bank of Zambia, 1973-85).

[a] In kwacha for a 90-kilogram bag of grade A maize at all depots.

The policy to increase the production of maize by increasing the number of small-scale farmers has been successful. Small-scale farmers now produce more than 60 percent of all maize. This is a phenomenal achievement since in 1964, when the country became independent, small-scale farmers contributed only 20 percent of the nation's maize production. Efforts to increase the area cultivated with maize have also been successful despite the declines between 1978 and 1984 (see Table 4.4).

Table 4.4—Area cultivated with maize, Zambia, 1974-86

Agricultural Year	Number of Hectares	Percentage Change
1974/75	212,194	...
1975/76	268,078	16.3
1976/77	485,000	80.9
1977/78	595,000	22.7
1978/79	335,000	-43.7
1979/80	540,000	61.2
1980/81	493,783	-8.6
1981/82	482,000	-2.4
1982/83	538,600	11.7
1983/84	507,000	-5.9
1984/85	566,900	11.8
1985/86	588,490	3.8

Source: Bank of Zambia, *Report and statement of accounts for the year ended 31st December* (Lusaka, Zambia: Bank of Zambia, 1975-85).

The trend in the marketed production of maize shows the degree to which efforts to increase production were successful from 1970 to 1983 (see Table 4.5). From 1984 to 1986 the recorded production of maize remained high: 571,230 tons in 1984, an increase of 8 percent from 530,640 tons the year before, and 636,267 tons in 1985, another 11 percent increase. In 1986 production increased 50 percent to reach 953,981 tons (Bank of Zambia 1986, 13).

General Price Policy

Until 1982 the price of all agricultural commodities was governed by the official structure of prices. Once set, official prices for agricultural commodities were administered by statutory boards supervised by Zambia's Ministry of Agriculture and Co-operatives.

Table 4.5—Marketed production of maize in Zambia, by province, 1970-83

Year	Central	Copperbelt	Eastern	Luapula	Lusaka[a]	Northern	Northwestern	Southern	Western	Total
1970										
Number	903,200	6,700	15,600	19,600	...	56,800	15,200	461,400	11,800	1,490,300
Percent	60.6	0.4	1.0	1.3	...	3.8	1.0	31.0	0.8	99.9
1971										
Number	2,604,400	33,100	152,000	25,400	...	63,800	33,100	1,504,200	27,800	4,443,800
Percent	58.6	0.7	3.4	0.6	...	1.4	0.7	33.8	0.6	99.8
1972										
Number	4,200,000	30,000	330,000	27,000	...	69,000	39,000	2,300,000	19,000	7,014,000
Percent	59.9	0.4	4.7	0.4	...	1.0	0.6	32.8	0.3	100.1
1973										
Number	2,535,266	132,647	505,937	29,196	...	58,984	25,504	1,346,395	14,750	4,648,499
Percent	54.5	2.9	10.9	0.6	...	1.3	0.5	29.0	0.3	100.0
1974										
Number	3,920,995	24,530	612,161	15,518	...	61,997	30,881	1,946,710	30,123	6,642,915
Percent	59.0	0.4	9.2	0.2	...	0.9	0.5	29.3	0.5	100.0
1975										
Number	2,844,008	33,330	769,713	17,664	...	111,333	28,867	2,335,657	74,418	6,214,690
Percent	45.8	0.5	12.4	0.3	...	1.8	0.5	37.6	1.2	100.1
1976										
Number	3,844,808	71,592	912,122	26,637	...	183,607	38,050	3,031,070	80,329	8,188,255
Percent	47.0	0.9	11.1	0.3	...	2.2	0.5	37.0	1.0	100.0

(continued)

1977										
Number	3,322,046	69,091	1,026,153	33,731	...	210,014	30,057	2,961,505	85,753	7,738,347
Percent	42.9	0.8	13.3	0.4	...	2.7	0.4	38.3	1.1	99.9
1978										
Number	2,421,155	51,308	771,628	34,286	...	203,034	[illegible]	2,907,349	39,436	6,462,847
Percent	37.5	0.8	11.9	0.5	...	3.1	[illegible]	45.0	0.6	99.9
1979										
Number	1,232,030	41,777	529,462	19,318	...	120,304	31,749	1,898,719	33,605	3,906,964
Percent	31.5	1.1	13.6	0.5	...	3.1	0.8	48.6	0.9	100.1
1980										
Number	1,540,706	35,138	730,744	19,164	192,596	151,039	15,541	1,907,322	13,759	4,606,009
Percent	33.4	0.8	15.9	0.4	4.2	3.3	0.3	41.4	0.3	100.0
1981										
Number	2,662,628	37,333	1,184,042	50,822	292,584	328,273	49,686	3,055,630	42,601	7,703,599
Percent	34.6	0.5	15.4	0.7	3.8	4.3	0.6	39.7	0.6	100.2
1982										
Number	1,865,338	65,700	1,273,237	52,763	218,035	648,590	49,083	1,642,443	38,202	5,674,163
Percent	32.9	1.2	22.4	0.9	3.8	11.4	0.9	28.9	0.7	103.1
1983										
Number	2,236,714	90,350	1,599,000	40,155	217,545	644,001	51,263	962,823	50,638	5,892,469
Percent	38.0	1.5	27.1	0.7	3.7	10.9	0.9	16.3	0.9	100.0

Source: Zambia, Department of Agriculture, *Annual report of the extension branch* (Lusaka, Zambia: Government Printer, 1970-83).

Note: Numbers refer to the number of 200 pound/90 kilogram bags of maize produced. Totals may not add to 100.0 due to rounding.

[a] Until 1979 Lusaka was one of the five districts (Kabwe, Lusaka, Mkushi, Mumbwa, and Serenje) in Central Province.

To understand how the pricing mechanism works, it is important to know whether a marketing board exists and to understand how it works for a particular commodity.[8] Thus, the extent to which the official price relates to the effective price depends on the existence of a marketing board and the degree to which it is involved in marketing the commodity. If a board handles the commodity at all levels, from the producer to the processor to the consumer, the official price is also the effective price. Where no marketing board exists, as is the case with fruits and vegetables, the free market price is the effective price.

Price Policy for Maize

The pricing regime for maize is characterized by three distinct structural dimensions, namely the producer price, the consumer price, and uniform pricing. The official price of maize is kept consciously and consistently low in order to keep the cost of food to the urban population low. This policy objective conflicts directly with the government's declared objective of providing remunerative prices and adequate incentives to encourage producers to increase their agricultural production and marketed surplus.

Available data for 1977 to 1986 show yet another policy contradiction: the pricing mechanism favors commodities (such as maize, rice, soybeans, tobacco, and wheat) produced by large-scale and small-scale farmers in the modern sector and in agriculturally advanced provinces.

Compared with international prices (adjusted for the cost of transporting the product to Zambia's border), the rate of protection for all Zambian agricultural commodities is uniformly negative (for studies on agricultural prices in Zambia and other countries, see Jansen 1977). The exceptions are maize and wheat. Instead of protecting Zambian farmers by imposing import duties that equalize the price, artificially low producer prices penalize Zambian farmers and subsidize foreign farmers.

Another contradictory policy governs the consumer price of agricultural commodities. First, this pricing structure produces a price differential subsidy exceeding the total cost of marketing. Second, it

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[8] The following statutory boards were concerned with the marketing of agricultural commodities in 1985: National Agricultural Marketing Board, Dairy Produce Board, Cold Storage Board, Lint Company of Zambia Limited, and National Tobacco Company.

discourages farmers from keeping maize for their own consumption since the opportunity cost of retention (that is, the consumer price) is lower than the selling price. The policy governing consumer prices contradicts the national policy supporting self-sufficiency because it encourages farmers to sell all the maize they produce and to repurchase maize for their own consumption. It also doubles handling, storage, and transportation costs.

The third policy contradiction relates to uniform pricing. A by-product of the early 1970s, uniform pricing calls for greater equity in the distribution of income and other real resources (see Kaunda 1970, 1972, 1973; and Zambia, National Commission for Development Planning 1979). Instead, it produces inequitable distribution of income and inefficient patterns of production. For maize, it particularly exacerbates the differential between incomes in the enclave sector, which lie close to the railroads and have low production costs, and incomes in rural areas (especially in Eastern, Western, Northern, Northwestern, and Luapula provinces), which have high production and transportation costs. Uniform pricing results in inefficient allocations among both crops and regions, since differential handling, storage, and transportation costs are simply ignored. This in effect heavily subsidizes the goods that have the lowest value per ton and discourages farmers from growing crops (such as coffee, tea, and cotton) that could contribute the most to satisfying the country's economic needs. To turn the agricultural sector into the base for the country's economic growth, policymakers in Zambia must critically examine the policy of uniform pricing.

Agricultural Subsidies

In theory, subsidies can be used to support the decision-making process in targeted economic groups. In Zambia subsidies were designed to stimulate farmers to make a series of production decisions, although not all subsidies provide the same stimulus.

To appraise specific agricultural subsidies fully, their relative weight, such as their relation to the total production of the agricultural sector or of individual subsectors within agriculture, must be measured. Although such analysis is beyond its scope, this paper does examine the impact that consumer and producer subsidies have on agricultural production.

Agricultural subsidies in Zambia may be classified as consumer and producer subsidies. The government uses consumer subsidies to keep the price of maize low for the consumer. It uses producer

subsidies to keep the price low for the producer. Thus the government controls both producer and consumer prices by granting farmers and marketing agencies subsidies to cover the costs of producing and marketing maize.

The central argument against both types of subsidies is that they distort the patterns of supply and demand. More important, however, is that practically all consumption subsidies benefit consumers in urban areas and accentuate rather than reduce the existing gap between urban and rural consumers. They also fail to take into account the chronic shortage of food that exists in rural areas, where the daily caloric intake per capita can be as low as 1,300 calories.[9]

The system that distributes input subsidies is inherently discriminatory. First, fertilizer subsidies are distributed selectively and almost exclusively to the producers of the enclave sector (large-scale and small-scale commercial farmers who are relatively well-to-do). Second, the distribution policy favors advanced provinces that are relatively accessible. Central, Lusaka, Southern, and parts of Eastern provinces account for nearly 90 percent of the fertilizer used in 1980, and Northern Province was favored more recently. The net effect of fertilizer subsidies is that farmers in the commercial sector or enclave economy have lower costs of production, which enable them to receive, in effect, a higher price than that received by producers in the peasant sector. This is the result of the price differential of fertilizer. The commercial farming sector employs capital-intensive technology and also benefits from subsidies on inputs such as machinery, equipment, diesel, and other agricultural imports. These imported agricultural inputs are exempt from import duties and, most important, are available to commercial farmers at grossly undervalued foreign exchange rates.

The Marketing Policy of the National Agricultural Marketing Board

The National Agricultural Marketing Board (NAMBOARD) was established by Parliament in 1969 to consolidate the functions of the Grain Marketing Board and the Agricultural Rural Marketing Board,

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[9] Food insecurity requires immediate, concerted attention. In 1986, 2.7 million Zambians, or 48 percent of the population, did not have secure supplies of food. The other countries in which more than 40 percent of the population suffer from food insecurity are Chad, Ethiopia, Mozambique, Somalia, Uganda, and Zaire. See World Bank (1988).

which had been created by the settler government of Rhodesia and Nyasaland in 1954. During federal rule (1953-63), the system of marketing agricultural products was structured on the basis of political considerations. Crops grown by white farmers were protected against competition from crops grown by Africans, and Africans were not permitted to sell their agricultural products in certain urban markets. The result was an acutely dualistic marketing structure with a pronounced bias favoring medium- and large-scale white farmers. The inputs of these farmers were subsidized through the Grain Marketing Board, which marketed their crops and distributed their inputs. Enjoying an artificial and protected monopoly on marketing, white farmers paid lower unit costs and realized maximum returns (for a detailed discussion of federal marketing policies governing agricultural products, see Mumeka 1987, 153-66).

NAMBOARD was established to function as the government's marketing agency, to provide "cheap" food to mining and industrial workers, and to guarantee a market for maize and other major crops.[10] The policies administered by NAMBOARD still favor the commercial farmers of the enclave sector and accentuate the dualistic economic structure inherited at the time of independence. To stimulate the desired agricultural growth, the government must formulate and implement policies that radically change the structure and institutions of the agricultural marketing system. Until 1980, NAMBOARD enjoyed an absolute monopoly over the purchase and distribution of controlled and uncontrolled farm products and inputs. One fruitful change might be to amend the NAMBOARD act, or enact a new one, to create a financially viable, profit-oriented parastatal company.

Institutional Reforms in Marketing

Structural and institutional changes implemented in the late 1970s and early 1980s transferred some of NAMBOARD's marketing

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[10] NAMBOARD's operating expenses are reimbursed by the government when they cannot be met by the difference between the Board's selling price and its purchase price and by the "price equalization funds." The government thus pays the "price differential" and "handling cost" subsidies annually.

functions to newly established parastatal companies.[11] In 1980 the new policy eliminated NAMBOARD's monopoly over the trading and supply of inputs for maize. By December 1982 all of NAMBOARD's functions relating to the primary marketing of and intraprovincial trade in maize (and other crops) were transferred to provincial cooperative unions. This major shift in policy led to the formation of cooperative unions in Copperbelt, Lusaka, Northwestern, and Western provinces, where no cooperatives had existed. The new policy proved effective. Provincial cooperative unions account for more than 60 percent of the maize marketed, although their coverage of the market is most intense in Central, Lusaka, Southern, and Eastern provinces, which supply 94 percent of all marketed maize.

After 1982 NAMBOARD retained the following marketing functions: transporting maize among provinces and storing the national reserves, importing and exporting produce, and importing fertilizer. NAMBOARD subsidizes fertilizer by selling it to cooperatives and farmers at a price that is 50 percent of its own cost. Fertilizer subsidies absorbed 94 percent of NAMBOARD's recurrent budget in 1984.

This pricing policy means that NAMBOARD depends almost entirely on government subsidies (operating subsidies) and guarantees to pay for its capital works and recurrent expenditures. From 1975 to 1983 NAMBOARD's deficits before subsidies totaled K 631.5 million. On the other hand, from 1975 to 1983 the subsidies that NAMBOARD received to cover its operating expenditures averaged 75 percent of the sales value. In 1970-80, NAMBOARD received K 587.9 million in subsidies, or 82 percent of the amount allocated.

Although fertilizer subsidies cover a wide geographic area, they are directed selectively and almost exclusively to large-scale farmers in the enclave sector. During 1979-84 the enclave sector received 84 percent

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[11] In 1978 NAMBOARD transferred functions relating to the promotion, production, and marketing of cottonseed to Lint Company of Zambia Limited. The promotion, production, and marketing of horticultural produce were transferred to the Zambia Horticultural Products Board the same year. In 1981, NAMBOARD ceased handling the importation and distribution of seeds and pesticides, which were handed to the newly established Zambia Seed Company Limited and the private sector. The supply and distribution of pesticides were transferred to the private sector in 1980, and the supply and distribution of implements were transferred to the National Import and Export Company in 1981. NAMBOARD was allowed to reenter the pesticide market after it was discovered that private companies were being exploitative and not meeting the needs of farmers.

of all fertilizer distributed to the agricultural sector (for the quantity and type of fertilizers distributed from 1979 to 1984, see Zambia, National Agricultural Marketing Board 1979-84). The subsidy on fertilizer prices preponderantly favors medium- and large-scale farmers.

NAMBOARD also imports and distributes about 8.0 million empty bags each year. To perform these statutory functions NAMBOARD must have easy access to storage and transportation facilities. NAMBOARD purchases virtually all grains from cooperative unions through its provincial branches, which control storage points throughout the country (see Table 4.6). In 1985 NAMBOARD had 160,000 tons of specialized storage facilities at 20 locations.

Storage facilities remain inadequate despite the influx of foreign aid since 1977, when the shortage of main storage facilities was especially

Table 4.6—Storage facilities of the National Agricultural Marketing Board, Zambia, by type of shed and province, December 1986

Province	Covered Sheds	Grains		Fertilizer	
		Silos	Hardstanding	Sheds	Hardstanding
Central	35,000	45,000	161,500	19,500	...
Copperbelt	...	37,000	104,400	20,500	...
Eastern	50,000	...	...	24,500	...
Luapula	15,000	...	5,300	10,100	...
Lusaka	50,000	14,500	58,500	27,000	...
Northern	40,000	...	...	10,500	...
Northwestern	7,430	...	3,150	3,875	...
Southern	80,000	14,500	88,500	42,000	...
Western	15,000	...	11,250	2,500	750
Total	292,430	111,000	432,600	160,475	750

Source: Zambia, Ministry of Agriculture and Water Development, Department of Marketing and Co-operatives, *Annual report for the year ending 31st December* (Lusaka, Zambia: Government Printer, 1981-85).

acute.[12] Furthermore, available storage facilities are not strategically located to meet the needs of small-scale farmers. The existing storage policy emphasizes placing storage facilities at consumption distribution points. The lack of storage facilities for both fertilizer and maize at strategic production points, such as multipurpose service centers, further aggravates the chronic shortage of food in rural areas. Locating storage facilities appropriately would alleviate the problem of in-area retention of food grains and ease the recurrent delays that affect the delivery of inputs to small-scale farmers.

DEVELOPING SMALL-SCALE COMMERCIAL AND INDUSTRIAL ENTERPRISES IN RURAL ZAMBIA

The genesis of government policies to develop small-scale commercial and industrial enterprises (generally referred to as small-scale enterprises) can be traced to the 1968 Mulungushi Declaration, which called for a series of economic reforms.[13] The Declaration had

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[12] In 1977 NAMBOARD purchased K 1.1 million of tarpaulins to cover maize and other grains. These tarpaulins have a serviceable life of no more than two seasons, and permanent storage facilities must be planned now. Grain storage facilities were extremely inadequate between 1977 and 1980, when the European Economic Community contributed K 2.4 million to support a storage shed program that constructed 11 fertilizer sheds providing 20,000 tons of storage capacity. In 1981 NAMBOARD received K 1.0 million from the Canadian International Development Agency to support the first phase of a project to build 25 sheds for storing maize and 11 for storing fertilizer. These storage facilities are located in Lusaka (10 sheds); Central (2 sheds); Southern (8 sheds); and Eastern (5 sheds). Construction began in 1982. See the reports of NAMBOARD's chair, which are contained in Zambia, National Agricultural Marketing Board (1977-84).

[13] Small-scale enterprises do not include small-scale farming enterprises. These nonfarm enterprises employ at most 50 persons and include one-person operations. They do not include enterprises with no fixed place of business or branches of parastatal companies and national statutory boards such as NAMBOARD. They do include businesses in the areas of service, vending, manufacturing (including the repair of manufactured goods), construction, mining, and transportation.

(continued)

three major objectives: to nationalize the economy, which was completely dominated by foreign and expatriate ownership; to establish a state-owned (100 percent equity capital) monopoly holding corporation that would intervene in the economy; and to open business opportunities to Zambians whose participation had been restricted by colonial economic and public policies to small trading businesses (such as operating grocery stores and being peddlers and petty traders in African townships).

These goals were accomplished through the government's active sponsorship and fiscal and monetary policies (Elliott 1971, 379-390). The major beneficiaries of the economic reforms appear to have been urban, medium- and large-scale enterprises owned by Zambians or partnerships between Zambians and foreigners. During the second and third national development plans, industrial development policies had an inherent bias against small-scale commercial and industrial enterprises and for large-scale parastatal enterprises. Between 1972 and 1982, for example, the central government lent an average of 13 percent of all government expenditures to parastatal enterprises, and government subsidies to parastatal enterprises averaged 15 percent of all government expenditures.

State-owned enterprises also enjoyed preferential treatment when borrowing funds from commercial banks. Between 1972 and 1981, the loans and advances to parastatal companies averaged 54 percent of all commercial bank loans and advances. In 1982 loans to parastatal companies totaled 46 percent of all commercial bank loans. These lending policies thwarted the government's efforts to promote small-scale, privately owned Zambian enterprises.

The government's desire to promote the development of small-scale commercial and industrial enterprises was, however, strengthened in 1981 by an act creating the Small Industries Development Organization (SIDO), which was established toward the end of 1982. SIDO was

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(footnote 13 continued)

The Mulungushi Conference Center of the United National Independence Party is located on the bank of the Mulungushi River in the Kabwe (formerly Broken Hill) District. In August 1969, the leaders who founded the United National Independence Party secretly met at this spot to form the political party that successfully led the masses of black people to independence. Since then, Mulungushi has remained the site of the party's annual conference. President Kaunda made the Mulungushi Declaration at such a conference on April 19, 1968.

created to be the central agency responsible for assisting small industries in the areas of policy formulation, research, surveys, training, extension services, procurement, and industrial estates. It caters to enterprises with capital assets in the range of K 15,000 to K 250,000 (up to K 350,000 for so-called ancillary enterprises that subcontract services to large manufacturing units).

Although it is too early to evaluate SIDO's impact on the development of small-scale enterprises, particularly in rural areas, the indications are good. SIDO management envisions an economy in which small-scale industries play an important role in producing goods and services that meet needs not being met by medium- and large-scale industries.[14]

SIDO has already begun to decentralize its operations by acquiring offices in all provincial capitals. Its policy is deliberately biased toward rural areas even though limited funding meant that much of its work during the 1986/87 period tended to favor small-scale industries located in large urban centers.[15]

Since independence, policy has been biased against the establishment of small-scale enterprises in general. Despite the importance attached to their development, the government has made little effort to accomplish this goal. Instead, it has made vigorous efforts to foster the development of urban-based, medium- and large-scale enterprises.

Small-scale enterprises have an important role to play in developing the agricultural sector. According to a recent study of select rural areas, about 224,000 small-scale enterprises are involved in manufacturing, services, and vending (Milimo and Fisseha 1985). These enterprises employ 373,000 persons, but when part-time and child workers are excluded, they employ 306,000 workers. If the estimates are extrapolated for the whole country, small-scale enterprises employ close to 575,000 persons, or about 472,000 full-time workers. This sector could make a significant contribution to easing the country's

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[14] The author had an informative, one-hour meeting with A. S. Chapewa in SIDO headquarters on December 15, 1988, in which the role that small-scale industries could play in the agricultural sector was discussed and how SIDO could collaborate with provincial cooperative unions.

[15] SIDO received a grant of K 10 million from the government of Zambia to be used for operational costs during 1986/87 (see Small Industries Development Organization 1987).

high rate of unemployment. Small-scale enterprises could widen the employment opportunities in rural areas. They could also help conserve the country's much-needed foreign exchange because they use local raw materials for the most part.

CONCLUSIONS AND POLICY RECOMMENDATIONS

In times of global recession, the Zambian economy has kept its economic infrastructure intact. The Zambian economy could achieve higher economic goals by devising appropriate policies. Inconsistent government policies are the greatest threat to realizing this potential. Despite concerted efforts made during the two national development plans, Zambia still lacks a broad-based economy capable of increasing real income and increasing the rapidly diminishing resources of its households. Moreover, policies that increase the efficiency of agriculture and shift the terms of trade to favor agriculture would not only improve the income of many poor, low-income groups, but spur economic growth as well.

Two sets of questions need further analysis: (1) What relationship does agricultural policy have to the official macroeconomic objectives of the government and to other instruments of economic policy? (2) What would the institutional consequences be of including agricultural policy in a wide system of economic development objectives?

Sufficient evidence suggests that all measures directed toward economic development in general, and agricultural development and food production in particular, must be properly synchronized to avoid displacing the stated goals. To avoid conflicting objectives requires coordinated action so that countervailing measures can be precluded from the outset. This is especially important in Zambia, where government intervention is crucial if the policy objectives of agricultural development and monetary and fiscal management are to be harmonized.

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-93

5
Credit Policies and Agricultural Credit in Eastern Province

Moses Banda

Like most developing economies, Zambia regards credit as a key variable in shaping its economic destiny. Most efforts to develop Zambia's economy or to improve the ability of the small-scale farming sector to adopt and adapt technological changes tend to have some credit component. Unfortunately, despite the volume of funds attracted and disbursed, the systems of delivering credit are inappropriate. Indeed, virtually all credit programs fail to reach their intended beneficiaries and goals.

Credit policies in Zambia make a concerted effort to shift the pattern of investment from the modern to the traditional economic sector. The shift does not, however, reduce investment in the modern sector. Instead it consolidates and widens investment to encompass the traditional sector and continues to entrench investment in the modern sector.

The modern sector in Zambia includes expatriate and foreign-owned companies; mining, especially large-scale copper extraction; commercial farming located along the railroad line in Southern, Lusaka, and Central provinces; trading, especially of nonessential, consumable, luxury items; and many activities not involving production.

The traditional sector consists of indigenous entrepreneurs and Zambian companies; small-scale mining of copper and mining of minerals other than copper; small-scale farming, rural agricultural enterprises, and cultivation of nontraditional export crops; manufacturing for export; and many other activities.

The system of delivering credit has improved somewhat, the number of lending institutions has proliferated, and a multitude of credit packages exists. Nonetheless, little attention has been directed to making credit accessible to the traditional sector, especially smallholder farmers. This paper seeks to highlight some of the credit policies forwarded by the Zambian government since independence in 1964. It examines whether these policies have widened the base of participation to include smallholder farmers in the agricultural sector and whether they have improved the structure of credit disbursements. It then recommends approaches to designing an agricultural credit policy appropriate to smallholder farmers.

THE EXISTING CREDIT MARKET

The Zambian credit market is characterized by two financial sectors. The banking sector is composed of commercial banks and financial institutions (see Table 5.1). The nonbanking sector is composed of all other financial institutions that offer credit, such as insurance companies, housing mortgage companies, and pension funds.[1]

All financial credit and nonbank financial institutions are owned by the government (see Table 5.2). Nonetheless, other institutions provide credit on a contract basis, and this arrangement is common in the agricultural sector, especially in the promotion of single-market cash crops.

The existing credit structure is a legacy of the economic policies of the colonial government and of the independent government since 1964. In the early days of the colonial period, the business community relied largely on credit services based in South Africa and Southern Rhodesia (now Zimbabwe). Nonetheless, as early as 1906 when Standard Chartered Bank opened the first bank in the territory, Zambia has always had a commercial bank service. Barclays Bank opened a branch in 1918, and Grindlays Bank International opened one in 1956.

The credit sector developed to supply credit to the mining industry and its satellite industries, which include white settler farming and the colonial administration. This financial framework was reinforced by the policies of the colonial government, which discriminated against the indigenous population. In 1953, for example, the federal government established the Land and Agriculture Bank, which provided capital to white immigrants and marginalized the indigenous population into inferior areas designated as reserves. Persons living on reserves were not given title to land and could not receive credit. This factor alone kept smallholder farmers from gaining access to secure credit.

After independence, the government was concerned primarily with nationalizing the economy. Its credit plan sought to widen the coverage of the existing financial institutions and to create its own credit institutions, which would be responsive to government policies.

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[1] Financial institutions other than banks include the Credit Unions Association of Zambia, State Lottery of Zambia, Workmen's Compensation Fund, Zambia Cooperative Federation-Financial Services, Zambia National Building Society, Zambia National Provident Fund, Zambia National Insurance Brokers, and Zambia State Insurance Corporation.

Table 5.1—Commercial banks in Zambia, by founding date and geographic distribution, 1988

Bank	Year of Founding	Distribution of Branches Urban	Rural	Total
Standard Chartered Bank	1906	16	8	24
Barclays Bank	1918	20	12	32
Grindlays Bank International	1956	6	1	7
National Savings & Credit Bank[a]	1970	86	114	200
Zambia National Commercial Bank[b]	1975	20	12	32
Citibank	1980	1	0	1
Bank of Credit and Commerce	1982	5	0	5
Indo-Zambia Bank	1984	2	0	2
Meridian Bank	1984	7	0	7
African Commercial Bank	1985	3	0	3
Export and Import Bank	1987	1	0	1
Lima Bank[c]	1987	4	14	18
Finance Bank	1988	2	0	2
Capital Bank	1988	1	0	1
Total	...	174	161	335

Source: Various documents from Zambia National Commercial Bank, Lusaka, Zambia, 1988.

[a] Operates through the network of the Posts and Telecommunication Corporation.

[b] Established through the amalgamation of the Commercial Bank of Zambia and the National Commercial Bank.

[c] Established through the amalgamation of the Agricultural Finance Company and the Zambia Agricultural Development Bank.

Attempts to Widen the Access to Credit

At independence, most financial institutions were in private hands, owned by foreigners, or both (Bank of Zambia 1974). Most of their business was with the mining sector and the foreign-dominated sector, which included commercial farmers. The new government did not attempt to change this structure, but it did seek to expand the coverage of credit institutions to accommodate indigenous Zambians.

Table 5.2—Sectoral financial institutions in Zambia, by sector

Institution	Sector
Development Bank of Zambia[a]	Industry
Export and Import Bank[b]	Export and import trade
Lima Bank[c]	Agriculture
Small Enterprises Promotion Fund	Small-scale industries
Zambia Cooperative Federation-Financial Services	Cooperatives

Source: Various documents from Zambia National Commercial Bank, Lusaka, Zambia, 1988.

[a] Provides mainly medium- and long-term finance for projects oriented to industry and agriculture.

[b] Operates like any other commercial bank; its import finance component supports the production of products for export.

[c] Operates like any other commercial bank.

In practice, indigenous Zambians still lacked access to credit institutions. Lending institutions demanded secured loans even though the bulk of the Zambian population continued to live in reserves where title to land was precluded. The government asked lending institutions to be more lenient about extending credit to the agricultural sector and to Zambian entrepreneurs. By 1968, however, lending institutions still did not extend credit to agriculture. Although bank advances grew 41 percent in the first four years of independence (1964-67), bank advances to the agricultural sector declined 4 percent. Even the proportion of credit going to the agricultural sector decreased: from 8 percent in 1964 to 2 percent in 1967 (see Table 5.3). The state nationalized other economic sectors in the Mulungushi (1968) and Matero (1969) economic reforms and soon nationalized the insurance and housing sectors. In 1970, the government announced a third wave of reforms establishing the Finance Development Corporation as a holding company for state-run financial institutions. These included commercial banks, 51 percent of which were owned by the government (Beveridge and Oberschall 1979).

Table 5.3—Commercial bank loans to the agricultural sector of Zambia, 1961-85

Year	All Sectors	Agriculture	Agriculture's Share of Total
	(K million)		(percent)
1961	11.9	1.6	13.4
1962	11.6	1.6	13.8
1963	15.7	1.5	9.0
1964	16.6	1.4	8.4
1965	30.8	1.4	4.5
1966	36.6	1.1	3.0
1967	65.9	1.2	1.8
1968	77.4	1.6	2.1
1969	71.0	1.5	2.1
1970	91.0	4.1	4.5
1971	139.4	16.2	11.6
1972	156.2	8.3	5.3
1973	140.4	8.4	6.0
1974	241.0	14.5	6.0
1975	293.8	9.8	3.3
1976	311.4	12.1	3.0
1977	319.5	15.7	3.8
1978	273.5	34.8	5.7
1979	415.3	23.9	8.3
1980	354.2	67.3	6.7
1981	498.6	257.1	13.5
1982	1,877.2	235.3	11.7
1983	1,997.0	297.7	11.7
1984	2,530.2	297.7	11.7
1985	2,614.6	358.6	13.7

Source: For 1961 to 1969, Frank A. Wilson, The role of the nonspecialist credit agency: The Commercial Bank in Zambia, in *Financing Rural Development*, eds. Frank A. Wilson and Victor F. Amann. Proceedings of the Eastern Africa Agricultural Economics Society conference, University of Zambia, Lusaka, Zambia, May 22-25 (Kampala, Uganda: Eastern Africa Agricultural Economics Society and the Makerere Institute of Social Research, 1975); for 1970 to 1985, Bank of Zambia, *Quarterly Financial and Statistical Review* 16:3 (1986).

The proportion of total commercial bank advances to the agricultural sector began to increase in 1970 as the white settler farming community gained confidence in the government's agricultural policies and some Zambian farmers made inroads in commercial farming (Table 5.3; Roberts and Elliott 1971). More significant was the increasing involvement of parastatal enterprises in farming. Some commercial banks, such as Barclays, began disbursing seasonal loans to the small-scale farmers who were clustered in settlement schemes that had appropriate technical support (Wilson 1975). In Eastern Province this support was concentrated in the Katete districts.

Institution Building

The Zambian government used institution building to gain confidence in the financial market and circumvent collateral requirements. Through the Industrial Development Corporation, it created institutions that could borrow on business terms—with a government guarantee—for projects supported by the government. This measure supported, in particular, the drive to industrialize rural areas.

To widen the base of participation in economic pursuits, and to make credit more accessible, the government created a series of credit packages with government-approved requirements. Lending institutions still wanted potential borrowers to demonstrate business acumen, and few Zambians could meet this requirement at that time (Young 1973). In the early years of independence and despite the good intentions and policy prescriptions of the government, lending institutions continued to restrict their credit coverage.

Nurturing Zambian-owned Businesses

Recognizing the credit constraints faced by indigenous entrepreneurs, the government initiated a business development program for Zambian entrepreneurs through the Industrial Development Corporation. It created the Department of Finance and Commerce to provide loans on normal commercial terms for projects promoted by indigenous entrepreneurs, who had to provide some type of security.

Another initiative through the Industrial Development Corporation was the establishment of the Zambia National Wholesale Corporation and the Zambia Steel and Building Supplies Limited, whose main objective was to nurture Zambian shopkeepers and building contractors by giving them stock and supplies or credit and technical assistance.

Unfortunately, the economic impact of these programs was limited

because most of the beneficiaries were entrepreneurs in the service and small-scale industrial sectors. Big industrial projects remained in the hands of expatriates and foreign-owned companies.

Legislative Measures

In 1968, the government amended the Banking Act to restrict bank lending to expatriates and foreign-owned companies. As part of the Mulungushi economic reforms, the new act required all credit applications submitted by expatriates and foreign-owned companies to be approved by The Bank of Zambia. Unfortunately, this law did not make credit more accessible to Zambians; it only blocked credit to expatriates and foreign-owned businesses. It affected productivity both in the industrial and the commercial farming sectors (Roberts and Elliott 1971).

THE THREAT OF NATIONALIZATION

From the time of independence, the Zambian government asked credit institutions to disburse credit on liberal terms to individuals and enterprises that could not, under normal conditions, meet the requirements of commercial lending institutions. Most institutions that provided agricultural credit were commercial institutions (see Table 5.4).

The Credit Organization of Zambia was established in 1967 to disburse government subsidized credit to individuals who could not meet the conditions of conventional lending institutions.[2] Although created to promote cooperative credit to industrial and farming societies, the Credit Organization of Zambia had a weak administrative system. It soon became associated with a poor record of processing and recovering loans (Roberts and Elliott 1971; Due 1978). In 1970 it was dissolved and replaced with the Agricultural Finance Company, which was established to serve small-scale farmers and administer credit more efficiently (Due 1978). One year earlier the Cattle Finance Company had been formed to provide medium-term loans to breed beef cattle.

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[2] The Credit Organization of Zambia was formed through the reorganization of the Land and Agriculture Bank. Established in 1953 to cater largely to the white settler farming community, the Land and Agriculture Bank only supplied credit to Zambians.

Table 5.4—Nonbank financial institutions funding rural and agricultural development in Zambia, by date established and abolished, 1967-87

Institution	Established	Abolished
Credit Organization of Zambia[a]	1967	1970
Cattle Finance Company[b]	1969	1984
Industrial Finance Company[c]	1969	1975
Agricultural Finance Company[d]	1970	1987
Zambia Agricultural Development Bank[d]	1982	1987

Source: Various documents from Zambia National Commercial Bank, Lusaka, Zambia, 1988.

[a] Formed to provide credit to indigenous Zambians and taken over by the Agricultural Finance Company when the Land and Agriculture Bank was reorganized in 1970. The Land and Agriculture Bank had been established by the federal government in 1953 to serve the white settler farming community.

[b] Taken over by the Agricultural Finance Company in 1984.

[c] Taken over by the Development Bank of Zambia.

[d] Amalgamated to form Lima Bank.

In addition to creating special credit institutions, the government began to provide input credit to small-scale farmers who produce specific crops. These loans are disbursed by crop support institutions, which also offer technical and marketing services. The crops currently under this program are soybeans and cotton, promoted by the Lint Company of Zambia, tobacco, by the National Tobacco Company, and sugar, by the Zambian Sugar Company. Some private companies have recently created similar arrangements to support schemes to grow tobacco (Kabwe 1986).

The government also established its own financial institutions to carry out its policy objectives. After contemplating partial nationalization of Barclays, Grindlays, and Standard banks, the government chose instead to become a major shareholder in the comparatively small Commercial Bank of Zambia and form its own National Commercial Bank. In 1975, the two commercial banks were

amalgamated to form the present Zambia National Commercial Bank, which is 99 percent government owned. The Indo-Zambia Bank Limited was established in 1964, with its shares being held equally by the Zambian government, through the Zambia Industrial and Mining Corporation, and the Indian government, through the Bank of India and the Bank of Baroda.

To complement its efforts to increase the number of financial institutions in Zambia, the government liberally granted licenses to commercial banks, which are required to have only a minimal capital base (K 2.5 million). This produced the recent proliferation of commercial banks.

Most of the institutions reviewed so far provide seasonal agricultural loans and set requirements for working capital funds. In order to finance projects that are long term or require specially tailored financial packages, the government created sectoral lending institutions. In the industrial sector, the Industrial Finance Company was formed in 1969 to provide medium- and long-term loans to Zambians seeking to acquire foreign-owned companies and establish manufacturing enterprises. The political pressure to do so outpaced the company's capital base (Beveridge and Oberschall 1979). In 1975 the Industrial Finance Company was dissolved, and the Development Bank of Zambia was created with a much broader base of functions. The Development Bank of Zambia finances projects in industry, agriculture, tourism, and any other productive sector.

In the early 1980s, the government began to streamline the operations of agricultural credit agencies. The Zambia Agricultural Development Bank was established in 1983 to take over the functions of the Agricultural Finance Company and the Cattle Finance Company. Their liquidation was delayed, however, because of their equity position. The Cattle Finance Company was liquidated in 1984, and its functions were given to the Agricultural Finance Company. Two years later, the Agricultural Finance Company and the Zambia Agricultural Development Bank were amalgamated to form the Lima Bank.

Another agricultural bank that deserves mention is the Export Import Bank of Zambia, which was formed in 1987 as part of the government's new economic recovery program. Its purpose was to provide leadership in export financing. Part of the Mulungushi and Matero economic reforms was an investment action strategy that included subsidized credit to exporting industries. The Export Import Bank of Zambia institutionalized earlier measures to promote exports.

Another important credit agency is the Cooperative Credit Scheme initiated by the cooperative movement in 1975 and taken over by the

Zambia Cooperative Federation-Financial Services Limited in 1984.[3] The Zambia Cooperative Federation holds 55 percent of the shares, and cooperative unions control the rest. The Cooperative Credit Scheme offers seasonal and medium-term loans to cooperative societies and their members. The Zambia Cooperative Federation recently began to consider establishing a cooperative bank.

The Zambian financial market also offers noninstitutional credit packages targeted at particular sectors of the economy. The most vital is the Credit Guarantee Scheme, which was introduced by the Bank of Zambia in 1987. Under this facility the Central Bank secures 70 percent of any viable loan to a small-scale manufacturer that is endorsed by either the Small Industries Development Organization or the Village Industry Service, which promote the activities of small-scale industrialists and cottage-based industries. From time to time these two organizations also disburse commodity loans, mostly for capital equipment, to promising entrepreneurs. The Development Bank of Zambia also promotes small-scale business with its Small Enterprises Promotion Fund. Government ministries and development agencies (especially private organizations) often target credit programs to their clients or intended beneficiaries. Some ad-hoc credit programs have also been introduced from time to time. The United National Independence Party sponsored, for example, an agricultural credit program during the 1986/87 agricultural season that was implemented through the cooperative unions.

Throughout the period under review (1964-88), the government, through the Central Bank, instituted monetary instruments to influence the flow of credit to targeted areas. The most pervasive instrument was determining the interest rate. In a number of instances the government set a preferential (low) interest rate on loans to the agricultural sector. Moreover, state-sponsored agencies that promote specific crops offered subsidized interest rates on their loans to agriculture. Since interest rates are focused on the agricultural sector, they are enjoyed by all categories of farmers who can receive credit, irrespective of their level of technological intensity, location, crop, and level of development. This policy mistakenly assumes that farmers, especially smallholders, cannot obtain institutional credit because interest rates are too high. Smallholders do not have access to loans primarily because the conditions for acquiring them are too restrictive.

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[3] The Zambia Cooperative Federation is the apex organization of the cooperative movement.

PERFORMANCE AND POLICY IMPLICATIONS FOR AGRICULTURAL CREDIT

The thrust of Zambia's credit policy was initially to consolidate the existing lines of credit while making loans more accessible to nontraditional and priority sectors. Policy emphasized disbursing loans rather than mobilizing savings. Thus the government's credit policy still targets supply rather than demand. It seeks to increase the number of institutions supplying loans and the number of credit packages available rather than to make more Zambians eligible for credit.

Zambia's agricultural credit policy has passed through three phases during 1964-70. In the early period, the government encouraged the existing lending structure to consolidate its loans to the commercial farming community. At the same time it created state lending institutions to provide loans to indigenous Zambians on more liberal terms. In the second phase, private lending institutions began offering credit to state agricultural enterprises and to Zambians who could meet credit requirements. At the same time, state-run credit agencies were reorganized to improve their ability to assess clients and manage credit efficiently. In the last phase, the financial sector became more crowded as the number of lending institutions and credit schemes proliferated. Although the amount of funds lent by the agrofinancial sector increased, their coverage and accessibility narrowed. This section will discuss how loans to the agricultural sector are allocated and distributed, particularly in Eastern Province.

Coverage of Loans

In the 1979/80 agricultural season in Zambia as a whole, 62 percent of all loan applications were approved and 40 percent of the amount applied for was advanced. In the 1983/84 season only 54 percent of all applications were approved and 43 percent of the amount applied for was advanced. Despite the 24 percent growth in the total amount advanced, the number of loan applications approved declined 2 percent from 1979 to 1984 (see Table 5.5).

In Eastern Province, 82 percent of the loan applications were approved in the 1979/80 season, but only 27 percent of the amount applied for was advanced. In the 1983/84 season, 65 percent of the applications were approved, and only 42 percent of the amount requested (K 5,300,970) was advanced (see Table 5.6).

Table 5.5—Number and amount of agricultural loans requested and approved in Zambia, 1979-84

Agricultural Season	Number of Loans		Number Approved as a Percent of Number Requested	Amount of Loans		Amount Approved as a Percent of Amount Requested
	Requested	Approved		Requested	Approved	
				(K million)		
1979/80	36,505	22,598	61.9	163.7	65.6	40.0
1980/81	58,819	24,284	41.0	219.4	87.4	39.8
1981/82	63,589	24,714	38.8	387.9	125.5	32.3
1982/83	49,932	24,279	48.6	314.6	150.1	47.7
1983/84	38,807	20,988	54.0	357.7	154.8	43.2

Source: Zambia, Ministry of Agriculture and Water Development, Planning Division, Survey of agricultural loans issued by commercial banks and other financial institutions during 1979/80-1983/84 financial years, Lusaka, Zambia, 1986.

Table 5.6—Number and amount of agricultural loans requested and approved in Eastern Province, Zambia, 1979-84

Agricultural Season	Number of Loans		Number Approved as a Percent of Number Requested	Amount of Loans		Amount Approved as a Percent of Amount Requested
	Requested	Approved		Requested	Approved	
				(K million)		
1979/80	6,831	5,592	81.8	17.6	4.8	27.2
1980/81	7,965	4,067	51.0	18.8	7.5	39.8
1981/82	10,101	5,545	54.8	58.4	5.5	9.2
1982/83	13,084	5,694	43.5	30.7	7.2	23.4
1983/84	12,932	8,359	64.6	53.0	22.2	41.8

Source: Zambia, Ministry of Agriculture and Water Development, Planning Division, Survey of agricultural loans issued by commercial banks and other financial institutions during 1979/80-1983/84 financial years, Lusaka, Zambia, 1986.

Term Distribution and End Use

An analysis of the term structure and end use of agricultural credit both at the national level and in Eastern Province reveals another alarming situation. At the national level in the 1979/80 season, 73 percent of the amount advanced, and 95 percent of the number of loans advanced, went for seasonal loans (see Tables 5.7 and 5.8). By the 1983/84 season the proportions had increased to 93 and 97 percent, respectively.

During the period from 1979/80 to 1983/84, the total amount of all loans issued grew 24 percent. Long-term loans decreased 53 percent, seasonal loans increased 32 percent, and medium-term loans increased 9 percent. During the same period, the total number of loans issued declined 2 percent. Seasonal and medium-term loans declined 1 and 12 percent, respectively, while long-term loans grew less than 1 percent.

A high proportion of agricultural credit goes to finance crops (see Table 5.9). In the 1979/80 to 1983/84 period, loans to finance inputs for crops grew 33 percent, which was higher than the growth rate for other uses. Indeed, land-related construction and farm improvements declined 6 and 7 percent, respectively.

The picture for Eastern Province is marginally different (see Table 5.10). In the 1979/80 season, 83 percent of the amount of all loans disbursed was for seasonal loans. This disbursement covered 96 percent of the number of loans sanctioned (see Table 5.11). In the 1983/84 season, the proportions jumped to 96 and 99 percent, respectively.

Between the 1979/80 and 1983/84 seasons, the total amount of loans advanced in Eastern Province grew 47 percent. The amount going to seasonal and medium-term loans grew 52 and 13 percent, respectively, while disbursements for long-term loans were virtually nonexistent by the 1983/84 season. At the same time, the number of loans grew 11 percent for all loans and 12 percent for seasonal loans. The number of medium-term loans declined 29 percent, and no long-term loans were sanctioned for the 1983/84 season.

In Eastern Province, much of the credit approved goes to finance crops (see Table 5.12). From 1979/80 to 1983/84 crop financing recorded the highest growth rate of any end use (59 percent), while livestock declined 7 percent. Construction related to land did not grow at all. These statistical details indicate that agricultural financing is becoming increasingly concentrated on fewer farmers and crop production activities. The conditions governing participation in the credit program in Eastern Province, the subject of the next section, suggest that the situation could not have been otherwise.

Table 5.7—Amount of agricultural loans approved in Zambia, by type of term, 1979-84

Agricultural Season	Total	Seasonal		Medium-term		Long-term	
		Amount	As a Percent of Total	Amount	As a Percent of Total	Amount	As a Percent of Total
		(K million)		(K million)		(K million)	
1979/80	65.6	47.9	73.0	7.5	11.4	10.1	15.3
1980/81	87.4	69.6	79.6	8.6	9.8	9.0	10.3
1981/82	125.5	109.7	87.4	11.4	9.0	4.3	3.4
1982/83	150.1	129.4	86.2	13.8	9.1	6.8	4.5
1983/84	154.8	143.5	92.7	10.7	6.9	0.5	0.3
Growth rate (percent)	23.9	31.5	...	9.4	...	-52.5	...

Source: Zambia, Ministry of Agriculture and Water Development, Planning Division, Survey of agricultural loans issued by commercial banks and other financial institutions during 1979/80-1983/84 financial years, Lusaka, Zambia, 1986.

Table 5.8—Number of agricultural loans approved in Zambia, by type of term, 1979-84

Agricultural Season	Total	Seasonal		Medium-term		Long-term	
		Number	As a Percent of Total	Number	As a Percent of Total	Number	As a Percent of Total
1979/80	22,598	21,428	94.8	1,126	4.9	44	0.2
1980/81	24,284	22,302	91.8	1,124	4.6	858	3.5
1981/82	24,714	21,281	86.1	2,903	11.7	530	2.1
1982/83	24,279	22,856	94.1	1,206	4.9	217	0.9
1983/84	20,988	20,278	96.6	665	3.1	45	0.2
Growth rate (percent)	-1.8	-1.4	...	-12.3	...	...	0.6

Source: Zambia, Ministry of Agriculture and Water Development, Planning Division, Survey of agricultural loans issued by commercial banks and other financial institutions during 1979/80-1983/84 financial years, Lusaka, Zambia, 1986.

Table 5.9—Number of agricultural loans approved in Zambia, by end use, 1979-84

End Use	1979/80	1980/81	1981/82	1982/83	1983/84	Growth Rate, 1979/80-1983/84
Inputs for crops	40.4	50.2	53.8	67.9	128.1	33.4
Machinery	8.4	10.5	44.1	46.8	8.2	-0.8
Livestock	7.9	16.3	9.2	9.3	8.6	2.2
Land	2.0	2.2	2.3	2.7	1.6	-6.2
Chickens	1.0	1.6	4.7	2.7	1.2	4.5
Construction and improvements	0.8	1.3	2.9	2.8	0.6	-6.9
Other livestock	0.1	1.3	3.9	1.2	0.2	19.3
Other	4.7	3.6	4.2	16.7	6.1	6.5
Total	65.6	87.4	125.5	150.1	154.8	23.9

Source: Zambia, Ministry of Agriculture and Water Development, Planning Division, Survey of agricultural loans issued by commercial banks and other financial institutions during 1979/80-1983/84 financial years, Lusaka, Zambia, 1986.

Table 5.10—Amount of agricultural loans approved in Eastern Province, Zambia, by type of term, 1979-84

Agricultural Season	Total	Seasonal		Medium-term		Long-term	
		Amount	As a Percent of Total	Amount	As a Percent of Total	Amount	As a Percent of Total
		(K million)		(K million)		(K million)	
1979/80	4.8	4.0	83.3	0.5	10.4	0.2	4.1
1980/81	7.5	5.8	77.3	1.1	14.6	0.4	5.3
1981/82	5.4	3.9	72.2	1.5	27.7	0.0	0.0
1982/83	7.2	6.4	88.8	0.7	9.7	0.1	0.1
1983/84	22.2	21.3	96.0	0.8	3.6	0.0	0.0

Source: Zambia, Ministry of Agriculture and Water Development, Planning Division, Survey of agricultural loans issued by commercial banks and other financial institutions during 1979/80-1983/84 financial years, Lusaka, Zambia, 1986.

Table 5.11—Number of agricultural loans approved in Eastern Province, Zambia, by type of term, 1979-84

Agricultural Season	Total	Seasonal		Medium-term		Long-term	
		Number	As a Percent of Total	Number	As a Percent of Total	Number	As a Percent of Total
1979/80	5,592	5,366	95.9	225	4.0	1	0.0
1980/81	4,067	3,821	93.9	98	2.4	148	3.6
1981/82	5,545	5,335	96.2	204	3.6	6	0.1
1982/83	5,694	5,551	97.4	140	2.4	3	0.1
1983/84	8,359	8,302	99.3	57	0.6	0	0.0
Growth rate (percent)		10.6	...	11.5	...	-29.1	...

Source: Zambia, Ministry of Agriculture and Water Development, Planning Division, Survey of agricultural loans issued by commercial banks and other financial institutions during 1979/80-1983/84 financial years, Lusaka, Zambia, 1986.

Table 5.12—Number of agricultural loans approved in Eastern Province, Zambia, by end use, 1979-84

End Use	1979/80	1980/81	1981/82	1982/83	1983/84	Growth Rate, 1979/80-1983/84
Inputs for crops	2,982	4,191	2,263	4,437	19,073	59.0
Machinery	390	340	881	2,054	2,073	51.8
Livestock	272	664	677	0	202	-7.2
Land	117	55	0	111	19	...
Chickens	0	435	1,574	0	86	...
Construction and improvements	0	31	4	98	44	...
Other livestock	0	53	0	98	0	...
Other	1,061	1,747	96	458	714	-32.7
Total	4,822	7,516	5,495	7,256	22,211	46.5

Source: Zambia, Ministry of Agriculture and Water Development, Planning Division, Survey of agricultural loans issued by commercial banks and other financial institutions during 1979/80-1983/84 financial years, Lusaka, Zambia, 1986.

THE OPERATION OF LENDING INSTITUTIONS IN EASTERN PROVINCE

Only two commercial banks (Barclays and Zambia National Commercial Bank) are located in Eastern Province. Both are based in Chipata, and both focus their financing on specific areas (see Table 5.13). Barclays Bank concentrates on Petauke, Chadiza, Katete, and Lundazi, while Zambia National Commercial Bank focuses on Chipata, Lundazi, Sinda, and Chadiza. Lima Bank, a public agricultural bank, has two branches, one in Chipata and one in Lundazi.

Within each district, the two commercial banks focus on settlement schemes. Indeed, most of the farmers financed by the Zambia National Commercial Bank are in tobacco schemes: Kazimule, Sindamisale, Chipangali, and Lumezi. As discussed later, the National Tobacco Company provides just enough credit for farmers to purchase inputs for up to 3 hectares. Beyond that, farmers must obtain credit from other sources. Moreover, farmers in tobacco schemes also grow crops other than tobacco and need sources of funding other than the National Tobacco Company. Other farmers can participate if they prove that they are actively cultivating a marketable crop. Banks require farmers to have at least 2 hectares of land and an active bank account.

Table 5.13—Geographic location of farmers receiving agricultural credit in Eastern Province, by bank, 1988

Location	Barclays Bank	Zambia National Commercial Bank	Total
Chadiza	125	13	138
Chipata	0	140	140
Katete	168	12	180
Lundazi	220	45	265
Mambwe	0	2	2
Nyimba	0	1	1
Petauke	126	3	129
Sinda	0	17	17
Total	639	233	872

Source: Barclays Bank, Head Office of the Lusaka Zambia National Commercial Bank, Chipata, Zambia, 1988.

The Eastern Province Cooperative Union is involved in the Cooperative Credit Scheme that was initiated by the cooperative movement in 1975. This scheme loans money to cooperative societies and their members. Between 1975 and 1986, member participation grew 33 percent and the disbursement of funds grew 58 percent (see Table 5.14). By 1986, however, the participation rate was only 9 percent (5,663 of the Eastern Province Cooperative Union's 65,152 membership; Fichtner 1986).

The Eastern Province Agricultural Development Project also initiated a Medium Term Credit Scheme that is being implemented through the cooperative societies. In the first year (1986) only 5 societies with a total of 25 members participated. In the second year (1987) 24 more societies were added, with a total of 288 participating members.

Cooperative societies are well developed in Eastern Province, although the level of participation in these two schemes is very low. This could be attributed to the dearth of complementary, local credit resources, since the Eastern Province Cooperative Credit Scheme and the Eastern Province Agricultural Development Project rely largely on grants from the Swedish International Development Agency and the World Bank, respectively.

The Lima Bank (which absorbed the functions of the Agricultural Finance Company and the Zambia Agricultural Development Bank) provides seasonal, medium- and long-term loans for agricultural operations not necessarily tied to a specific crop, institution, or area. Whereas the Agricultural Finance Company had wide coverage because it only required farmers to cultivate a minimum of 1 hectare of cereal crops and had 42 branches by 1978 (Due 1978), Lima Bank concentrated its loans on areas with high "emergent farmer" density by operating only 14 branches. Indeed, before it joined Lima Bank, the Agricultural Finance Company had already stopped dealing directly with individual clients and started working with farmer groups. Lima Bank seems to have adopted the group approach, especially in the Medium-Term Credit Scheme initiated by the Eastern Province Agricultural Development Project.

Agencies that promote specific crops, the Lint Company of Zambia for cotton and soybeans and the National Tobacco Company for tobacco, have wide coverage because they are not particular about where a farmer is located. The Lint Company requires farmers to cultivate at least 2 hectares of either cotton or soybeans and have two years of experience farming a marketable crop. These conditions have made the Lint Company's program more accessible to smallholders

Table 5.14—Participation and recovery of funds in the Cooperative Credit Scheme in Eastern Province, 1975-86

Agricultural Season	Number of Societies	Number of Members	Amount Requested	Amount Disbursed	Recovery Rate
			(K1,000)		(percent)
1975/76	7	328	35.3	34.6	98
1976/77	33	2,258	263.5	214.1	81
1977/78	20	1,706	181.1	134.3	74
1978/79	14	1,678	132.9	93.3	70
1979/80	15	1,017	241.2	211.9	88
1980/81	20	2,045	366.4	338.4	92
1981/82	26	4,346	1,184.7	977.5	82
1982/83	30	5,329	2,493.2	2,231.3	89
1983/84	32	5,391	3,196.1	2,823.8	88
1984/85	43	5,272	3,329.1	2,957.5	89
1985/86	45	5,663	3,412.3	2,919.4	86
Growth rate (percent) 1975/76-1985/86	...	20.5	33.0	57.9	-1.3

Source: Obermeyer Project Management GMBH. Consultancy services for grain storage in rural areas of Eastern Province. Vol. 1, Baseline survey, Munich, Germany, 1987.

than in the past. For example, from 1985/86 to 1987/88 the number of farmers participating in Eastern Province's cotton program grew 45 percent, from 7,240 to 15,137 individuals (see Table 5.15). During the same period the amount of funds disbursed for cotton production grew 127 percent. In the soybeans program, the number of farmers participating grew 39 percent and the amount of funds disbursed grew 109 percent (see Table 5.16).

The National Tobacco Company primarily works with farmers clustered in settlement schemes, although it also sublets its schemes to private companies that provide input loans to individual contract farmers. The loan package is limited to a minimum of 0.5 and a maximum of 3.0 hectares of tobacco inputs. Farmers with more land must seek other sources of financing. Indeed, commercial banks prefer to assist farmers who have successfully borrowed money from other credit programs.

LOAN RECOVERIES

The repayment of agricultural credit has a profound effect on the attitude of lenders toward financing smallholder farming activities. Most of the credit schemes introduced by the state soon after Zambia's independence had poor recovery records (Roberts and Elliott 1971). The reasons for the dismal performance are many: poor administration of credit, which emphasized the disbursement of funds rather than the effective use of loans, dishonest farmers who circumvented the stop-order system by selling through other farmers, and problems connected with loan recovery. Credit measures introduced later were more cautious in selecting farmers in order to improve farm productivity and ensure repayment. Nonetheless, high repayment records tend to be associated with single-market cash crops and credit programs based on communal sanctions. Lending programs that have no specialized technical services and rely on third parties to recover loans tend to have low repayment rates.

In Eastern Province, credit programs of the institutions that promote single-market crops and of the cooperative society tend to have high repayment records. Lint Company of Zambia, which promotes cotton and soybeans, has a better recovery record with cotton, where it is the sole buyer and processor, than with soybeans, where it is only a principal buyer (Tables 5.17 and 5.18). Some private traders also buy

Table 5.15—Participation in and funds disbursed by the Cotton Credit Scheme in Eastern Province, Zambia, 1985-88

District	1985/86		1986/87		1987/88	
	Amount Disbursed	Number of Farmers	Amount Disbursed	Number of Farmers	Amount Disbursed	Number of Farmers
	(K1,000)		(K1,000)		(K1,000)	
Chadiza	15.1	53	70.5	96	142.6	387
Chama	34.3	289	75.1	380	561.6	1,076
Chipata						
North	151.3	1,646	193.0	1,801	851.3	2,736
South	153.3	1,624	244.4	1,787	1,081.7	3,836
Katete	248.0	1,353	611.4	1,488	953.5	3,530
Lundazi	69.3	488	46.4	540	167.3	407
Mambwe	131.7	921	179.9	1,014	303.5	1,806
Nyimba	19.9	142	20.7	200	114.4	244
Petauke	61.2	724	111.1	824	363.7	1,115
Total	884.4	7,240	1,552.8	8,130	4,539.8	15,137

Source: Information provided by the Lint Company's Chipata Office.

Table 5.16—Participation in and funds disbursed by the Soybeans Credit Scheme in Eastern Province, Zambia, 1985-88

District	1985/86		1986/87		1987/88	
	Amount Disbursed	Number of Farmers	Amount Disbursed	Number of Farmers	Amount Disbursed	Number of Farmers
	(K1,000)		(K1,000)		(K1,000)	
Chadiza	58.4	989	93.9	1,000	207.8	1,485
Chama	4.1	84	3.1	62	44.7	101
Chipata						
North	18.2	277	96.1	986	176.0	1,021
South	29.7	396	104.9	342	203.3	1,813
Katete	54.8	922	129.9	1,065	187.1	1,306
Lundazi	41.9	658	60.5	641	119.7	578
Mambwe	9.3	169	30.5	275	12.5	362
Nyimba	14.4	119	14.5	73	32.0	
Petauke	9.0	76	57.8	361	68.7	333
Total	240.0	3,682	591.7	5,405	1,052.0	7,117

Source: Information provided by the Lint Company's Chipata Office.

Table 5.17—Funds disbursed and recovered in the Cotton Credit Scheme in Eastern Province, Zambia, 1985-87

District	1985/86			1986/87		
	Amount Disbursed	Amount Recovered	Recovery Rate	Amount Disbursed	Amount Recovered	Recovery Rate
	(K1,000)		(percent)	(K1,000)		(percent)
Chadiza	15.1	6.5	43.0	70.5	44.4	63.0
Chama	34.3	32.3	94.1	75.1	61.9	82.5
North	151.3	130.4	86.1	193.0	156.8	81.2
South	153.3	128.0	83.4	244.4	219.2	89.6
Katete	248.0	262.7[a]	105.9	611.4	567.0	92.7
Lundazi	69.3	26.8	38.6	46.4	31.6	68.1
Mambwe	131.7	99.9	75.8	179.9	151.7	84.3
Nyimba	19.9	19.9	100.0	20.7	21.2	102.4
Petauke	61.2	56.3	92.0	111.1	81.8	73.7
Total	884.1	762.8	86.2	1,552.5	1,335.6	86.0

Source: Information supplied by the Lint Company's Chipata Office.

[a] Includes the repayment of loans outstanding from the previous season.

Table 5.18--Funds disbursed and recovered by the Soybeans Credit Scheme in Eastern Province, Zambia, 1985-87

District	1985/86			1986/87		
	Amount Disbursed	Amount Recovered	Recovery Rate	Amount Disbursed	Amount Recovered	Recovery Rate
	(K1,000)		(percent)	(K1,000)		(percent)
Chadiza	58.4	45.4	77.7	93.9	54.2	57.7
Chama	4.1	3.7	89.9	3.1	2.3	74.1
Chipata						
North	18.2	19.2[a]	105.5	96.1	73.9	76.8
South	29.7	30.5[a]	102.6	104.9	74.9	71.4
Katete	54.8	48.4	88.2	129.9	77.1	59.3
Petauke	9.0	9.0	100.0	57.8	19.9	34.4
Lundazi	41.9	28.2	67.4	60.5	39.6	65.4
Mambwe	9.3	6.4	69.4	30.5	22.2	72.7
Nyimba	14.4	9.3	65.2	14.5	7.8	53.7
Total	239.8	200.1	83.4	591.2	372.3	62.9

Source: Information supplied by the Lint Company's Chipata Office.

[a] Includes the repayment of loans outstanding from the previous season.

soybeans directly from farmers.[4]

The overall repayment rate on loans to cotton farmers was 86 percent in both 1985/86 and 1986/87. In Eastern Province district, the average repayment rates improved from 79 percent in 1985/86 to 81 percent in 1986/87. For soybeans, however, the average for both the aggregate and the district decreased 21 percent (from 84 to 63 percent) and 22 percent (from 85 to 63 percent), respectively.

The recovery rate in the Cooperative Credit Scheme ranged between 70 and 98 percent from 1975 to 1986 (Table 5.14). During that period the average yearly repayment rate was 86 percent.

The loan recoveries of commercial banks tended to range between 70 and 98 percent, with the repayments of smallholders being lower on the scale and those of commercial farmers being higher (World Bank 1984). The predecessors of Lima Bank, especially the Agricultural Finance Company, had poor recovery records, which is one reason they were liquidated. In the 11 years from 1970/71 to 1981/82, the recoveries of the Agricultural Finance Company decreased 32 percent (see Table 5.19). This rate was too low to sustain the operations of the company. Commercial banks are now attempting to improve their recovery of smallholder loans by adopting the single-market promotion strategy. They are working closely with crop promotion institutions like the National Tobacco Company to provide a supplementary package for tobacco and other crops; they are also lending funds to these institutions, which in turn lend them to smallholders under a contract arrangement. The Lima Bank is adopting the society group lending model, which was introduced in Eastern Province by the Eastern Province Agricultural Development Project. Unfortunately, a coherent program integrating these two approaches (single market and group lending) has not yet emerged.

POLICY RECOMMENDATIONS

The state is keenly interested in channeling investments to the smallholder sector. Unfortunately, it has not removed any of the structural constraints that impinge on the access of smallholders to loan funds. The disbursement of funds tends to be concentrated on activities related to the production of seasonal crops, and the participation of

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[4] Personal communication with the manager of Lint Company for the Eastern Province Division.

Table 5.19—Funds disbursed and recovered by the Agricultural Finance Company in Eastern Province, Zambia, 1970-81

Agricultural Season	Amount Disbursed	Amount Recovered	Amount Recovered as a Percent of Amount Disbursed
	(K1,000)		
1970/71	3,762	2,973	79.0
1971/72	4,597	3,750	81.6
1972/73	10,121	9,118	90.1
1973/74	6,934	5,875	84.8
1974/75	8,617	6,341	73.8
1975/76	12,741	10,268	81.8
1976/77	16,733	11,937	72.1
1977/78	22,166	12,370	57.7
1978/79	11,754	7,865	68.3
1979/80	27,452	13,744	56.2
1980/81	37,792	17,748	53.0
1981/82	43,348	20,187	54.1

Source: World Bank, *Zambia: Policy options and strategies for growth*, Supplementary volume on methodology and commodity analysis (Washington, D.C.: World Bank, Eastern Africa Projects Department, Southern Agriculture Division, 1984).

farmers and the amount of funds going to medium- and long-term loans are decreasing. One of the major bottlenecks to making medium- and long-term loans available to smallholders is the lack of title to land. Farmers can only participate in credit packages that do not require land security and are for the production of seasonal crops.

Most smallholder credit programs restrict farmers to specific crops or crops that rely on state marketing agencies. Credit is not available for crops not promoted by state agencies. Indeed, the crop bias is reinforced by the priority that the Eastern Province Cooperative Union

gives to growing maize. Most loans from the Cooperative Credit Scheme go to maize, and the production of maize tends to be at the core of national agricultural policies as well. Indeed, most credit programs are oriented toward rainfed crops. In spite of the profitability of market gardens, no credit package is designed to promote horticultural products. Most loans clearly support rainfed cereal products.

Another area of concern is the lack of coordination within and between borrowers and lenders. One reason that the recoveries of some institutions are poor is the duplication of and competition for clientele (that is, good farmers); some institutions are only lenders, while others are both lenders and marketers. The former rely on the latter to effect recoveries. Unfortunately, lenders who are involved in marketing usually recover their own loans before recovering those of others.

Although the communal sanctions approach is acknowledged to be effective, the tendency is to create groups controlled by the lender, not to work through existing institutions. In the agricultural credit project sponsored by the United National Independence Party in 1986, the party hierarchy considered the loan applications, while the cooperative societies disbursed and recovered credit. In 1975, the Agricultural Finance Company experimented with using Ward Development Committees to screen loan applications and to recover loans. However, in spite of the farmers' general endorsement of the experiment, the Ward Development Committees were not influential in enforcing repayments (Due 1983). Since the societies and the committees were merely disbursement points, they did not take responsibility for recovering loans, many of which became bad debts.

The credit schemes being initiated seem to be changing their strategy. The Eastern Province Agricultural Development Project's scheme to support the cooperative union initiated a Rural Credit Component to be implemented through the cooperative societies. The Zambia Agricultural Development Bank created a similar credit package to be implemented through farmer groups using the training and visit system. This strategy is special because all participants are involved in similar economic pursuits and because the community—or group—sanctions the loan. Unfortunately, although members of the cooperative society are also farmers, membership in the society has not been linked with group lending.

Mobilizing savings has not attracted much attention in Zambia, and most intervention measures focus on disbursements. Indeed, in spite of the existence of the Credit Unions Association of Zambia, which works through the cooperative unions, mobilizing savings has not been used

to disburse loans or mobilize funds that are disbursed to farmers through crop payments. The nature of agricultural credit in Zambia seems to preclude aggressive attempts to encourage farmers to save. Farmers know that repaying even part of their loan early ensures other loans in the future, which discourages them from saving for agricultural investments. The issue of determining the interest rate for agricultural loans is critical. On the one hand, the government wants to encourage lenders to finance farming activities. On the other hand, it sets low interest rates for agricultural loans. Since May 1987, when the interest rate was fixed at between 15 and 20 percent and the rate on agricultural loans was 1 percent above the prime rate, agricultural lending has not increased significantly. Unfortunately, the policy of low interest rates sends the wrong signal to the financial sector. While interest rates are held below the nominal rates, the cost of administering and supervising small deposit accounts scattered among individual smallholders tends to be high. Lenders respond by keeping their loans to the smallholder sector low and concentrated. They do so by raising bank charges, increasing the minimal amount of deposits, and extending the minimal period required for loan eligibility. Interest rates should not be the only factor determining loans to smallholders. The experience with society and group lending suggests that administrative costs could be reduced and recoveries improved if beneficiaries were effectively involved. The risk factor could be reduced if agricultural certainty were improved by promoting (that is, financing) irrigated agriculture and by diversifying agricultural activities in response to the changing market. The potential for financing horticultural activities in the slack lending period from February to July should also be exploited.

CONCLUSIONS AND POLICY DIRECTIONS

In the 24 years between 1964 and 1988, Zambia saw tremendous developments in its financial sector. Financial intermediary institutions and preferential credit schemes proliferated, and the Zambian business sector benefited from the advances and loans they made. Indeed, policy channeled investment capital toward indigenous investors, agriculture, and small-scale farmers.

Despite the multiplicity of financial intermediary institutions and agricultural credit packages, credit was concentrated in fewer recipients, fell short of the amount requested, and financed short-term crops more and medium- and long-term crops less than before. If the Zambian government still regards credit as an important instrument for

directing the pattern of investment and still seeks to widen the provision of credit to include both modern and traditional agriculture in the economy and to encourage a significant role for smallholders, intervention measures in the structural adjustment phase will have to correct the current imbalances in credit.

Zambia's policy on smallholder credit should address the following recommendations: (a) limit and remove structural constraints, (b) encourage institutions to lend to agriculture and smallholders, (c) strengthen credit linkages, (d) liberalize fungibility and the mode of paying loans, and (e) mobilize savings.

Limit and Remove Structural Constraints

The existing system of land tenure does not keep small-scale farmers who grow seasonal cereal crops from obtaining institutional credit. For most small-scale farmers, however, the minimal amount of hectares required to participate in a credit program is prohibitive. The minimal requirement of land should accommodate farmers with small amounts of land. Farmers who want to develop their farms with capital investments and expand their area with credit for machinery and equipment (an oxen package, for example) must have secure land tenure. The government should set the minimal amount of land required and provide land titles when they do not compromise the interests of smallholders on the bottom of the scale. Monetizing the rural sector requires a type of security acceptable in the market.

Provide Incentives for Institutions to Lend to Agriculture and the Smallholder Sector

Zambia's policy on agricultural credit does not encourage financial institutions to lend to agriculture. The trend is toward liberalizing producer prices, and the interest rate should be liberalized as well. Interest rates are not the issue for smallholders; accessibility to loan funds is. Lenders should be encouraged to take appropriate action in their agricultural credit schemes. For example, they could reduce administrative costs, make the use of loans more effective, and improve the recovery rate by lending primarily to farmers groups. The government could provide tax concessions or refinancing facilities for banks initiating such programs.

Strengthen Credit Linkages

The vertical linkages in credit packages that promote a specific crop and the horizontal linkages between cooperative societies and farmers groups are effective. These vertical and horizontal linkages are not themselves linked, however. Lending institutions operate independently of one another, and efforts are not coordinated at the local level. Resources could be rationalized if the government would promote refinancing schemes and if the cooperative society or group were adopted as a primary unit for disbursing and recovering credit.

Liberalize Fungibility and Mode of Payment

Most credit programs only provide smallholders with input credit for crops promoted by the state, and most preclude other income support activities, such as activities in forestry. Vertically integrated crop promotion packages use this strategy to provide inputs, market produce, and recover loans. Where third parties provide the inputs and recover loans, however, inputs are often unavailable and recovery rates are low. The specification of the crops supported should be more flexible in loans meant for multiple-market crops. Providing loans in cash would allow farmers to decide which activity would maximize their returns in a given market situation. They should be able to pay back the loan on their own terms.

Mobilize Savings

Where horizontal linkages exist, savings and credit unions based on a society or farmers group should be formed. These credit unions should have refinancing linkages with other financial intermediary institutions.

Smallholders with limited investment capital would be adversely affected by the adoption of more stringent measures for controlling the national deficit and more liberal credit policies. Nonetheless the severity of the effects could be reduced and the potential productivity increased if appropriate agricultural support systems, like credit, were made available at the right time, in the right package, and for the beneficiary's own choice of enterprise.

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6
Land Tenure and Agricultural Development in Eastern Province

John T. Milimo

Zambia has approximately 750,000 square kilometers of land, and in 1980 its population density was 7.5 persons per square kilometer. In 1988, its population was an estimated 7,803,000 persons and its population density was just below 10.4 persons per square kilometer. More than 60 percent of its population live in rural areas, and most are engaged in agriculture.

The government is gradually becoming aware of the key role that agriculture could play in freeing the structure of the national economy from its dependence on copper. The agricultural sector depends less on imports and is less capital intensive than other economic sectors. It also has a large and undeveloped potential for producing exports and import substitutes and contributes a substantial amount of value added to manufacturing. Zambia has over 0.4 million square kilometers of unused arable land, which is 10 percent of the total amount of land that could be cultivated. Zambia could increase the number of farm holdings and thereby increase agricultural productivity, but its system of land tenure limits the government's ability to do so.

PATTERNS OF LAND TENURE

Under Zambian law, all land is invested in the president of the republic and divided between state land and reserve or traditional land.

State Land

State land, called crown land during the colonial period, was taken from the indigenous population and given to white settlers or used to build cities and towns. Most of this land lies along the so-called line-of-rail connecting Zambia's Copperbelt Province to the rest of southern Africa. Pockets are also found in other provinces, particularly Eastern Province.

State land is prime agricultural land because it is fertile and located close to markets. It constitutes about 6 percent of the total amount of land in Zambia and 4 percent of that in Eastern Province. The commissioner of lands issues titles to state land. Individuals can seek

government authorization to settle on state land or, which is more common, purchase property that has already been developed on state land. Such purchases include all land associated with the property being bought. According to the Fourth National Development Plan (1989, 88), Zambia's state land has been exhausted.

Reserve Land

Most of the land in Zambia is traditional or reserve land, which belongs to the community living on it. It is invested in traditional rulers (that is, chiefs and village headmen), who are its custodians. Although this land belongs legally to the chief or headman, in reality it belongs to the entire community. Members of each community receive one piece of land to establish dwellings, another, or several others, to cultivate crops, and a third to graze livestock. Grazing land is shared, while the first two types are used exclusively by individual households. Farm plots revert, however, to communal (grazing) land during the dry season, when they are not being used to grow crops.

Individuals have a right to land, and everyone has access to it. The community's chief or headman allocates the land, which then remains in the family and is passed on for generations. Although individuals do not own land, they have usufruct rights over it and relatively secure tenure. The exception is when the head of a family commits a serious crime and is physically expelled from the community, thus losing the land. These cases are rare, however, and individuals and their households are almost never forced off their land.

PATTERNS OF LAND ACQUISITION

The research project of the International Food Policy Research Institute, the Rural Development Studies Bureau, the National Food and Nutrition Commission, and the Eastern Province Agricultural Development Project asked a sample population in Eastern Province how they acquired their land. That survey asked farming households the number, not the size, of the plots they owned or used (see Table 6.1).

Some of the individuals surveyed have as many as four plots. Virtually none of the plots were bought, the only type of plot for which users have title. The majority do not have title because their plots are on reserve or traditional land. Only 4 percent of the plots were cleared recently and cultivated for the first time (own fields); nearly 50 percent were received as a gift or inherited.

Land in the reserves is clearly handed down from one generation to the next (see Table 6.2). Following the old system of land tenure, parents give their children the land that a traditional ruler had allocated to the founder of their family.

Table 6.1—Patterns of acquiring the first four plots of land, Eastern Province, Zambia, 1989

Mode of Acquisition	Plot 1	Plot 2	Plot 3	Plot 4
		(percent)		
Bought	0.6	0.6	0.0	0.0
Given	73.0	72.3	61.6	39.0
Inherited	16.4	16.4	13.8	10.7
Own field[a]	10.0	0.4	8.8	4.4
Not applicable	0.0	1.3	15.7	45.9

Source: Land tenure survey conducted by the International Food Policy Research Institute, the Rural Development Studies Bureau, the Eastern Province Agricultural Development Project, and the National Food and Nutrition Commission, Eastern Province, Zambia, 1989.

[a] Fields that have been recently cleared and cultivated for the first time.

Table 6.2—Original owner of plots bought or inherited, Eastern Province, Zambia, 1989

Original Owner	Percentage
Parent	41.5
Sibling	2.5
Chief	4.4
Village headman	14.4
Grandparent	5.7
Parent-in-law	8.8
Own field	10.7
Uncle or nephew	10.7
Spouse	1.3

Source: Land tenure survey conducted by the International Food Policy Research Institute, the Rural Development Studies Bureau, the Eastern Province Agricultural Development Project, and the National Food and Nutrition Commission, Eastern Province, Zambia, 1989.

Descent Systems

Land, like any other piece of property, is handed from one generation to the next according to a system of descent. Two systems operate in Eastern Province, the patrilineal and the matrilineal (see Table 6.3 for the descent systems of the dominant ethnic groups in Eastern Province).

The majority (57 percent) of persons living in Eastern Province live under a matrilineal system, and the percentage is even larger for the country as a whole. The rest live under a patrilineal system. In both systems, property is owned by a lineage, that is, a group of closely related individuals who trace their descent through either the male or the female side of the family. In a patrilineal system, property passes through the male; in a matrilineal one, through the female. Property thus does not belong to the individual using it or even to his or her immediate family. It belongs, instead, to the extended family, which is determined by lineage. Matrilineal societies also practice uxorilocal marriages, which explains why a significant proportion of the plots (9 percent) had been received from the parents-in-law as a gift.

Table 6.3—Ethnic groups in Eastern Province, Zambia, by descent system

Ethnic Group	Percentage of Sample Population	Type of Descent System
Chewa	34.8	Matrilineal
Kunda	13.6	Matrilineal
Lala	0.6	Matrilineal
Ngoni	11.9	Patrilineal
Nsenga	7.7	Matrilineal
Senga	9.4	Patrilineal
Tumbuka	21.4	Patrilineal
Yao	0.6	Patrilineal

Source: Land tenure survey conducted by the International Food Policy Research Institute, the Rural Development Studies Bureau, the Eastern Province Agricultural Development Project, and the National Food and Nutrition Commission, Eastern Province, Zambia, 1989.

Landlessness does not exist in Zambia (Food and Agriculture Organization of the United Nations 1988). Access to and security and use of land, not ownership or title, are the crucial issues in African agriculture. In Eastern Province, everyone who needs and can use land has access to it, and holdings are relatively secure despite the lack of title.

LAND TENURE AND ITS IMPACT ON AGRICULTURAL DEVELOPMENT

Farmers settled on reserve land in Eastern Province generally have more than one plot of farmland. They do not have one large plot, but several scattered within walking distance of the household. Thus a field inherited from a mother's brother is in one location, while a field or fields given by parents and parents-in-law is in another.

It is more difficult and costly to look after land that is scattered than land that is in one place. Fencing is impractical, and the hours spent traveling from one plot to the next inflate the cost of operating a farm. Multiple plots have advantages as well, however. They are relatively secure. Even if the production on one plot suffers because livestock eat the produce, another may prosper and produce enough to support the family during the year. They also simplify decisions about how to allocate crops, since farmers can rotate crops among fields.

Land Tenure and Agricultural Credit

Small farmers produce more than 60 percent of Zambia's food, and financial institutions that deal with them do not demand collateral for seasonal loans to purchase the fertilizer, seeds, and labor required for a particular farming season. These loans must be repaid at the end of the season. Parastatal organizations that promote specific cash crops also provide seasonal credit to small farmers without requiring security. These institutions only ask that credit applicants have a piece of land they can plow and plant during a particular farming season. Indeed, seasonal credit helps develop agriculture by enabling small-scale farmers to adopt technology, mainly fertilizers and hybrid seeds, that improve their agricultural performance and nutritional status.

Land tenure practices constrain the access of small-scale farmers to medium- and long-term credit and thus slow the development of the agricultural sector. Medium- and long-term loans require land as collateral. Commercial farmers have title and can use it as collateral for

any type of loan. Small farmers do not have title and thus cannot seek credit to buy farm implements and property that could be used as security for more loans in the future. The lack of title keeps smallholder farming operations from developing.

Land Husbandry

Farmers without title have no incentive to develop the land they use. They have no incentive to erect physical infrastructure, such as dams, dipping tanks, and fences, or to upgrade their property by replanting trees or making contour ridges. These improvements need heavy capital investments, which can only be financed with loans that require titled land. Communal land is bound to deteriorate. Title to land is therefore tied to equity considerations. Commercial farmers have title to land and are able to improve their property and accumulate more wealth; small-scale farmers have no title, their land deteriorates, and they remain poor.

Access to More Agricultural Land

For every hectare of land used for agriculture in Eastern Province, two remain unclaimed and uncleared; the country as a whole has nine unclaimed hectares for every hectare used. The majority of unused, arable land is not readily accessible or is not available for farming because of inadequate infrastructure and restricted land tenure. Unused land generally lies far from human settlements and is costly to claim. The recent increase in the production of major crops is due largely to growth in the amount of land cultivated by smallholder farmers. Production is bound to slow considerably because farmers cannot afford to keep increasing their amount of land.

Small-scale farmers who lack title to their land probably will not move from their present community and open up new tracts of land for agriculture because their access to capital and technology is limited. Commercial farmers, who have better access to credit and better technology, could move into and develop these empty lands, thus increasing agricultural production overall. Zambia's current land tenure system does not, however, allow this. Only members of the community can settle in an area, and potential land developers do not always belong to the community in or near the area they propose to develop. They could obtain title to land in traditionally owned land by passing through many bureaucratic procedures. They would have to get the consent of the village headman, the traditional chief of the area, and the

local ward councillor. With their consent in hand, the developer would have to obtain the consent of the district development secretary, the whole district council, and, finally, the office of the commissioner of lands in the Ministry of Lands. This takes a lot of time.

Another major hurdle in procuring title to reserve land is that developers are often members of the family who owns and uses land in the traditional communal manner. They cannot always keep other family members from sharing the land, which keeps the title from being operational.

In short, existing land tenure practices in Zambia ensure that the vast amount of unused, arable land is not available either to small-scale or to commercial farmers.

Land Tenure Practices and Gender Issues

Women make a considerable contribution to Zambian agriculture. They work the land and own farming units. This is especially true among small-scale farmers. As much as 39 percent of the rural households in Eastern Province are headed by women (Zambia, Central Statistical Office 1985, 1:207, 211). Almost two out of every five farmers in Eastern Province are women.

According to the system of descent, property, including land, is handed down through sons in patrilineal groups and through the sons of sisters in matrilineal groups. Women do not inherit land or receive the first gifts of land from their parents or mother's brothers. In both systems, land is inherited by, given to, and belongs to males; if a woman needs land, a close male relative will give her part of his own. This often happens in female-headed households. Women have limited access to land even though they are agriculturally productive.

Spouses rarely give land to one another. Plots belong to the lineage, so spouses cannot give land to one another even if they wished. They can only let their spouse use one or two plots during their lifetime, as happened in 1 percent of the sample households in Eastern Province.

Given the importance of the role that women play in agriculture, this has significant implications for Zambia's agricultural development. Limited access to land is a big constraint to agricultural development, and in matrilineal societies it adversely affects women. When a marriage dissolves, either through divorce or death, the property, including the land used by the couple, reverts to the absolute owners, that is, to the lineage of the husband. The wife must return to her natal home where she will have a minimum claim to land. This rarely

happened in the past since marriages in matrilineal societies were uxorilocal. When the marriage ended, the wife was already residing in her native home. This custom appears to be changing and having an adverse effect on women.

Settlement Schemes

The government is concerned because traditional heads of tribes or villages are reluctant to open their lands to "strangers" and small-scale farmers cannot acquire or develop land on their own. The government has responded by devising strategies to increase the access of both small-scale and large-scale, commercial farmers to land. It has declared some tracts of traditional land to be state land and thus available to commercial farmers. At the same time, large pieces of traditional land have been turned into settlement schemes for small-, medium-, and large-scale farmers. Twenty-four such settlement schemes have been created in Eastern Province involving more than 2,000 farming households and 88,000 hectares of land. In some of these schemes, farmers grow specific crops, such as tobacco, bananas, sugar, rice, and, of late, wheat. In others, such as the family farms in Southern Province, farmers grow any crop they want. Retired miners and civil servants often settle on these schemes.

Settlement schemes have two main advantages. They make land available to persons who intend to use it and, especially in crop-specific schemes, provide expert agricultural extension services. They do not, however, offer secure tenure to the land. In many cases settlers are on probation. Once they prove themselves to be good farmers, they can settle on the land permanently. When the original occupier dies, however, the family must negotiate to keep the land. In other words, tenure is more secure in reserve land than in settlement schemes. Most settlement schemes are relatively young, however, and the original occupants still work the land. Some schemes are already considering giving their best farmers title to the land.

CONCLUSIONS AND POLICY RECOMMENDATIONS

Zambia has inherited a land tenure system that assures every member of the local community a piece of land on which to live and grow crops. Households have practically all the security of tenure they want. Any attempt to reform the land tenure system in Zambia should assure these two most important elements, namely, access to and secure

ownership of land.

Land reform is urgently required if Zambia is to develop its agriculture. The obvious alternative to the current system is to grant title to all users of land, that is, both small- and large-scale farmers. Many administrative problems would be encountered in such a venture, especially since households use and own land scattered over a village, and in some cases several villages. Reform is essential, however, and individual title is not the only alternative. Group title could be given to a community for the right to use a large tract of land. The group approach has been successful in agricultural credit. Titled land could also be given to the whole community, which would allocate plots to its members (as, indeed, is the case presently). The community could use the title as collateral in credit applications and could develop the land by erecting infrastructure. In the meantime, the government should intensify its efforts to induce chiefs and village headmen to accept individuals from outside their area and reexamine the issue of women farmers. This may involve attempts to change social and cultural attitudes toward the two sexes. The recently passed Act of Parliament on Succession and Inheritance, which recognizes a woman's right to the property her household has been owning and using during the lifetime of both spouses, promises to encourage society, especially men, that change is needed.

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7
The Institutional Setting in Eastern Province

Emmanuel C. W. Shula

In Zambia, efforts to develop institutions for a given province are clearly identified with the development goals of the nation. The resources needed to develop institutions in provinces are assumed to be available to the appropriate implementing authority, which, in turn, makes them available to institutions at the district level and below. Thus institutional development is a means of transferring national resources to the local economy and of facilitating local development.

Zambia's government is committed to distributing the means of production equitably, industrializing rural areas, enlarging the rural work force, and increasing local participation in the decisionmaking process. To meet these objectives, Zambia seeks to achieve national capital formation, mostly by involving the public sector in the national economy.

Soon after independence, the government reorganized nationalized enterprises into public sector institutions that form part of state packages to develop the socioeconomic infrastructure of the provinces. A centralized structure of public sector management and administration emerged, while political and economic power was decentralized at the local level. To date, unfortunately, this new institutional setup does not include an autonomous entity responsible for developing the provinces. No mechanism facilitates the emergence of provincial, district, and local planning based on authority over the finances and administration of the provinces.

For the sake of national planning, the National Commission for Development Planning groups institutions into three sectors. These sectors and their associated institutions are as follows. First, the productive sector includes ministries, parastatal and statutory bodies, and private institutions involved in economic activities such as agriculture, forestry, transportation, energy, communications, finance, and marketing. These institutions are directly involved in the exploitation of Zambia's economic resources. Second, the social sector is made up of health and education, which represent areas of social planning and are not linked directly to the productive exploitation of national economic resources. They do, however, have an important indirect effect on the overall productivity of the population. Third, the administrative sector provides the framework for institutional

development. These three types of institutions can be further grouped into public sector and private sector institutions.

PUBLIC SECTOR INSTITUTIONS

Public sector institutions make available the socioeconomic infrastructure necessary for the economic and social well-being of the provincial population. The pattern of provision, access to, and use of this infrastructure is highly correlated with the degree to which the province's agriculture, health, education, communication, and industrial activities are deveioped. Three categories of public sector institutions operate in Eastern Province: central government line ministries, parastatal organizations, and statutory agencies (see Table 7.1).

The Central Government Line Ministries

At the provincial level, these public sector institutions are represented by line departments. They constitute a sector of the civil service and function under the scrutiny of the national parliament on all administrative matters. All provincial departments are unified, through their respective ministries, under a cabinet office.

Parastatal Organizations

Parastatal organizations function either under the line ministries or the Zambia Industrial and Mining Corporation (ZIMCO). Both have boards of directors who choose operational strategies, although they differ in their degree of autonomy. The organizations under ZIMCO perform their operational and investment functions more autonomously than those under line ministries. ZIMCO, for example, is the holding company for the Zambia Consolidated Copper Mines, the Industrial Development Corporation, and various other parastatal companies in the areas of finance, transportation, energy, tourism, and public utilities. The central government is beginning to shift public sector responsibilities away from line ministries and toward parastatal and statutory agencies.

Statutory Agencies

Statutory agencies include boards, councils, bureaus, and institutes that have emerged as strategic, ad hoc, or crisis-response local

Table 7.1—Allocation of public responsibilities in Zambia, by institution

Office of the President
Office of the Secretary-General of the Party

Office of the Prime Minister

Coordinate and supervise the administration of government and parastatal businesses, the cabinet, and the civil service. Parastatal and statutory bodies include Zambia Industrial and Mining Corporation, Anti-Corruption Commission, Commission for Investigations, Electoral Commission, Police and Prisons Service Commission, Prices and Incomes Commission, Teaching Service Commission, and Management Services Board.

Office of the Secretary of State for Defense and Security

Coordinate the affairs of the ministries of Defense and Home Affairs.

Ministry	Parastatal Organization or Statutory Agency
Agriculture and Water Development (policy and its execution)	Lima Bank, Lint Company, National Tobacco Company, Tobacco Development Board, Water Board
Commerce and Industry (policy on industry and commerce, import and export, foreign trade, patents, price controls, trade licensing, trade fairs and shows, environmental protection)	Export Council, Standards Institute, Small Industries Development Organization, Tariff Advisory Board, Village Industry Service, Investment Council, Export Board

Cooperatives (agricultural marketing policy, cooperative policy and education)	Credit Union and Savings Association, provincial cooperative unions, Zambia Cooperative Federation, Dairy Produce Board, National Agricultural Marketing Board
Decentralization (decentralization, provincial and local government administration, village registration and development, housing policy)	House of Chiefs, National Housing Authority, National Fire Services Training School, provinces (district councils)
Finance and National Commission for Development Planning (financial policy, agreements, banking, budget matters, income tax, insurance, loans and investments, supply and tender procedures, development planning, census and statistics, joint economic commissions, regional and sectoral planning)	Bank of Zambia, Development Bank of Zambia, Lotteries and Betting Control Board, Aid National Savings and Credit Bank, Zambia National Building Society, Zambia State Insurance Corporation, Zambia State Lottery, Zambia Stock Exchange Council, Standing Accident Board, War Pensions Board/Fund
General Education and Culture (primary and secondary school policy and its administration)	Kenneth Kaunda Foundation, Examinations Council
Health (health policy and its execution, food and nutrition)	Food and Drugs Board, General Nursing Council, Medical Council of Zambia, Medical Stores, National Food and Nutrition Commission, Pharmacy and Poisons Board, Pneumoconiosis Medical and Research Bureau, University Teaching Hospital Management Board, Zambia Flying Doctors Service, Medical Services Board, Tropical Diseases Research Centre
Higher Education (development of science and technology, teacher training, technical education, library services)	National Council for Scientific Research, University of Zambia, Copperbelt University, National Commission for Unesco

(continued)

Table 7.1—Continued

Ministry	Parastatal Organization or Statutory Agency
Labor and Social Services (labor policy and its administration, adult literacy education, social development, population policy, occupational assessment services, industrial relations, juvenile reformatories, Zambianization)	Industrial Participatory Democracy, Industrial Relations Court, Pneumoconiosis Compensation Board; Workman's Compensation Fund Control Board, Zambia Council for the Blind and Handicapped, Zambia National Provident Fund
Lands and Natural Resources (environmental protection and control, industrial plantations, land surveys and registry, policy and its administration)	Agricultural Lands Board, Compensation and Advisory Board (land acquisition), Natural Resources Advisory Board, Surveys Control Board
Legal Affairs (constitutional matters, laws of Zambia, oaths, arbitration, law revision and reform, supreme, high, and local courts, penal and criminal procedures)	Council of Law Reporting, Council of Legal Education, Law Association of Zambia, Law Development Commission, Institute of Legislative Drafting, Law Practice Institute, Legal Services Corporation
Mines (mines and mining policy)	Prescribed Minerals and Materials Commission, Reserved Minerals Corporation
National Guidance, Information and Broadcasting Services (political education, humanism, information services)	President's Citizenship College, Film Censorship Board, Zambia Publishing Company and subsidiaries
Power, Transportation, and Communications (development and administration of power, energy and transportation policies)	Aeronautical Authority, Central African Power Corporation, Kariba North Bank Company, National Energy Council, Roads and Road Traffic Board, Road Traffic Commission, Tanzania-Zambia Railway (TAZARA), Zambia National Clearing and Forwarding Company

Tourism (policy and its administration)	Commission for the Preservation of Natural and Historical Monuments and Relics, Hotels Board, Museums Board, National Parks Board, National Tourist Board
Youth and Sports (policy and its administration)	National Sports Council, National Youth Development Council, Outward Bound Association, Professional Boxing Control Board, Professional Wrestling Control Board
Foreign Affairs	None
Presidential Affairs	None
Works and Supply	None

Source: Government of the Republic of Zambia, Statutory functions, portfolios, and composition of government, *Government Gazette* 23:22 (7 March 1987), notice 287.

Note: Portfolios and composition of ministries were merged and reformed in November. The most important change is that the Ministry of Decentralization became a department placed directly under the Prime Minister's Office. The Ministry of Agriculture and Water Development and the Ministry of Cooperatives were merged to form a new Ministry of Agriculture and Cooperatives.

institutions. The Eastern Province Cooperative Union is one of the prominent statutory agencies in the province.

The departments of line ministries, parastatal organizations, and statutory agencies operate with the support of an influential subsector of projects sponsored by multilateral and bilateral agencies and nongovernmental organizations (see Table 7.2). For Eastern Province, these are funded by the Swedish International Development Agency, the United States Agency for International Development, the Norwegian Agency for Development, the International Fund for Agricultural Development, the World Bank, the European Economic Community, and the government of the Netherlands. These projects are important sources of capital and expertise; in certain cases, they also build local capacities.

Table 7.2—Source of funding for selected projects in Eastern Province, Zambia

Program, Project, or Investment	Donor or Financial Agency
Agriculture, forestry, and fisheries	
Lint Company	EEC loan
Cooperative Development Fund	SIDA grant
Lima Company	Local
Dairy Produce Board	Local
Artificial Insemination	DANIDA loan
Land Development Service	Local
Cold Storage Corporation	Local
Rural Storage Facilities	Local
Cattle Development Areas Program	EEC grant
Seed Control and Certification	SIDA grant
Eastern Province Agricultural Development Project	IBRD loan
Women Appropriations Technology	SIDA grant
Katete Coop Training School	...
Tsetse Control and Training	EEC grant
Adaptive Research Planning Team	Netherlands grant
Agricultural Research Project	IDA/IDF loan
Integrated Rural Development Program	SIDA grant
Rice Development Project	EEC grant
Women's Programme	...

(continued)

Table 7.2—Continued

Program, Project, or Investment	Donor or Financial Agency
Land, natural resources, and water development	
Rural Water Supply Programme	Irish grant
Demarcation of State Farm (Survey)	Local
Chipata Water Supply	KWF loan
Provincial Water Works	Local
Aerial Photograph Printing Maps	SIDA grant
Mapping of Land Under Customary Tenure	SIDA grant
Project Administration/Personnel	SIDA grant
International Drinking Water Supply and Sanitation Decade	UNDP grant
Mines	
Hydrocarbonate Programme	Loan
Small Mines Promotion Project	EEC
Uranium Assessment Project	IAEA grant
Tourism	
Luangwa Valley Development	Local
Luangwa Integrated Resource Development Project	Local
Electrification of Chichele Lodge	Local
Lundazi Castle Hotel	Local
National Monuments and Museums	Local
Manufacturing	
Investment	Agency
Small Industries Development Organization	Local
ZAFFICO	Local
Village Industry Service	Local
Oxdrawn Plough Projects	Local

(continued)

Table 7.2—Continued

Program, Project, or Investment	Donor or Financial Agency
Trade	
Chipata-Mchinji	Local
Third Highway Project	IBRD loan
Luangwa (Mfuwe Airport)	Local
Energy	
Lusiwasi-Chipata-Lundazi Powerline	Foreign
Msoro Substation	Local
Health	
Primary Health Care	SIDA grant
National Drug Organization System	SIDA grant
Improvisation of Hospitals and Stations	Local
Rural Health Centres	SIDA grant
Nurse-Tutor Programme	SIDA grant
Staff Accommodation	Local
ZFDS	Local
Nutrition Transport System	SIDA grant

Source: Zambia, National Commission for Development Planning, *The interim plan, 1987-December 1988* (Lusaka, Zambia: Government Printer, 1987).

Note: DANIDA, Danish International Development Agency; EEC, European Economic Community; IAEC, International Atomic Energy Commission; IBRD, International Bank for Reconstruction and Development; IDA/IDF, International Development Association/International Development Fund; SIDA, Swedish International Development Agency; UNDP, United Nations Development Programme.

PRIVATE SECTOR INSTITUTIONS

The private sector in Eastern Province is strong largely in manufacturing, trade, and transportation, most of which are carried out by a community of Asian-origin settlers living in urban areas. In Eastern Province this community is located mostly in Chipata and, in small measure, in other district headquarters. It owns a fleet of vehicles that play a strategic role in marketing and transporting agricultural produce and urban consumer goods within the province.

THE PRODUCTIVE SECTOR

Agriculture, energy, and transportation and communications are the major services performed by the productive sector. Their activities are described below.

Agriculture and Allied Activities

The production of crops and livestock, forestry, fisheries, and wildlife are the province's main agricultural activities. Agriculture as a group also claims the largest share of public sector services, which include research, extension, credit, and marketing, storage, and transportation.

The line departments of the Ministry of Agriculture are organized by subject specialty. At the provincial level, for example, the Department of Agriculture has areas dedicated to training, research, crop husbandry, livestock, horticulture, extension, and agricultural engineering. This provincial system is grouped into district-level subject specialists supervised by a district agricultural office. Below the district offices are block and camp offices.

Research on Crops. The Department of Agriculture produces improved varieties of seed and animal breeds, disseminates information, especially through training institutions at the provincial and district levels, links the results of research to the farming community (through demonstration plots and the training and visit system of extension), conducts field surveys for forecasting crops, monitors infestations of pests and diseases, plans the use of land, demarcates land, and conserves soil.

The Department of Agriculture also communicates with, and

maintains functional linkages to, other line departments and specialized parastatal organizations to promote the marketing, storage, and transportation of specific crops. It maintains links with, for example, the Zambia Seed Company, which is the statutory agency for marketing seed, and with the National Agricultural Marketing Board (NAMBOARD) and the Eastern Province Cooperative Union, which stock and distribute fertilizers and buy surplus agricultural produce. The Department of Agriculture manages these inputs at the farm level through contact with farmers and extension services. Other specialized parastatal organizations include the Lint Company, which oversees the production and marketing of cotton and soybeans, and the National Tobacco Company and the Tobacco Board of Zambia, which promote the production of tobacco. Milk and dairy products are the responsibility of the Dairy Produce Board, while livestock marketing is carried out mainly by the Cold Storage Corporation.

Subsistence agriculture continues to exist in Eastern Province, which indicates that these institutional services do not reach far enough into the rural areas to develop subsistence agriculture into commercial agriculture. Only 27 percent of the population in Eastern Province is influenced by parastatal institutions, and those persons are not located in smallholder areas.

About 1.3 million hectares are under crops each year, or about 19 percent of the province's total physical land mass and about 35 percent of its potentially good arable land. The crops grown include maize, sorghum, finger and pearl millet, beans, cowpeas, pigeon peas, groundnuts, paddy, cotton, tree crops, vegetables, root crops, grasses, and bushes. Research is being carried out on maize, beans, peas, and groundnuts and on farming practices in different agroclimatic regions of the province. Adaptive research planning teams and commodity research teams are putting together research packages on these crops for the Department of Agriculture. Agricultural research has been reorganized by establishing a substation at Masumba to study the valley's agronomic conditions. An evaluation and monitoring unit, initiated under the Eastern Province Agricultural Development Project, now forms part of the provincial planning unit.

Research on Livestock. Livestock rearing is another important activity in Eastern Province. It is predominantly a traditional activity, and approximately 25 percent of the rural population own livestock herds, which graze largely on open land. During the dry season, supplementary feeds are generally lacking, and a large proportion of

cattle weaken and become highly susceptible to disease. This reduces the possibility of using cattle for draft power. In 75 percent of the provinces, cattle suffer from trypanosomiasis and east coast fever, which severely limits the viability of better uses of the land. So far, the Dairy Produce Board has not shown interest in popularizing or stimulating dairy farming among farmers with traditional stocks. Sporadic efforts have been made, without consistency or success, to introduce dairy cattle, pigs, goats, poultry, and rabbits to the smallholder sector of the province. The livestock industry needs loans that help small-scale, traditional farmers improve their breeds, build paddocks and milk sheds, develop pastures, and improve their water supply and veterinary services. Veterinarians will, in turn, require increased funding, staff mobility, and drugs to combat tsetse flies and other cattle infestations.

Research on livestock involves two main projects: one to develop a vaccine to fight east coast fever among cattle, and one funded by the European Economic Community to establish a cattle development area in Lundazi. The aims of the second project are to increase the production of cattle by improving animal husbandry and to establish cooperatives (or individuals) that are adequately self-sufficient. Increasing and upgrading the rate of calving and reducing calf mortality are priorities of the project to develop cattle.

Research activities, particularly in crops, intensified between 1980 and 1987, not so much because the provincial research program was reorganized, but because projects began to address specific problems facing small-scale farmers and their capital and recurrent needs were adequately funded. In Eastern Province funding from the International Bank for Reconstruction and Development and the International Fund for Agricultural Development established, for example, the Eastern Province Agricultural Development Project to facilitate this intensified agricultural research.

Agricultural Extension. The training and visit system was initiated by the International Bank for Reconstruction and Development. Using contact farmers as local agents of change, it has been operating in Chipata South and Katete since 1983; in Chipata North, Chadiza, and Lundazi since 1984; in Mambwe since 1985; and in Petauke, Nyimba, and Chama since 1986. Its success has been mixed, however, because of new responsibilities, poor supervision, and lack of skilled staff.

The province has logistical problems. Its geographical expanse is large, and its population is relatively sparse and dispersed. So far the

Department of Agriculture has been able to reduce its administration to 10 agricultural districts. Establishing effective contact with farmers is difficult, and the Department tends to concentrate on farmers who are already doing well, are accessible, and are producing cash crops. An additional problem is the continuity of agricultural or livestock development and extension programs established with foreign funding; when their term ends and they no longer have funds or staff, they usually revert to a parastatal department and adopt a more passive role.

Forestry, Fisheries, and Wildlife. Forestry aims to produce and develop wood-based resources, convert and process wood into primary and secondary products, and manage and conserve forests. Forestry is important to the growth of employment in the informal sector, which includes the manufacture of charcoal, crafts, and carpentry.

Funds raised through forest-based activities should remain with provincial institutions, which currently transfer them to the central government. The Department of Forestry has successfully targeted and improved its coverage of small-scale farmers; it should, however, make more of an effort to popularize tree planting. Forest services should be expanded by establishing nurseries that grow and sell plants to local farmers. Funds for these activities come entirely from the central government and are insufficient.

The province has 250 small reservoirs, some of which could be used for fisheries. No studies have been made to assess the feasibility of developing fisheries systematically in Eastern Province.

The Luangwa Integrated Resource Development Project is the most important project in wildlife. It conducts research and, given local support, has the resources to be successful. One of its major planks is to prevent wildlife poaching and to make the Luangwa National Park more attractive to tourists from Zambia and abroad.

Credit. Credit for agriculture is the most chaotic institutional service in the province. Despite the large number of institutions involved, providing agricultural credit to smallholder agriculture is but a token agricultural service.

The public sector institutions that specifically serve smallholder farmers have a poor record of accumulated losses in unrecovered and unrecoverable loans. This does not reflect well on the Credit Organization of Zambia, the Cattle Development Bank, and the Agricultural Finance Company, which are responsible for distributing agricultural credit in the province.

The system of delivering credit is patently faulty because its link with institutions supplying other inputs is weak. Through the use of stop orders and local purchase orders, NAMBOARD, the Eastern Province Cooperative Union, and the Zambia Seed Company have consistently failed to supply the required type and quantity of seeds and fertilizers on time. In 1985, for example, the Zambia Agricultural Development Bank (Eastern Province branch) had K 3.4 million from the Eastern Province Agricultural Development Program to distribute seeds and fertilizers to 1,962 farmers; K 2.1 million worth of local purchase orders were returned unused because these inputs were not available on time.

The supply of credit linked to inputs involves coordination and planning at the national level. During the 1986/87 season, for example, the Zambia Agricultural Development Bank arranged to acquire inputs for its customers and issued local purchase orders to farmers. However, NAMBOARD, which was responsible for distributing fertilizer, refused to accept them and demanded, instead, certified bank checks. The bank agreed, but NAMBOARD ran out of basal fertilizers at about the time that the checks were issued. The result was that farmers who bought inputs through this type of institutional credit planted late or fertilized late, which lowered their yields.

Barclays Bank, Zambia National Commercial Bank, Lima Bank, Lint Company, and the Eastern Province Cooperative Union also supply credit to farmers in the province. They do not, however, have many funds to loan and have not decided whether or not financing small-scale agriculture is a viable operation. The Eastern Province Cooperative Union supplies only a token amount of credit to its affiliated societies despite their commendable record of repayment. Lima Bank has a limited amount of resources and remains a minor provider of credit and credit in-kind. Lint Company, however, efficiently provides credit to cotton growers.

Marketing, Storage, and Transportation. The institutions involved in these activities are the Eastern Province Cooperative Union, NAMBOARD, Zambia Seed Company, Contract Haulage, and the Eastern Province Transport Cooperative Association. These organizations do not plan or coordinate their operations well, and their performance in marketing, storage, and transportation is dismal.

The Eastern Province Cooperative Union and NAMBOARD compete, rather than cooperate, with each other. The union purchases surplus agricultural crops at uniform prices and determines the volume

to be consumed, stored, and processed in the region. NAMBOARD, the buyer of last resort, also determines the proportions of crops to be exported to other provinces and to be stored by the national food security system. At periods of peak demand, NAMBOARD may, for example, hire a vehicle at Chipata to deliver fertilizers to districts and return empty, while the union sends an empty truck to the same districts to bring produce back to its depot in Chipata.

The system faces serious transportation problems of timing, availability, and cost. The agricultural marketing system is characterized by an almost perfect countercyclical movement of inputs and produce that transports agricultural produce from, and fertilizers and seeds to, districts between May and October.

The Eastern Province Transport Cooperative Association has 45 trucks, while the Eastern Province Cooperative Union and the Lint Company have none. Trucks from outside the province are, therefore, required to supplement the local fleet in times of heavy demand. No more than 50 percent of the trucks contracted report for service each year. The main reason for this low turnout is that the charges per ton or per kilometer that marketing agencies, both parastatal organizations and statutory agencies, pay the association to hire trucks are much lower than the charges that public sector businesses receive elsewhere.

Marketing also suffers because the network of collection points is inaccessible. The buying points of the NAMBOARD and the Eastern Province Cooperative Union cannot cover the entire smallholder farming population. Agroprocessing is ineffective, with the mills at Chipata, Lundazi, and Petauke operating at 25 percent of their installed capacity. Some private mills operating in Petauke, Chipata, and Chama were closed in 1986.

Energy

In addition to the provincial capital, Chipata, only two other district centers, Msoro and Masumba, receive electricity generated by diesel engines or hydropower. The Lusiwasi-Katete-Chipata-Lundazi 66 kilovolt grid was financed by a donor country. Most electricity is used for domestic purposes, and little is used for industrial production, let alone agriculture. Even for domestic use, electricity is available only to a small proportion of the persons living in the province's urban centers.

The Zambia Electricity Supply Company has the formidable task of electrifying rural areas. Making electricity available to agriculture is not a high priority, and service charges for line extensions are well

beyond the means of the average domestic consumer.

Public Transportation and Communications

Public institutions involved in transportation and communications include the line departments of Power, Transport, and Communication, Works and Supply, and Contingency Planning, district councils, and the Zambia Industrial and Mining Corporation through Contract Haulage and the United Bus Company; private sector institutions include the Haulage Trucks and Traders Association of Zambia and the Taxis and Transportation Association. This subsector suffers from a lack of spare parts and foreign exchange to replace old fleets and lack of adequate planning and scheduling to prevent crisis operations. Public transportation is particularly weak since the United Bus Company lacks capital and spare parts and does not maintain its current fleet well.

The province's road network includes approximately 651 kilometers of bitumen road, 5,000 kilometers of graded and ungraded roads, and a system of paths, trails, and tracks. In Eastern Province, 25 percent of the population lives within 7.5 kilometers of the bitumen road connecting parts of Malawi with Lundazi and Lusaka.

The plateau is better served than the valley. Virtually no road links the province to the Central and Lusaka rural provinces on the western side. Only the Muyombe Road makes the Northern Province accessible by motor vehicle. The province is served by Zambia Airways at Chipata and Mfuwe.

District centers are linked to the national network of post offices and telephones. Ordinary mail, parcels, telexes, and telegrams are delivered by the Posts and Telecommunications Corporation; a fleet of buses delivers mail and passengers between Chipata and Lusaka.

THE SOCIAL SECTOR

The social sector offers services in education, health, and housing and water supply.

Education

The province has 460 primary schools, 16 secondary schools, and 1 teacher training college. The goal of primary education is to cover all seven-year-olds entering the first grade and proceeding through the ninth grade without interruption. This objective is increasingly elusive.

The province faces an acute shortage of school rooms: 3,750 primary school classes are taught in double and triple sessions. Because the number of classrooms is inadequate, many children cannot enter the first grade when they are seven years old. Approximately 30 percent of the pupils completing the fourth grade do not proceed to the fifth grade because many schools do not offer the fifth through the seventh grade. Only 14 basic schools in Eastern Province offer classes in these grades. Only pupils in the basic schools have the opportunity to continue their education past the seventh grade. Less than 18 percent of seventh-grade pupils secure places in the eighth grade, and only 50 percent of these eventually reach senior secondary school.

In 1985 the regional office of the Ministry of Education predicted that 750 more classrooms were needed to absorb all children not attending primary schools; with the population growing 2.3 percent annually, the province needs 5,600 classrooms. If the current system of double or triple sessions continues, about 4,100 new classrooms are needed. If the problem is not resolved, illiteracy will increase, and about 50 percent of the children eligible for primary education will not be able to attend schools in 1996. Capital allocations for building new structures are almost nonexistent in the provincial plans. The Ministry of Education coordinates and controls the planning and provision of educational facilities at all levels.

Getting around the resource constraints is difficult. In Eastern Province, a tripartite arrangement involving the central government, district councils, and local communities is slowly emerging. Under this arrangement, the local community supplies accommodations to its primary schoolteacher(s) and works under the direction of, and receives support from, the district council to provide buildings, furniture, and equipment for the school.

District councils are, in turn, responsible for developing, constructing, and maintaining educational facilities for the first phase of basic education. After that, local communities through parent-teacher associations take care of the structures. According to government policy, parent-teacher associations must become increasingly involved in both the professional and the educational activities of boarding schools. Until such a system develops fully, the standards of the system of primary and secondary education will continue to decline.

Health

In 1985, the ratio of doctor to population was 1 to 21,070; that of nurses, 1 to 1,200; and that of clinical officers, 1 to 4,910 persons.

Health service institutions face various problems: the number of qualified staff is inadequate, the decisionmaking process is highly centralized, the policies for procuring equipment and medicine are poor, transportation is seriously lacking, knowledge of problems is inadequate, and, of course, financial and other resources are scarce.

The province has three nursing schools in Chipata, Mwami, and St. Francis (Katete). Together, these have trained 530 nurses since 1983. District health centers, such as that in Chama, find it difficult to attract, let alone retain, nursing personnel. Although staff may be available, keeping them at some of the centers is difficult because accommodations are not available or remunerations and other social inducements are poor.

Health services have shifted from curative to preventive care. Primary health care takes place at the community level. Beginning in 1980, community health workers are trained to work in rural areas, but many drop out because they do not receive support from the local community, cannot obtain a regular supply of drugs, and are not carefully selected.

Maternal and child health, the most important health service, emphasizes immunization and vaccination against communicable diseases such as tuberculosis, whooping cough, tetanus, diphtheria, and poliomyelitis.

Traditional healers supplement the efforts of these health services. The government recognizes the role that traditional healers and their medicine play in health care. All traditional healers are registered in the province with the Traditional Healers and Practitioners Association of Zambia.

Housing and Water Supply

The province's rapid rate of urbanization is causing pressing problems in the areas of housing, urban amenities, and services. From 1963 to 1969, the population of Chipata grew 68 percent; from 1969 to 1980, it grew a dramatic 151 percent.

The province's plateau region does not have perennial rivers or streams. Public institutional support provides the area with sources of clean water: 500 villages in the plateau region are equipped with boreholes, and 250 small reservoirs catch water that can be used for purposes other than safe drinking water. The Eastern Province Agricultural Development Project helped provide safe drinking water by sinking 121 wells.

ADMINISTRATIVE SECTOR

Planning decisions in the productive and social sectors are handed down from the central government to the province and from the province to the district and local levels. Maintaining these lines of communication is difficult, even in the best of times. The difficulties are compounded by the constraints on resources and the role that bilateral and multilateral funding plays in development.

In order for the administrative sector to function properly and encourage the development of agricultural and rural areas, the following issues must be resolved quickly. Within an economy with constrained resources, development work is often duplicated by the numerous public institutions in the province. This duplication should be reduced and eventually eliminated completely. Within Zambia, actual power needs to be devolved to the provinces so that they can prepare and execute plans for provincial development. This would cut down bureaucratic delays and establish decisionmaking capacities in the provinces. Further, provinces should be encouraged by both the public and the private sectors to set priorities for development within the productive and social sectors of the economy. This should be done without undercutting the existing authority of line ministries, parastatal organizations, and statutory agencies to establish priorities. Priorities should be set locally, and planning and execution should be accomplished locally. This would not take away the center's prerogative to rearrange provincial priorities in light of national needs and available resources.

In the current administrative sector, there is some discussion about the geographical area in which local planning exercises should be conducted; some have suggested that this should coincide with the boundaries of wards. Wards would then become the unit where all planning begins and where all public and private sector development plans converge. According to this suggestion, the next higher level of aggregation would be the district, followed by the province.

CONCLUSIONS

This paper describes the institutional setup responsible for all developmental activities within Eastern Province. This includes public and private institutions that intervene significantly in the productive, social, and administrative spheres of development planning. Their impact, or the lack of it, can be considerable.

These institutions could improve their performance, even with constrained resources, by setting priorities, avoiding duplicate activities, and exercising more power locally. Of course, the central government must, in turn, allow provincial institutions to perform their functions adequately and somewhat independently.

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8
Distribution of Businesses and Service Institutions in Eastern Province

Sudhir Wanmali

This paper seeks to understand the distribution, growth, employment, and other characteristics of businesses and service institutions in Eastern Province, Zambia. To do so, a survey was conducted in January through March 1987 of businesses and institutions in 93 locations: (a) the headquarters of the 10 agricultural districts chosen for the main survey; (b) the 10 villages in which the respondents of the main survey were located; and (c) 73 villages that provide business and service activities and lie within 10 kilometers of the first two types of locations. These were identified by the regional service use questionnaire. The survey collected information about the type and number of activities, employment, and year of establishment of businesses and service institutions; for business establishments, it also asked about the main problems related to credit, storage, and transportation facilities.

PATTERNS OF EMPLOYMENT

The study region has more businesses than service institutions, but service institutions employ more persons than businesses (see Table 8.1). This, however, varies by district. Not surprisingly, the largest concentration of business activities and service institutions is in Chipata District, which accounts for 42 percent of the number of businesses and 45 percent of the employment in businesses; it also accounts for 41 percent of all service institutions and 49 percent of all employment in service institutions (see Table 8.2). Other major concentrations of business activities and employment are Lundazi, Katete, and Petauke; Lundazi and Katete also have significant concentrations of service institutions and employment.

The dominance of service institutions in employment is immediately apparent. With the exception of Petauke, service institutions employ more persons than businesses. For the study region as a whole, they employ 2.5 persons for every 1.0 employed in business. In Mambwe and Chadiza, they employ 6.30 and 5.20 persons, respectively.

Table 8.1—Structure of services in Eastern Province, Zambia

Type of Service or Shop	Businesses		Service Institutions	
	Companies	Persons Employed	Companies	Persons Employed
		(numbers)		
Education	0	0	55	1,377
Health	0	0	20	733
Postal and telecommunications	0	0	8	104
Savings, credit, and finance	0	0	7	103
Government department	0	0	82	2,166
District council	0	0	4	92
Parastatal agency	0	0	35	1,787
Forestry	0	0	3	19
Special project agency	0	0	4	43
Agricultural services and implements	6	226	8	485
Dairy products	2	9	1	11
Transportation and trucking	3	82	0	0
Stocks of hardware, cloth, and ready-made clothes	9	48	0	0
Wholesale merchandise	13	75	0	0

(continued)

Table 8.1—Continued

Type of Service or Shop	Businesses		Service Institutions	
	Companies	Persons Employed	Companies	Persons Employed
	(numbers)			
Retail merchandise	220	464	0	0
Butcher	9	26	0	0
Liquor outlet	27	135	0	0
Motel and rest house	4	139	0	0
Open market	543	659	0	0
Garage	6	49	0	0
Filling station	4	22	0	0
Pharmacy and drug store	3	18	0	0
Restaurant	37	167	0	0
Bakery	6	52	0	0
Woodwork and carpentry	19	95	0	0
Blacksmith and tinsmith	21	35	0	0
Cobbler	22	24	0	0
Tailor	38	47	0	0
Repair shop and stall	19	28	0	0
Agroprocessing	15	51	0	0

(continued)

Hairdresser	11	41	0	0
Factory	2	29	0	0
Photo studio	3	16	0	0
Charcoal and wood for fuel shop	1	1	0	0
Tea and coffee shop and stall	2	4	0	0
Other	22	286	3	125
Total	1,067	2,828	230	7,045

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission business survey, Eastern Province, Zambia, 1987.

Table 8.2—Number of establishments and persons employed in businesses and service institutions in Eastern Province, Zambia, by district

District	Businesses				Service Institutions			
	Companies		Persons Employed		Companies		Persons Employed	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Chadiza	53	5.0	78	2.8	19	8.2	406	5.8
Chama	16	1.5	97	3.4	18	7.8	293	4.2
Chipata	448	41.9	1,257	44.4	94	40.8	3,462	49.1
Katete	140	13.1	443	15.7	27	11.7	1,321	18.8
Lundazi	153	14.3	312	11.0	40	17.4	779	11.1
Mambwe	11	1.0	22	0.7	13	5.6	140	1.9
Nyimba	75	7.0	155	5.5	12	5.[illegible]	259	3.7
Petauke	154	14.4	464	16.4	24	10.4	385	5.5
Total	1,067	100.0	2,828	100.0	230	100.0	7,045	100.0

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission business survey, Eastern Province, Zambia, 1987.

Employment by Activity

The dominance of service institutions becomes even more apparent when employment is analyzed by activity. Businesses employ 2.65 persons for each activity, whereas service institutions employ 30.63 persons. Thus service institutions employ 11 times more persons per activity than businesses, most of which operate on a small scale.

Density of Employment

The project also calculated the density of employment in the study region for every 1,000 persons in the district (see Table 8.3). For the study region as a whole, the density of employment was 4.19 persons in businesses and 10.45 persons in service institutions. Only two districts, Chipata and Katete, had denser employment than the region for both types of activities.

Table 8.3—Density of employment in businesses and service institutions in Eastern Province, Zambia, by district

District	Businesses	Service Institutions
Chadiza	1.73	9.02
Chama	2.72	8.24
Chipata	6.13	16.87
Katete	4.68	13.97
Lundazi	2.71	6.77
Mambwe	2.00	6.57
Nyimba	3.41	5.70
Petauke	4.13	3.42
Total	4.19	10.45

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission business survey, Eastern Province, Zambia, 1987.

Among the districts, Chipata had the highest density in both types of activity. Within the study region, the southern districts of Katete, Petauke, and Nyimba fared better than the northern districts of Mambwe, Chama, and Lundazi in business employment. With the exception of Chipata, again, employment in the northern districts was more dense in service institutions than in businesses.

Employment in Regional Activities

The density of employment was also calculated for activities that serve the town and those that serve the region. The so-called regional activities of service institutions include health, savings, credit and finance, government offices, parastatal agencies, special project agencies, and agricultural services. Similarly, the business activities that serve the region include agricultural services, transportation, hardware, clothes and garments, retail trading, wholesale trading, liquor, motels and rest houses, garages, filling stations, drug stores, repair shops, agricultural processing factories, tailoring, and photo studios.

The density of employment for activities that serve towns was 1.65 and 2.34 persons in businesses and service institutions, respectively; for activities that serve the region, the density was 2.36 persons and 7.80 persons, respectively. Thus activities that serve the region dominate the region's employment structure.

The Dynamics of Growth

The growth in the number and employment of businesses and service institutions was also analyzed to indicate a pattern of comparative dynamics (see Tables 8.4 and 8.5). Before 1961, only 5 percent of the businesses existing in 1986 had been established compared with 35 percent of the service institutions. Many service institutions had been present in the study region before businesses arrived. From 1961 to 1974, the growth of businesses was sluggish compared with that of service institutions: 17 percent of the businesses existing in 1986 were added to those established by 1961, compared with an impressive 35 percent of the service institutions. However, 78 percent of the businesses existing in 1986 were added between 1975 and 1986 compared with a steady 30 percent of the service institutions.

The growth in employment reflects the growth in the number of businesses and service institutions. Employment in businesses grew slowly at first, but gained rapidly between 1975 and 1986, whereas

employment in service institutions grew steadily during the past 25 years. About 39 percent of the total employment in service institutions occurred before 1961 compared with only 5 percent of that in businesses.

Table 8.4—Time period in which businesses and service institutions were established in Eastern Province, Zambia, 1961-86

Time Period	Businesses	Service Institutions
Before 1961		
Number	58	81
Percent	5.4	35.2
1961-64		
Number	36	17
Percent	3.4	7.4
1965-70		
Number	76	46
Percent	7.2	20.0
1971-74		
Number	63	17
Percent	5.9	7.4
1975-80		
Number	231	26
Percent	21.6	11.3
1981-86		
Number	603	43
Percent	56.5	18.7
Total		
Number	1,067	230
Percent	100.0	100.0

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission business survey, Eastern Province, Zambia, 1987.

Table 8.5—Number of persons employed by businesses and service institutions in Eastern Province, Zambia, 1961-86

Time Period	Businesses	Service Institutions
Before 1961		
Number	133	2,776
Percent	4.8	39.3
1961-64		
Number	170	464
Percent	6.0	6.6
1965-70		
Number	430	838
Percent	15.2	11.9
1971-74		
Number	172	955
Percent	5.1	13.5
1975-80		
Number	664	548
Percent	23.4	7.8
1981-86		
Number	1,259	1,464
Percent	45.5	20.9
Total		
Number	2,828	7,045
Percent	100.0	100.0

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission business survey, Eastern Province, Zambia, 1987.

PHYSICAL AND ECONOMIC CONSTRAINTS ON GROWTH

Transportation and the receipt of supplies and stocks from wholesalers are the major constraints on the development of businesses. In three surveys, these two problems were mentioned by 40, 46, and 37 percent of the respondents. Further, not more than 6 percent of all respondents noted credit as a major problem even though only 2

percent had any credit at all. Those who received credit did so from wholesale traders or other individuals, such as relatives and friends. Few received assistance from formal credit institutions. Little capital is available either for starting a new business or for improving an existing business. No credit problems exist simply because the scale of operations is not complex. The principal problems mentioned by the survey respondents relate to transportation facilities and the sources of supply and replacement of stocks and goods.

Transportation

More than 90 percent of the shopkeepers said that either they or the suppliers use some form of mechanized vehicular transportation to bring in stocks. A major difference exists, however, between the transportation available to shopkeepers and suppliers. Suppliers generally deliver stocks in their own vehicles, whereas shopkeepers generally bring stocks in rented vehicles. In all districts, most shopkeepers pick up their own stocks (see Table 8.6). In Chipata, which is well connected to all-season roads, the proportion of shopkeepers picking up their own stocks is 60 percent; elsewhere, it is well over 70 percent. The exception is Lundazi, where 17 percent of shopkeepers have supplies delivered and 3 percent pick them up.

Table 8.6—Proportion of stocks picked up by shopkeepers or delivered by suppliers in Eastern Province, Zambia, by district

District	Delivered	Picked Up
	(percent)	
Chadiza	15.6	84.4
Chama	11.1	88.9
Chipata	40.7	59.3
Katete	21.8	78.2
Lundazi	16.9	3.1
Mambwe	30.0	70.0
Nyimba	19.0	81.0
Petauke	19.7	80.3

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission business survey, Eastern Province, Zambia, 1987.

Major Sources of Supply

Eleven major sources supply goods to business establishments in the study region as a whole (see Table 8.7). These sources supply at least 50 percent of the stocks of the shops and businesses surveyed. Chipata, not surprisingly, tops the list as a major source of supplies for 41 percent of the businesses. Lusaka, Petauke, and Lundazi follow, being the major suppliers of 35 percent of the businesses. The remaining 25 percent of businesses named Katete, Chadiza, Sinda, and Chama as their major suppliers within the study region, Lusaka and Nidola outside the study region, and Malawi and Mozambique outside Zambia.

Sinda emerges as a major, local source of supply for Nyimba and Petauke districts, and local sources play an important role in distributing goods in Mambwe and Chama districts as well. A category of other suppliers, named by 9 percent of the businesses, includes shops in the local area of the village.

Table 8.7—Source of goods supplied to businesses in Eastern Province, Zambia

Source	Number of Businesses	Percent of Total
Zambia		
Chama	18	1.9
Lusaka	141	14.5
Chadiza	18	1.9
Chipata	394	40.9
Katete	72	7.5
Lundazi	98	10.2
Lusaka	141	14.5
Nidola	25	2.6
Petauke	100	10.4
Sinda	10	8.5
Malawi	3	0.3
Mozambique	2	0.2

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission business survey, Eastern Province, Zambia, 1987.

The significance of Chipata as a major source of supply decreases as one goes away from Chipata and toward Lusaka, Lundazi, and Chama (see Table 8.8). This decrease is a function of distance. Within the district itself, for example, 79 percent of the shopkeepers named Chipata as a major source; in Chadiza District, this dropped to 38 percent; in Katete, to 12 percent; and in Petauke and Nyimba, to less than 3 percent each.

GENERAL OBSERVATIONS

Several characteristics describe the distribution of businesses and service institutions in the study region. First, in both the study region and the districts as a whole, service institutions employ more persons than businesses do. Second, in the study region, business activities are concentrated in the southern districts, while service activities are concentrated in the northern districts. Third, the number of service institutions is less dense than that of businesses in both the study region and the districts. Fourth, the number of persons employed in service institutions is more dense than that of businesses in both the study region and the districts. Fifth, activities that serve the region employ more persons than activities that serve the towns. This is true for both businesses and service institutions. Sixth, the number of businesses has grown faster in recent times than in the past. The number of service institutions has, however, grown steadily during the past quarter of a century. Finally, the growth in employment reflects the growth in numbers, so that employment in businesses has grown faster in recent years than in the past.

The level of development in business and service activities in the study region reflects, and is reflected by, the level of development of agriculture. Although the development of agriculture is particularly impressive, businesses and services have grown rapidly in recent years.

Table 8.8—Major source of goods supplied to businesses in Eastern Province, Zambia, by district

Source	Mambwe		Chama		Lundazi		Chipata		Chadiza		Katete		Petauke		Nyimba	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Zambia																
Chadiza	0	0.0	0	0.0	0	0.0	0	0.0	18	38.3	0	0.0	0	0.0	0	0.0
Chama	0	0.0	6	42.9	12	8.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Chipata	11	91.7	2	14.3	13	9.0	332	78.5	18	38.3	13	11.5	3	2.2	2	3.0
Katete	0	0.0	0	0.0	0	0.0	1	0.2	2	4.3	68	60.2	1	0.7	0	0.0
Lundazi	0	0.0	3	21.4	95	66.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Lusaka	0	0.0	1	7.1	17	11.8	58	13.7	6	12.8	18	15.9	29	20.6	12	17.8
Nidola	0	0.0	0	0.0	5	3.5	9	2.1	2	4.3	4	3.5	4	2.8	1	1.4
Petauke	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.9	84	59.6	15	21.7
Sinda	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	6	5.3	3	2.1	0	0.0
Malawi	0	0.0	0	0.0	0	0.0	3	0.7	0	0.0	0	0.0	0	0.0	0	0.0
Mozambique	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	1.4	0	0.0
Other	1	8.3	2	14.3	2	1.4	19	4.5	1	2.1	3	2.7	15	10.6	39	56.5
Total	12	100.0	14	100.0	144	100.0	423	100.0	47	100.0	113	100.0	141	100.0	69	100.0

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission business survey, Eastern Province, Zambia, 1987.

Part II
The Determinants and Effects of Technology Adoption

9
The Use of Improved Agricultural Technology in Eastern Province

Dayanatha Jha, Behjat Hojjati, and Stephen Vosti

Significant changes took place in agriculture between 1979 and 1985 in Eastern Province: most notably, the production of maize, the major food crop, more than doubled. Although the expansion of area was the major factor behind this growth, yields improved as well.

Subsistence and small-scale agriculture occupy more than 97 percent of rural households in Eastern Province (Obermeyer 1987). The two main strategies being adopted to raise the income of smallholder farms are to increase productivity through the use of improved technology and to promote high-value commercial crops like cotton, sunflower, soybeans, and tobacco in existing farming systems. Investments in support systems such as research, extension, credit, input distribution, and marketing are also being made (Shula 1988).

This paper evaluates how smallholders respond to interventions that promote the use of improved biochemical (seeds and fertilizers) and mechanical (animal traction) technologies. Hybrid maize is the main focus of the seed-fertilizer thrust, although fertilizers are also being applied to local varieties of maize. Improved varieties of other crops (such as groundnuts, rice, finger millet, and sorghum) are being evaluated in adaptive trials, which seek to identify crops and regions that respond strongly to the use of fertilizers (Eastern Province Agricultural Development Project 1987b). These lead to yield improvements. Switching from hoe to animal traction increases total farm output by expanding the area cultivated and increasing the yield. Recent research has shown, however, that the effects on the area being cultivated are particularly important (Pingali, Bigot, and Binswanger 1987). Where land is abundant, labor-saving technical options are generally more efficient than other options, although developments in marketing and infrastructure enhance techniques that increase yield (Binswanger and Pingali 1988). In Eastern Province, farmers are adopting both labor-saving and yield-increasing techniques.

Data for this study were collected from 330 smallholder households located throughout the 10 agricultural districts of Eastern Province during 1985-86. The first part of the paper reports the survey findings about the extent to which hybrid maize, fertilizers, and animal traction have been adopted. This is followed by an analysis of the factors that

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determine how they are adopted. The implications of these results and policy issues are discussed last.

AGROECOLOGICAL CHARACTERISTICS OF THE PROVINCE

Eastern Province has two broad, distinct ecological zones: the plateau and the valley. Most of the population is concentrated in the plateau because the valley has higher temperatures, less rainfall, and infestations of tsetse flies. The Adaptive Research Planning Team of Eastern Province has identified three major zones within the plateau region and three within the valley (see Table 9.1 for the major characteristics of these zones). In the plateau zones, the annual rainfall ranges from 850 to 1,050 millimeters and the soils vary from sandy to clay-loam in texture. Maize is the dominant crop, accounting for over 80 percent of the cultivated area. Cattle are confined to this zone, although the incidence of east coast fever keeps the number of cattle unstable.[1] The valley zones have sparse population and no cattle. Maize and groundnuts are important, as are sorghum, rice, millet, and cotton (see Table 9.2 for the extent to which improved technology has been adopted in the province's various agroecological zones).

Differences between the valley and the plateau are striking. Prevalence of tsetse flies precludes cattle raising and, therefore, the use of oxen in valley areas. Technical constraints inhibit the adoption of hybrids and fertilizers as well. For example, adaptive research trials indicate that local maize in the valley responds poorly to fertilizers. Similarly, existing hybrids do not perform well under the harsh conditions of the valley (Eastern Province Agricultural Development Project 1987b). Moreover, the valley has relatively poor access to input distribution, marketing, and other services (Wanmali 1988).

Adoption varies significantly even within the plateau. The adoption of animal traction ranges from about 28 percent in the central zone to more than 73 percent in the north/south zone. Because of disease, the cattle population fluctuates both between and within zones. Fertilizers are well diffused in the central and north-south zones, where more than

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[1] For example, the cattle population in Eastern Province rose 8 percent between 1981 and 1982 and then declined 14 percent between 1982 and 1984. In some areas, like Petauke and Nyimba, it declined as much as 37 percent (Eastern Province, Department of Agriculture 1986a). Subsystems of both hoe and oxen prevail in the plateau.

Table 9.1—Characteristics of agroecological zones in Eastern Province, Zambia

Characteristic	Plateau			Valley		
	Western	North/South	Central	Chama	Central	South
Altitude		900-1,500[a]			400-600[a]	
Mean annual rainfall (millimeters)	900-950	850-1,000[b]	850-1,050	800-900	750-850[b]	700-800
Mean growing season (days)	125	135	140	145	140	125
Predominant type of soil	Clay/loam	Sandy	Clay/loam	Sedimentary	Variable	Variable
Farm households as a percent of all households, 1987	17	41	24	7	6	4
Population density, 1980[c]	9.3	11.7	17.1	2.0	2.0	2.0
Number of cattle per household	1.7	3.0	1.4	...	...	...

(continued)

Table 9.1—Continued

Characteristic	Plateau			Valley		
	Western	North/South	Central	Chama	Central	South
Percent of cultivated area planted with						
Maize	85.4	84.7	82.2	...	58.3[a]	...
Sorghum	...	...	...	...	15.6	...
Millet	...	5.0	...	...	5.6	...
Rice	...	...	...	...	2.4	...
Groundnuts	9.9	4.7	13.4	...	11.1	...
Soybeans	...	1.1	0.2	...	0.4	...
Sunflower	1.6	3.7	1.9	...	...	...
Cotton	1.0	...	0.4	...	2.8	...

Source: Based on the survey of the International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission, Eastern Province, Zambia, 1986.

[a] All zones of the region.

[b] Includes short drought periods.

[c] Obtained by district estimates.

Table 9.2—Proportion of farmers adopting improved practices in Eastern Province, Zambia, by region and zone

	Plateau			
Technology Adopted	North/ South	Central	Western	Valley
Hybrid maize	42.7	34.4	31.1	3.2
Fertilizers	78.2	75.4	36.1	6.3
Animal traction	73.4	27.9	67.2	0.0

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Program, and National Food and Nutrition Commission survey, Eastern Province, Zambia, 1986.

Note: Hoe and oxen subsystems are identified within each of the plateau zones. These have been aggregated in this and subsequent tables.

three-fourths of the farmers use them. In the western zone, however, their use drops sharply. In general, the use of hybrid maize is relatively low, but varies little between zones. Agroecological factors play a critical role even within a relatively small region, as the distinction between the valley and the plateau illustrates dramatically. The following sections detail the characteristics of use.

Fertilizers

Farmers in Eastern Province have known about and used fertilizers for 15 to 20 years. Harvey's study in Chipata district showed that farmers were using fertilizers on hybrid maize and tobacco in the early 1970s (Harvey 1973). The consumption of fertilizers grew rapidly during the 1980s, from 28,000 tons in 1980 to more than 43,000 tons in 1985 (Shula 1988). The consumption of plant nutrients grew even faster, and high-analysis fertilizers gained in importance. The demand for fertilizers is buoyant, and the supply of fertilizers is inadequate to meet the demand (Eastern Province Agricultural Development Project 1987a).

The use of fertilizers is heavily concentrated in the plateau zone (see Table 9.3). The western zone uses fertilizers less often and less intensively than other zones. The central and north/south zones account for nearly two-thirds of the farming population and use fertilizers on 59-65 percent of the cropped area. They do so at relatively high rates of about 97-106 kilograms of total plant nutrients per hectare. The rate for the province as a whole is about 63 kilograms per cultivated hectare. The comparable rate for Zambia was about 16 kilograms in 1985. The central and north/south zones of Eastern Province consume a large amount of fertilizers by the standards of developing countries (Food and Agriculture Organization of the United Nations 1986).

Maize is the only crop fertilized. Hybrid maize accounts for 50-75 percent of all the fertilizers used, and local varieties account for the rest. According to Harvey (1973) fertilizer was not used on local maize in the early 1970s, but was used on hybrid maize and tobacco.

Table 9.3—Fertilizer use in the plateau region of Eastern Province, Zambia, by zone

Indicator of Use	North/South	Central	Western
Fertilized crop area	59.4	65.0	36.2
Average rate of use per hectare (nutrients per kilogram)[a]	63.0	63.1	23.6
Average rate of use per fertilized hectare (nutrients per kilogram)[a]	106.0	97.1	65.1
Total fertilizer[a] allocated to			
Pure crop local maize	9.7	17.5	19.4
Mixed crop local maize	38.0	32.3	2.8
Pure crop hybrid maize	33.7	42.9	66.0
Mixed crop hybrid maize	18.5	7.3	9.3

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission survey, Eastern Province, Zambia, 1986.

[a] Total plant nutrients.

Over time, farmers have begun to use fertilizer on both local and mixed varieties of maize. According to field research conducted by the Adaptive Research Planning Team (Eastern Province, Department of Agriculture, Adaptive Research Planning Team various years), the average output per kilogram of plant nutrient used in the plateau area is about 15 kilograms for hybrid maize and 10 kilograms for local maize. At the prevailing prices, these responses are economically viable (Eastern Province, Department of Agriculture 1986b). The pattern of fertilizer diffusion in Eastern Province, which moved from a high response to a relatively low response situation, has occurred in other developing countries as well.

An important finding is the widespread use of fertilizers on fields cultivated with mixed crops (Table 9.3). In the two zones where fertilizer use is high, as much as 40-56 percent of the fertilizer used is applied on plots with mixed crops. In the western zone, where use is low, fertilizers are concentrated on maize grown alone, although they are used occasionally on plots with mixed crops.

The recommended rate of fertilizer application is 160 kilograms of plant nutrients ($130N + 20P_2O_5 + 10K_2O$) for hybrid maize and 80 kilograms ($65N + 10P_2O_5 + 5K_2O$) for local varieties of maize (Eastern Province, Department of Agriculture 1986b). The average rate for hybrid maize is lower in all three zones, although it is lowest in the western zone. For local maize, on the other hand, the rate approaches the recommended level in two of the three zones; once again, it is lowest in the western zone (Table 9.4). The Research and Evaluation Unit of the Eastern Province Agricultural Development Project (1984) conducted a survey in the northern zone in 1982-83 and attributed the high use of fertilizers on maize to inefficient practices. Rates were low in the 1985-86 season, however, perhaps because the delivery of fertilizer was inadequate (Eastern Province Agricultural Development Project 1987a). The rate of application is quite high for maize grown both in pure and mixed plots.

These data and other surveys (Harvey 1973; Eastern Province Agricultural Development Project, 1984, 1986) indicate that fertilizer use is well established in the plateau zone of Eastern Province. Over the past decade or so, its use has spread from hybrid maize to local maize and also to mixed crops. In the western zone, mixed plots of maize are rarely fertilized.

The use of fertilizers on both hybrid and local varieties is highly profitable in different plateau zones (Eastern Province Agricultural Development Project 1987b). The pattern of diffusion in Eastern Province is similar to that experienced in other parts of the developing

Table 9.4—Rates of application of fertilizers in Eastern Province, Zambia, by zone

Crop	North/South	Central	Western
		(kilograms)	
Local maize			
Pure crop	105	75	38
Mixed crop	75	76	...
Hybrid maize			
Pure crop	143	115	84
Mixed crop	115	...	...

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission survey, Eastern Province, Zambia, 1986.
Note: In kilograms of total plant nutrients per fertilized hectare.
... indicates too few observations.

world. The major constraint limiting the diffusion of fertilizers is the horizontal expansion of fertilized area. The major challenge is to ensure that fertilizer supplies are available and that farmers have access to them.

Hybrid Maize

Attempts to popularize the package of hybrid maize and fertilizers in Eastern Province were initiated around 1970 (Harvey 1973). About 18 percent of the farmers in Harvey's sample grew hybrid maize, and about 10 percent of the area planted with maize was devoted to hybrid maize during 1971-72. The adoption of hybrid maize lags behind the use of fertilizers, which is fairly widespread. Approximately 31-43 percent of the farmers in Eastern Province grow some hybrid maize, while 36-78 percent use fertilizers. In the valley, virtually no farmers grow hybrid maize, while in the plateau the lack of a suitable hybrid (in terms of yield) is not a constraint. In trials throughout the province, the Zimbabwian hybrid SR52 and its successor MM752 have

consistently yielded more than local maize (see Table 9.5 for the performance of hybrid and local maize in on-farm trials conducted by the Adaptive Research Planning Team from 1982 to 1987).

On average, hybrid maize yields about 122 percent more than local maize (see Table 9.5). Farmers fail to adopt hybrid maize not because higher-yielding varieties are unavailable, but because technical and other constraints exist. See Table 9.6 for data on the area cultivated with hybrids in different zones and under pure- as well as mixed-crop situations.

The percent of maize area cultivated with hybrids ranges from 27 to 31 percent. The adoption of hybrids does not vary as much among zones as does the adoption of fertilizers, which is significantly lower in the western than in other zones. Even farmers who plant hybrid maize do so in not more than 50 percent of the total area devoted to maize. The agricultural research system focuses on maize grown alone (Eastern Province, Department of Agriculture 1985). In fact, trials conducted by the Adaptive Research Planning Team in 1982, 1983, and 1984 show that mixed cropping does not increase the amount of total output. Mixed cropping is the dominant practice in the north/south and central zones, and a significant portion of hybrid maize is grown in mixed crops. An important gap exists in research and extension since crop recommendations are limited to single-crop situations.

Thus hybrids have not been substituted for local varieties in Eastern Province. With some exceptions, this has been the pattern on smallholder farms in most of central and southern Africa, despite the substantial yields of hybrid maize (Rohrbach 1988; CIMMYT 1985).

Farmers prefer to consume the traditional varieties of maize and identify hybrid maize as a cash crop. This preference is not related to taste. Siandwazi and Kumar (1988) show ready acceptance of mealie meal, which contains a large proportion of hybrids. Our survey of 38 farm families in the plateau found that 10 out of 12 farmers growing hybrid maize rate its quality as acceptable for food. The main factors hindering the use of hybrids for food are that dent hybrid corn does not store well and is difficult to pound. All 12 of the farmers who grow hybrid maize sell their produce soon after harvest, and 8 explicitly mention heavy losses in storage as a constraint.

Marketing deficiencies are another important constraint. Since hybrids are produced mainly for cash, the capacity of the marketing agency to reach and transport supplies from remote locations is critical. Differences in the spread of hybrids and fertilizers may also be attributed to time constraints on the supply of inputs. Fertilizers can be

Table 9.5—Mean yield of hybrid and local maize in the plateau region of Eastern Province, Zambia, 1982-87

Year	Hybrid	Local
	(kilograms per hectare)	
1982-83	n.a.	2,517
1983-84	5,798	n.a.
1984-85	5,626	2,294
1985-86	5,073	2,317
1986-87	n.a.	2,799
Average	5,499	2,480

Source: Eastern Province Agricultural Development Project, *Eastern Province Agricultural Development Project: Project completion report. Annex 7: Farming systems research*, Chipata, Zambia, 1987.

Note: The on-farm trials of hybrid maize were conducted at 29 sites, those of local maize were conducted at 46 sites.

n.a. is not available.

Table 9.6—Area planted with maize in the plateau region of Eastern Province, Zambia, by zone

Indicator	North/South	Central	Western
Cropped area under maize	84.7	82.2	84.5
Maize area under hybrids	29.3	30.7	27.1
Maize area under pure crops	26.7	41.7	87.0
Pure crop area under hybrids	66.4	56.5	25.3
Hybrid area under mixed crops	40.4	23.1	18.4
Maize area under hybrids[a]	46.3	50.0	47.5

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission survey, Eastern Province, Zambia, 1986.

[a] For hybrid maize adopters only.

adopted over a two- to three-month period, whereas hybrids can only be adopted at planting time.[2] If seed stocks are not available at that time, hybrids cannot be adopted. Finally, farmers must make higher outlays of cash to grow hybrids. Farmers are convinced that hybrids cannot be grown without fertilizers, and no farmer in the sample grows hybrids without them. This underscores the importance of credit, which will be evaluated quantitatively later in this paper.

Research has not yet developed hybrids that have flinty grains and can be stored well. The hybrid program concentrates on developing and evaluating hybrids for valley conditions and hybrids with shorter durations that can be planted late in the season (December). The underlying assumption is that hybrid plantings are delayed because farmers plant local varieties first. Late plantings reduce yields substantially. This effort has identified MM601, 603, and 604 hybrids, which can be planted in December. At the same time, recent work by the Adaptive Research Planning Team has identified some early-maturing local varieties (MMV400) and a semi-flint, open-pollinated variety (MMV600) suitable for late planting (Eastern Province Agricultural Development Project 1987a). Seeds of these varieties are scarce, although farmers have expressed considerable interest in them.

Animal Traction

Cultivation using oxen is confined to the plateau region and ranges from about 28 percent in the central zone to more than 73 percent in the north/south zone (see Table 9.7).

In all zones, ownership is more restricted than use of oxen. The percentage of farmers owning oxen ranges from about 25 percent in the central zone to 41 percent in the western zone. Although farmers who own oxen account for a disproportionate share of the cultivated land, the total amount of area cultivated with oxen is much higher than that belonging to farmers who own oxen. Many farmers rent oxen. The Research and Evaluation Unit survey (Eastern Province Agricultural Development Project, Research and Evaluation Unit 1986) reported that 31 percent of farmers hire oxen. The phenomenon is not as pronounced in the central zone, perhaps because fewer oxen are available there. According to Harvey (1973), the use of oxen was nonexistent in 1971.

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[2] For example, if a farmer cannot use fertilizers at planting time, he can still apply them as top dressing during subsequent stages of growth. In fact, the application of fertilizer is often spread over three to four months.

Table 9.7—Use and ownership of oxen in the plateau region of Eastern Province, Zambia, by zone

Indicator	North/South	Central	Western
Farmers using oxen (percent)	73.4	27.9	67.2
Area cultivated by oxen (percent)	73.6	48.2	68.8
Farmers owning oxen (percent)	36.3	24.6	41.0
Farmers owning a plow (percent)	46.8	16.7	32.8
Average number of work oxen per household	1.0	0.5	0.9
Area held by farmers who own oxen (percent)	49.1	30.9	57.2
Area cultivated per household			
Using oxen (hectares)	3.4	2.9	3.3
Using hoes (hectares)	1.6	1.1	2.1

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission survey, Eastern Province, Zambia, 1986.

Contrary to expectations, ownership of plows is even more restricted. Although farmers can raise their own oxen, they depend on the market for purchasing plows and other animal-drawn equipment. The market for tools and other equipment is obviously deficient.

The use of oxen affects output mainly through its impact on the amount of area cultivated. On average, farmers who use oxen cultivate 55-170 percent more area than farmers who use hoes.

Farm Size and Adoption of Improved Technologies

Who benefits from the adoption of these new and improved technologies? Experience with biochemical technologies in Asia suggests that well-to-do farmers reap the benefits during the initial

phases. As the technologies become more diffused and use intensifies, small farmers catch up and begin to benefit more than large farmers. What is the experience in Eastern Province? Although the sample consisted exclusively of smallholder farms, the size of farms varied considerably within the sample (see Table 9.8).

The distribution of land in the plateau zone belies the conventional view that land is relatively equally distributed within the traditional smallholder sector of Africa. Over 55 percent of the households cultivate less than 2 hectares of land and work less than one-fourth of the area cultivated; 11 percent of the households have more than 5 hectares of land and work nearly one-third of the total area cultivated.

Although a positive association exists between farm size, fertilizer adoption, and area fertilized, small farms do not lag behind large farms in their use of fertilizers. Over half (52 percent) of the farms with less than 1 hectare use fertilizers and fertilize 46 percent of the area they cultivate.

Size affects the adoption of hybrid maize more than it affects the use of fertilizer. Only 7 percent of the smallest farms adopt hybrid maize, while 96 percent of the largest farms devote some area to hybrids. This trend was also reported by the Research and Evaluation Unit's study on smallholder agriculture in Eastern Province. The proportion of hybrids in total area cultivated with maize rises from 3 percent on the smallest farms to almost 50 percent on the largest farms. Although almost all farmers in the largest group grow hybrids, they continue to plant a significant amount of land with traditional varieties. Most farmers view hybrid maize as a cash crop. Regardless of the size of their farm, farmers prefer to grow local varieties for their domestic consumption. The farmers with the smallest amount of land must plant most of their land with local varieties in order to meet the needs of their households. This constraint is eased only as farms expand in size.

Cultivating with oxen is also strongly related to farm size. Only 17 percent of the households with less than 1 hectare of land own oxen, but the use of oxen rises very fast and reaches 77 percent among farmers with more than 5 hectares. Cultivating with hoes is, as expected, confined to smaller farms. The direct relationship that exists between the size of a farm and the ownership of oxen in Eastern Province also occurs in Asia, but for different reasons. In Asia, where land is scarce, animal husbandry is based exclusively on crop residues and by-products and larger crop areas are required to sustain larger stocks. In Eastern Province, where land is relatively abundant, feeding requirements are not a severe constraint, and the acquisition of oxen tends to increase the area cultivated. If other constraints on the

Table 9.8—Size of farms and adoption of technology in the plateau zone of Eastern Province, Zambia

Indicator	Less than 1.00 Hectare	1.00-1.99 Hectares	2.00-2.99 Hectares	3.00-4.99 Hectares	More than 5.0 Hectares
Farm size					
Households (percent)	23.6	31.7	15.4	18.7	10.6
Total area (percent)	5.7	18.6	14.7	28.1	32.9
Average size (hectares)	0.6	1.5	2.4	3.8	8.0
Fertilizer					
Farmers using fertilizer (percent)	51.7	67.9	65.8	67.3	100.0
Crop area fertilized (percent)	45.5	49.8	52.3	43.5	72.3
Average rate of application (kilogram of plant nutrients per fertilized hectare)	102.5	92.2	94.6	104.5	93.9
Hybrid maize					
Farmers using hybrid (percent)	6.9	30.8	42.1	52.2	96.1
Maize area under hybrid (percent)	3.1	15.1	17.6	24.2	49.2
Cultivation with oxen					
Farmers using oxen (percent)	25.9	56.4	65.8	87.0	96.2
Farmers owning oxen (percent)	17.2	17.9	36.8	58.7	76.9
Area cultivated by oxen (percent)	18.4	46.0	58.4	70.3	93.2

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission survey, Eastern Province, Zambia, 1986.

acquisition of oxen were relaxed (if, for example, markets for oxen and implements were developed, medium-term credit were expanded, and diseases were controlled), farm sizes would increase.

Using oxen and fertilizers are the main dynamic forces in agriculture in Eastern Province. Access to oxen enables farmers to expand the area cultivated, which generates a marketed surplus. Fertilizer serves the same purpose. Once the requirements of domestic consumption are satisfied, hybrid maize becomes significant and adds substantially to the surplus, since most of the produce is marketed. Another study of smallholder farms in the province found that although hybrids have a small share of the area cultivated with maize, they constitute about half of the marketed quantity of maize (Eastern Development Agricultural Development Project, 1986).

DETERMINANTS OF ADOPTION

A series of hypotheses about the effects that characteristics of the farmers, households, and region have on adoption behavior were tested. The adoption process involves three decisions. First, farmers decide whether or not to adopt a high-technology package, or a component(s) of that package. Second, farmers decide how much to adopt (in this case, how much area to fertilize). Finally, they decide the intensity of use (that is, the amount of fertilizer to apply per hectare).

The introduction of high-value crops (like cotton, sunflower, soybeans, and tobacco) is an important element of the agricultural strategy promoted in Eastern Province. In addition to analyzing the determinants of hybrid maize, fertilizers, and cultivation using oxen, the factors influencing adoption of new (high-value) crops were analyzed.[3]

Simultaneity of Technological Choices

Contingency tables and odd ratios (Nerlove and Press 1973) for the plateau region of Eastern Province (see Table 9.9) were calculated. These are useful for evaluating the propensity of farmers to adopt the full package of technologies (consisting of hybrid maize, fertilizers,

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[3] However, only 18 percent of the sample farmers adopted high-value crops such as these. Since the adoption rates are so low, the results of this analysis are weak.

cultivation with oxen, and new crops) or to adopt certain components selectively. Each segment of Table 9.9 represents a cross-tabulation of two distinct technologies, which are treated dichotomously. For example, comparing the decision to adopt hybrid maize with the chosen method of cultivation shows that 61 farmers use neither hybrid maize nor oxen. Another 62 farmers use both. The odd ratio is the product of the on-diagonal cells divided by the product of the off-diagonal cells. A higher ratio indicates that farmers are likely to simultaneously adopt or reject a given pair of technologies.

Table 9.9—Simultaneity of adoption: Contingency table

Technology Option	Cultivation		Fertilizer Use		New Crop	
	Hoe	Oxen	Not Adopted	Adopted	Not Adopted	Adopted
Hybrid maize						
Not adopted	61	66	66	61	104	23
Adopted	10	62	0	72	58	14
New crop						
Not adopted	63	99	57	105	...	...
Adopted	8	29	9	28	...	...
Fertilizer use						
Not adopted	31	35	...	...	...	...
Adopted	40	93	...	...	...	...

Source: Based on data collected from 199 households in the plateau zone. International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission survey, Eastern Province, 1986.

Note: For the adoption of hybrid maize, the odd ratio to the use of oxen is 5.73, to the adoption of fertilizers, infinity, and to the adoption of new crops, 1.09. For the adoption of new crops, the odd ratio to the use of oxen is 2.31 and to the use of fertilizers is 1.69. For the use of fertilizers, the odd ratio to the use of oxen is 2.06.

The following pairs of technologies are more likely to be adopted simultaneously than separately: hybrid maize and oxen, fertilizer and hybrid maize, fertilizer and oxen, and oxen and new crops. The decisions to adopt new crops and hybrids, as well as fertilizers are more independent.

Deciding to adopt hybrid maize, fertilizers, and animal traction simultaneously implies that farmers in the plateau region respond positively to the prevailing economic environment.[4] This is driven mainly by maize; the expansion in area (facilitated by animal traction) and the increase in fertilizer use and hybrids expand the production and surplus of maize.[5] Evidence on the existence of simultaneity also underscores the need to design integrated development programs. For example, the Eastern Province Agricultural Development Project did not focus strongly on animal traction nor integrate the supply of fertilizers and seeds, even though the need for both is well recognized (Eastern Province Agricultural Development Project 1987).

Estimation of Relationships

Given the simultaneous nature of some of the decisions to adopt the technologies presented in Table 9.9, a combination of instrumental variables were used. The Heckman (1974) approach was used to estimate the impact that a set of farmer, farm level, and region-specific characteristics has on the adoption and use of modern farm technologies. A full description of the variables used in this analysis is provided in Table 9.10; the estimated relationships are presented in Tables 9.11 and 9.12; and the results are summarized in Table 9.13.

The following relationships within the equations are statistically significant. The age and genuer of the head of household significantly influence the adoption of hybrid maize. Heads of household who are older and female are not likely to adopt hybrid maize. Farmers in the north/south and central zones are very likely to adopt hybrid

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[4] For example, a study on marketing groundnuts in the province shows that during the 1978-83 period relative prices heavily favored maize (Zambia, Ministry of Agriculture and Water Development, Planning Division 1983).

[5] Between 1978 and 1986, the total area under crops increased 71 percent, far exceeding the rate of population growth. Maize accounted for 93 percent of this growth in area cultivated (Eastern Province, Department of Agriculture, 1986a).

technology, as are farmers who belong to farmer cooperatives. The relationship between the propensity to adopt hybrid varieties of maize and the size of the farm, as measured by cultivated area, is strong and positive. Results for instrumental variables that were included to test the relationship between the farmer's decision to use hybrids and the decision to use fertilizers and a particular cultivation method are not very satisfactory. Similarly, the variable for off-farm income carries an unexpected sign.

Table 9.10—Variables included in the analysis of the determinants of adoption

Variable	Description
Endogenous	
USEFERT	Fertilizer use (0 = no, 1 = yes)
USEHYM	Hybrid maize use (0 = no, 1 = yes)
CULTMETH	Cultivation technique (0 = hoe, 1 = oxen)
NCROP	Use of cotton, soybeans, sunflower (0 = no, 1 = yes)
NPKFHA	Plant nutrients used per fertilized hectare (kilograms)
PF	Percent of area fertilized
Exogenous	
AGEHD	Age of the head of household
HEADHH	Gender of the head of household (0 = male, 1 = female)
EDHD	Education of the head of household (years)
AREAHA	Area cultivated (hectares)
DRATIO	Dependency ratio (number of dependents per number of adults)
COOPMEM	Member of a cooperative (0 = no, 1 = yes)
YOTHS	Income from nonfarm sources (kwacha)
ADVICE	Use of extension advice (0 = no, 1 = yes)
DINF	Index of infrastructure[a]
Z_2	North/South zone of the plateau (1 = yes)
Z_3	Central zone of the plateau (1 = yes)
Z_4	Western zone of the plateau (1 = yes)

[a] For a definition, see Wanmali (1988).

Table 9.11—Probit maximum likelihood estimates of instrumental variables

Variable	USEFERT Coefficient	USEFERT t-ratio[a]	CULTMETH Coefficient	CULTMETH t-ratio[a]	USEHYV Coefficient	USEHYV t-ratio[a]	NCROP Coefficient	NCROP t-ratio[a]
EDHD	0.0050	0.128	0.0610	1.511*	0.0270	0.684	-0.004	-0.110
AGEHD	-0.0170	-2.071***	-0.0090	-1.125	-0.0250	-2.816***	-0.012	-1.497
Z_2	1.4100	4.942***	0.0030	0.011	0.6060	1.931**	0.665	2.127***
HEADHH	-0.0840	-0.331	-0.2380	-0.911	-0.6510	-2.106**	0.286	1.091
Z_3	1.3720	4.063***	-1.2240	-3.500***	1.0540	2.645**	0.193	0.527
ADVICE	0.2810	0.873	0.4550	1.335	-0.1840	-0.523	0.504	1.628
YOTHS	-0.0001	-0.335	-0.0004	-0.962*	-0.0005	-1.671**	0.681×10^{-4}	0.265
DINF	0.4920	3.572***	0.1780	1.349*	-0.1520	-1.131	0.083	0.667
AREAHA	0.2880	3.582***	0.4930	4.829***	0.5850	6.153***	0.096	2.270***
DRATIO	-0.0250	-0.145	-0.1400	-0.842	0.2190	1.181	0.076	0.473
COOPMEM	0.7780	2.135***	0.5690	1.550*	0.8140	2.672***	-0.340	-1.111
Constant	-1.0860	-1.944***	-0.3680	-0.667	-1.3400	-2.393***	-1.375	-2.477***
Chi-squared	85.4360		91.7800		104.6700		16.949	

Actual	Predicted 0	Predicted 1	Actual	Predicted 0	Predicted 1	Actual	Predicted 0	Predicted 1	Actual	Predicted 0	Predicted 1
0	38	28	0	47	24	0	112	15	0	159	3
1	18	115	1	19	109	1	23	49	1	36	1

Note: The sample consisted of 199 households. See Table 9.10 for definitions of the variables.

[a] Absolute values of t-ratios, where *, **, and *** indicate significance levels of 20, 10, and 5 percent, respectively.

Table 9.12—Probit maximum likelihood estimates of the adoption of fertilizer, hybrid maize, cultivation with oxen, and new crops

Variable	USEFERT Coefficient	USEFERT t-ratio[a]	CULTMETH Coefficient	CULTMETH t-ratio[a]	USEHYV Coefficient	USEHYV t-ratio[a]	NCROP Coefficient	NCROP t-ratio[a]
EDHD	0.071	1.235	0.016	0.385	0.075	1.832**	-0.009	-0.230
AGEHD	-0.040	-2.735***	-0.031	-3.142***	-0.017	-1.911	-0.013	-1.477**
Z_2	1.811	4.897***	1.226	2.577***	0.409	0.844	0.747	1.802**
HEADHH	-0.600	-1.523**	-0.657	-2.095**	-0.297	-1.105	0.293	1.114
Z_3	0.968	1.008	2.056	2.798***	-0.744	-1.407*	0.393	0.737
ADVICE	0.491	1.201	-0.193	-0.543	0.578	1.622**	0.499	1.610*
YOTHS	-1.001	-1.084	-0.001	-1.740**	-0.905	-1.036	0.7×10^{-4}	0.281
DINF	0.552	3.100***	-0.134	-0.945	0.190	1.333*	0.077	0.583
AREAHA	1.046	2.460**	0.623	5.279***	0.774	4.878***	0.692	1.786**
DRATIO	0.008	0.040	0.228	1.230*	-0.100	-0.598	0.084	0.516
COOPMEM	1.689	2.810***	0.960	2.917***	0.803	2.111**	-0.342	-1.097
USEFERT Hat	...	...	-0.847	-1.754*	-0.336	-0.697	-0.121	-0.287
USEHYV Hat	-2.824	-1.763**	...	...	-1.126	-2.569**	...	...
CULTMETF Hat	-2.750	-1.290	0.450	0.880	...	...	0.188	0.507
NCROP Hat	...	...	...	...	2.394	0.008	...	...
Constant	0.389	0.349	-1.454	-2.222**	-0.530	-0.935	-1.456	-2.416**
Chi-squared	90.269		108.12		98.765		17.250	

Actual	Predicted 0	Predicted 1	Actual	Predicted 0	Predicted 1	Actual	Predicted 0	Predicted 1	Actual	Predicted 0	Predicted 1
0	35	31	0	114	13	0	49	22	0	159	3
1	14	119	1	24	48	1	18	110	1	36	1

(continued)

Table 9.12—Continued

Variable	NPKFHA Coefficient	NPKFHA t-ratio[a]	PF Coefficient	PF t-ratio[a]
EDHD	2.718	1.658**	0.007	0.809
AGEHD	-0.155	-0.414	0.0002	0.085
Z^2	28.515	1.328*	0.080	0.786
HEADHH	-1.138	-0.113	-0.067	-1.338
Z^3	8.279	0.248	0.102	0.643
ADVICE	3.684	0.294	-0.015	-1.338
YOTHS	-0.015	-1.279	-0.544×10^{-4}	-1.044
DINF	20.450	3.028***	-0.039	-1.173
AREAHA	1.428	0.396	-0.016	-1.022
DRATIO	-0.991	-0.133	-0.022	-0.609
COOPMEM	6.432	0.481	0.118	1.890**
USEHYV Hat	62.660	1.610*	-0.025	-0.134
CULTMETH Hat	-42.946	-0.962	-0.049	-0.224
LAMBDA[b]	42.770	1.750**	-0.052	-0.437
Constant	34.848	0.821	0.855	4.246***
$R^2(\bar{R}^2)$	0.074 (0.172)	0.010		
F	1.750	1.097		

Note: The sample consisted of 199 households for USEFERT, CULTMETH, USEHYV, and NCROP and of 133 households for NPKFHA and PF.
[a] Absolute values of t-ratios, where *, **, and *** indicate significance levels of 20, 10, and 5 percent, respectively. The hat variables are instruments.
[b] LAMBDA is the inverse of the mills ratio that is obtained from the USEFERT equation.

Table 9.13—Significant variables determining the adoption of technology in Eastern Province, Zambia

Variable	Cultivation with Oxen	Use of Fertilizers	Use of Hybrid Maize	Intensity of Fertilizer Use: New Crops	Intensity of Fertilizer Use: Percent of Area	Intensity of Fertilizer Use: Rate of Application
EDHD	(+)					
AGEHD		(-)	(-)	(-)		(+)
HEADHH		(-)	(-)		(-)	
AREAHA	(+)	(+)	(+)	(+)		
DRATIO			(+)			
COOPMEM	(+)	(+)	(+)		(+)	
YOTHS			(-)			
DINF	(+)	(+)				(+)
Z_2 (north/south zone)		(+)	(+)	(+)		(+)
Z_3 (central zone)	(-)		(+)			
USEFERT[a]		(-)				
USEHYV[a]	(-)	(-)				
CULTMETH[a]						(+)
NCROP[a]						

Source: Summarized from Table 9.12.

Note: + and – indicate statistically significant positive and negative effects, respectively.

[a] Used as instruments.

A somewhat different set of interrelationships surfaces in the equation for the method of cultivation. The educational level of the head of household is positively linked to cultivation technique, with farmers having more education being more likely to use oxen than farmers having less. The age of the head of household is negatively related to cultivation technique, but the gender of the head of household does not seem to matter. The regional differences that are so strong in the equation for hybrid maize do not surface in the equation for method of cultivation. In fact, that equation only captures a weak, negative relationship between residence in the central zone and choice of cultivation method. Advice from the extension service and membership in a farmers cooperative both significantly influence decisions about methods of cultivation. The index of infrastructure is positively related to cultivation method, indicating that improvements in infrastructure increase the probability that a farmer will use oxen-based cultivation. Once again, farm size is positively and very significantly linked to cultivation choice, with larger farms being much more likely to use oxen-drawn technology than smaller farms. The instrumental variables for use of fertilizers, new crops, and hybrid maize again fail to yield the expected results.

Three equations were used to estimate fertilizer use. The first measures fertilizer use in a dichotomous way, the second focuses on the percentage of cultivated area being fertilized, and the third focuses on the intensity with which fertilizers are applied.

In the dichotomous case, farm households headed by younger males are much more likely to use fertilizer than those headed by older farmers and females. Farmers residing in the north/south zone of the plateau region are significantly more likely to use fertilizer than those residing in other zones. Infrastructure and cooperative membership add significantly to the probability that fertilizer will be used, and farm size is positively related to fertilizer use. Repeating an interrelationship in the equation for hybrid maize, the instrumental variable for the use of hybrids is negatively related to the use of fertilizers.

The equation for the extent of fertilizer use (represented by the percentage of cultivated area being fertilized) is significantly weaker than the dichotomous equation. The only strong relationships that surface are a positive link with membership in a cooperative and a negative link with female heads of household.

The equation for intensity of use (measured in terms of total plant nutrients per hectare) generated some interesting insights. Education of the head of household, although insignificant in the previous equations for fertilizer, is an important indicator of the intensity with which

fertilizer is applied. Better educated farmers tend to use more total plant nutrients per hectare than less-educated ones. Infrastructure once again is an important determinant of the intensity with which fertilizer is used, and the link between the use of hybrids and the intensity of fertilizer use is positive, suggesting that farmers who use hybrids use fertilizer more intensely than farmers who do not. Finally, lambda in the fertilizer equation is significant, which suggests that important differences exist between farmers who do and farmers who do not adopt modern chemical fertilizers. These differences need to be taken into consideration when making empirical estimates.

Finally, a 0/1 probit equation was run on the decision to grow new commercial crops to estimate the impact of the variables included in the previous equations. Older farmers are less likely than younger farmers to adopt new crops, and farmers in the north/south zone are more likely to adopt them than farmers in other zones. Extension advice has a positive impact on the probability of adopting new commercial crops, and once again farm size is a strong determinant of the likelihood that a given farmer will adopt this new form of agricultural technology.

Several very strong and interesting relationships carry through across equations. First, the educational level of the head of household seems to influence the choice of cultivation method and the intensity with which a farmer will adopt new technology. The age of the head of household is negatively related to virtually every indicator of modern technology used. The gender of the head of household tends to influence the use of hybrids and of fertilizers, but not the choice of cultivation technique or new crop. Agricultural extension influences the method of cultivation and choice of crop, but not the use of hybrids or fertilizers. Improved infrastructure increases the probability that a farmer will use oxen-drawn cultivation techniques and fertilizers, but not his or her choice of crop or use of hybrid seeds. The strongest and most consistent indicator of the probability of adopting one of the modern farm technologies studied is the size of the farm (total area cultivated). This is especially interesting since land is not scarce in this particular region of Eastern Province.

POLICY IMPLICATIONS

The most significant finding of this study is the sharp distinction between the plateau and valley regions. If farmers were to adopt the technological package being promoted, which is based on the use of animal traction, hybrid seeds, and fertilizers, income disparities

between these regions would be accentuated, not diminished. The reason is partly ecological. Since cattle cannot be raised in the valley because of the infestation of tsetse flies, the plateau region would benefit disproportionately. The lack of research suited to the conditions of the valley is another factor. Until the Adaptive Research Planning Team was established as part of the Eastern Province Agricultural Development Project in 1982, practically no research-based knowledge was available for this zone. Even the adaptive research work undertaken since then has been constrained by the lack of adequate facilities for experiment stations where base-level research could be undertaken. Notwithstanding these constraints, the team identified some promising innovations for the valley.[6] These innovations could be exploited if the region's infrastructure and support systems were improved at the same time. Two promising initiatives currently under way are the Luangwa Valley Development Program and the project to strengthen the Masumba research station. Social and agricultural researchers should address two critical issues: how to improve access to infrastructure and support services in this sparsely populated zone, which is also a game reserve, and how to introduce labor-saving options in addition to yield-augmenting technologies.

Strong inequalities are emerging in the smallholder sector of the plateau region, driven largely by the unequal distribution of land. The ability to acquire and use oxen enables farmers to increase their cultivated area, sales, and income (Celis and Bliven 1988). The rental market for oxen is growing and increasing the cultivated area per household. The situation of households without access to oxen is worsening, while that of those with access is improving. Agricultural development programs focus mainly on yield-increasing inputs. Farmers, however, appear to find the expansion of area equally, if not more, attractive.

Cultivation using oxen clearly deserves to be given a higher priority for reasons of both productivity and equity. Its promotion calls for three related activities. First, a vigorous disease control program is essential to minimize the risk of cattle mortality. Second, medium-term credit programs must be expanded significantly and their input package made flexible so that farmers will adopt it. Shula (1988) reports that the package, valued at K 10,000 in 1987, consists of oxen, cart, plow,

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[6] For example, the use of fertilizer for cotton, the identification of promising varieties, and the use of hybrids for maize, rice, and finger millet (Eastern Province Agricultural Development Project 1987b).

ridger, chain, veterinary pack, and insurance coverage. A flexible package would increase both the demand for and the number of loans. Unfortunately, the trend in recent years has been to offer inflexible packages and a smaller number of loans (Banda 1988). Finally, supplies of animal-drawn tools and equipment should be increased. The Adaptive Research Planning Team has tested some of these implements on farms, and its findings should be integrated with the supply and distribution system.

Two types of research are clearly lagging behind the practices of the farmers themselves. The first is the use of fertilizers for local mixtures of maize, and the second is the planting of hybrids in mixed plots. Farmers have received no recommendations on either of these practices. Adaptive research should focus more sharply on these and other issues.

Research on maize focuses principally on hybrids and accepts that farmers will continue to grow the traditional varieties for their domestic use. The Adaptive Research Planning Team has been evaluating the possibility of using higher-yielding, open-pollinated varieties as substitutes for traditional varieties. So far, their yield potentials are lower than those of hybrids. Options other than research have not been fully exploited, such as policies that promote improved farm storage (to extend the ability to store hybrids locally) and milling (to alleviate the constraint on pounding). Such policies would encourage farmers to expand their production of hybrids.

Maize is the major force transforming agriculture in Eastern Province. Should the profitability of producing maize decrease, agriculture would suffer a serious setback. It is extremely important to ensure that this does not happen. At the same time, diversifying the base of agricultural growth is crucial for the province. Crops like cotton, sunflower, soybeans, groundnuts, and rice have good potential and should be encouraged. Although relative prices are important for conveying appropriate signals to producers, improvements in marketing are equally important.

The decision to adopt improved technology is influenced by education, infrastructure, and credit, which are provided by the government. More investment in these sectors would produce higher levels of adoption. These investments are particularly crucial in the valley region. The decision is also influenced by gender, with female-headed households being less inclined to adopt improved technology. Such households constitute 30 percent of the project's sample. Mechanisms to reach and bring these households into the mainstream must be developed.

Extension makes only a small contribution to the process of adopting and diffusing technology. It contributes to specialized, commodity-oriented programs, but not to maize, the main crop. A proper extension system was being instituted in the province during the period of this field work, however, and its effects could not be evaluated in 1985-86. Its effectiveness should be monitored over time.

It has been argued that, other things remaining the same, yield-increasing technologies are not cost-effective in regions that have surplus land (Binswanger and Pingali 1988). The plateau of Eastern Province has surplus land, however, and farmers have adopted yield-increasing (hybrid maize and fertilizers) as well as labor-saving (animal traction) techniques. The farming system in the plateau remains largely bush fallow, and increased production requires development of the market infrastructure and control of the tsetse fly. Controlling tsetse flies would allow farmers to expand the amount of land cultivated, and developing the market infrastructure would link farmers to the national market. Adopting hybrids and fertilizers would increase the amount of marketed surplus. The plateau region provides a good example of how the evolution of a farming system can be modified by the development of infrastructure. The province now needs to extend this process to crops other than maize, and it is doing so by focusing attention on groundnuts, cotton, soybeans, sunflowers, and tobacco.

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202

10
Input Use and Productivity

Dayanatha Jha

Smallholder farms in Eastern Province, particularly in the plateau zone, have responded positively to technological changes (see Chapter 9). This chapter proposes to verify empirically the profitability of these changes. First, the relative profitability of various options is examined by looking at the average enterprise budgets. Second, the input-output relationship and the marginal effect of the inputs of labor, oxen, and fertilizer on the production of local maize, hybrid maize, and groundnuts are estimated. This analysis is constrained by severe limitations of the data (see Appendix 1), and only the robust results are emphasized.

THE RELATIVE PROFITABILITY OF CROPS

Table 10.1 summarizes the average output-input data for the three major crops grown in pure plots: local maize, hybrid maize, and groundnuts. Output data for crops grown in mixed plots were not available. Of these three crops, hybrid maize is the most profitable, followed by groundnuts. The net return realized for local maize is less than one-fifth of the return for hybrid maize and two-thirds of that for groundnuts. The average return to labor for hybrid maize is double the return to labor for local maize and groundnuts, which are about the same.

Viewed purely from the angle of profitability, local maize should not occupy as much of the cultivated area (22 percent in pure stands and 38 percent in mixed stands) as it does. Maize dominates because it is an important subsistence crop, and the cultivation of hybrid maize is cash-intensive. The share that cash expenses have in total expenditures is about 28 percent for local maize, but 65 percent for hybrid maize. In other words, nearly four times more cash is required to grow 1 hectare of hybrid maize than 1 hectare of local maize. In a cash-constrained, subsistence setting, this limitation is severe. As Chapter 9 argues, credit plays a crucial role in whether farmers choose to adopt hybrid maize.

The cultivation of groundnuts requires the minimum amount of cash because farmers use seeds saved from the previous season's harvest and do not use fertilizers. The critical constraint is high labor

Table 10.1—Average enterprise budgets for local maize, hybrid maize, and groundnuts in Eastern Province, Zambia

Characteristics	Local Maize	Hybrid Maize	Groundnuts
Output			
Kilograms per hectare	1,125	2,416	1,235
Value (kwacha)	686	1,474	1,111
Seeds			
Kilograms per hectare	30	20	71
Value (kwacha)	18	52	64
Fertilizers[a]			
Kilograms per hectare	36	159	0
Value (kwacha)	119	528	0
Pair of oxen			
Hours per hectare	15	19	17
Value (kwacha)	48	73	65
Labor			
Hours per hectare	723	592	1,483
Value (kwacha)	419	343	860
Total cost (kwacha per hectare)	604	996	989
Net returns (kwacha per hectare)	82	478	122
Returns per labor hour (kwacha)[b]	0.69	1.39	0.66
Cost per kilogram (kwacha)	0.54	0.41	0.80
Labor share in cost (percent)	69	34	87

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission survey, Eastern Province, Zambia, 1986.

Note: All calculations are rounded to the nearest kwacha and use estimated prices for 1985-86: for maize, K 0.61 per kilogram; for groundnuts, K 0.90 per kilogram; for local maize seed, K 0.61 per kilogram; for hybrid maize seed, K 2.60 per kilogram; for fertilizer, K 3.32 per kilogram of nutrient; and for labor, K 0.58 per hour. The price of oxen is based on the rental rates reported by households.

[a] Total plant nutrients.

[b] The value of output minus all costs except labor divided by the number of hours of labor.

intensity. On average, cultivating groundnuts requires more than twice as much labor as local maize given the same use of oxen. This is why farmers do not devote more than 7 percent of their cultivated area to groundnuts even though net returns are relatively high. If weeding and lifting implements were available, this constraint would decrease and the level of cultivation would expand.

Hybrid maize provides an opportunity to increase the earnings of labor dramatically. It also reduces the cost per unit of producing maize by about one-fourth.

A more disaggregated picture is presented in Table 10.2, which shows the relative profitability of using fertilizers, hybrids, and oxen given different budgets. Almost all farmers use fertilizers on hybrid maize, so evaluating the impact of fertilizers on hybrids was not possible. This is a crude evaluation since many confounding effects are present.

Local Maize

The average numbers presented in Table 10.2 do not show the effect of fertilizers on local maize. The incremental yield due to the use of fertilizers is not large enough to generate higher net returns or lower unit costs on farms using either hoes or oxen. On farms using oxen it does, however, increase the returns to labor somewhat. The effects of using animal traction are clearer. For farmers who do not use fertilizers, the adoption of oxen results in a 63 percent increase in the returns to labor. For those who use fertilizers, the use of oxen doubles the earnings for labor. Reductions in the unit cost of production are also clearly discernible.

Hybrid Maize

The adoption of hybrids follows the adoption of a fertilizer-hybrid package. For farmers who do not have access to oxen, this package increases the earnings of labor by 59 percent. Labor earnings on hybrid maize, when combined with the use of oxen, are nearly double those accompanying the next best option, using oxen and fertilizers on local maize. This package also reduces unit costs substantially.

Groundnuts

Farmers do not use fertilizers on groundnuts, nor is it recommended. The use of oxen, however, significantly increases the

Table 10.2—Average budget and returns to land and labor of enterprises in Eastern Province, Zambia

Characteristics	Local Maize with Fertilizers		Local Maize without Fertilizers		Hybrid Maize with Fertilizers		Groundnuts without Fertilizers	
	Hoe	Oxen	Hoe	Oxen	Hoe	Oxen	Hoe	Oxen
Yield (kilograms per hectare)	1,071	1,414	879	1,172	2,461	2,422	1,197	1,313
Value of yield (kwacha per hectare)	653	862	536	715	1,501	1,477	1,077	1,182
Seed (kilograms per hectare)	33	23	30	34	28	18	64	75
Value of seed (kwacha per hectare)	20	14	18	21	73	47	58	67
Fertilizer (kilograms of nutrients per hectare)	81	90	...	...	179	159	...	...
Value of fertilizer (kwacha per hectare)	269	299	...	...	594	528	...	...
Labor (hour per hectare)	748	439	954	706	1,069	436	1,703	1,376
Value of labor (kwacha per hectare)	434	255	553	409	620	253	988	798

(continued)

Table 10.2—Continued

Characteristics	Local Maize with Fertilizers		Local Maize without Fertilizers		Hybrid Maize with Fertilizers		Groundnuts without Fertilizers	
	Hoe	Oxen	Hoe	Oxen	Hoe	Oxen	Hoe	Oxen
Pair of oxen (hour per hectare)	...	23	...	34	...	25	...	25
Value of oxen (kwacha per hectare)	...	115	...	74	...	96	...	1-1
Net returns	-70	179	-35	211	214	553	31	168
Returns per labor hour (kwacha)	0.49	0.99	0.54	0.88	0.78	1.85	0.60	0.74
Cost per hectare (kwacha)	723	683	571	504	1,287	924	1,046	1,014
Cost per kilogram (kwacha)	0.67	0.48	0.65	0.43	0.38	0.87	0.77	...

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission survey, Eastern Province, Zambia, 1986.

Note: All calculations are rounded to the nearest kwacha and use estimated prices for 1985-86: for maize, K 0.61 per kilogram; for groundnuts, K 0.90 per kilogram; for local maize seed, K 0.61 per kilogram; for hybrid maize seed, K 2.60 per kilogram; for fertilizer, K 3.32 per kilogram of nutrient; and for labor, K 0.58 per hour. The price of oxen is based on the rental rates reported by households.

net returns per hectare and the returns to labor. As mentioned earlier, labor requirements for this crop are very high, even when animal traction is used.

Pingali, Bigot, and Binswanger (1987) argue that under farm conditions, the use of animal traction does not affect yields, and its positive impact on labor productivity comes mainly from labor savings. The results show that the yields for local maize and groundnuts are significantly higher on farms using oxen. The use of oxen does not, however, make any difference for hybrid maize. Thus, there is some evidence that the use of oxen improves tillage and the timeliness of operations, which results in higher yields. Using animal traction clearly saves labor for all three crops. This savings ranges from about 19 percent for groundnuts to 59 percent for hybrid maize.

PRODUCTION FUNCTIONS

The production functions of some of the determinants of production and marginal productivities of labor, fertilizers, and oxen are now presented. The estimated equations for each crop are reported in Appendix 2. Although these models could be refined, some interesting results are reported below.

The use of fertilizers, labor, and oxen are the major determinants of local maize production in Eastern Province. The results for hybrid maize are poor, and fertilizer is the only significant variable. Oxen and labor are not independently significant, but their interaction is positive and significant. This implies that both labor and oxen must be used to obtain further increases in output. The best results are for groundnuts. Labor, oxen, intensity of weeding, and incidence of crop damage are significant. The high coefficient for the risk variable indicates that the production of groundnuts is highly sensitive to environmental hazards. This could be another reason why farmers allocate a relatively small amount of land to this crop.

On the basis of these equations, the marginal productivity of labor, oxen, and fertilizers were worked out. These, along with the average prices, are reported in Table 10.3. The marginal productivity of labor is highest for hybrid maize, where cultivation uses both labor and oxen. For local maize and groundnuts, the traditional crops, the marginal productivity resembles the prevailing wage rate. The productivity of oxen is much higher than the reported rental rate, and it is highest for groundnuts, the most labor-intensive crop. The marginal fertilizer response coefficient for local maize is about 5.6 kilograms per kilogram

of nutrient. It is 18.7 kilograms for hybrid maize. At the fertilizer to output price ratio prevailing at the time, the use of fertilizers could be increased on hybrid maize, but not on local maize.

The package of improved technology that includes hybrids, fertilizers, and oxen improves productivity dramatically. Increasing the use of oxen would increase the production of all three crops. The use of fertilizers could be extended further on hybrid maize, but not on local maize.

POLICY IMPLICATIONS

The use of oxen should be promoted because it is the most significant factor that increases productivity. Increases in the use of fertilizers will be driven mainly by the expansion of the area devoted to hybrid maize. Groundnuts could emerge as a viable alternative to maize only if appropriate mechanization (animal-driven ridgers and lifters) were used to decrease the need for labor. Both these findings highlight the importance of placing a greater emphasis on animal traction in the plateau zone of Eastern Province.

Table 10.3—Marginal productivity of labor, oxen, and fertilizer in Eastern Province, Zambia

Input	Price per Unit[a]	Local Maize		Hybrid Maize		Groundnuts	
		Marginal Product	Value	Marginal Product	Value	Marginal Product	Value
Labor (hours)	0.58	0.98	0.60	1.38[c]	0.84	0.50	0.45
Oxen (hours)	3.68	11.51	7.02	24.54[c]	14.97	21.28	19.15
Fertilizer (kilograms)[b]	3.32	5.59	3.41	18.66	11.38	n.a.	n.a.

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission survey, Eastern Province, Zambia, 1986.

Note: The prices and values are in kwacha; the marginal products are in kilograms.

[a] Estimated average price for the region as a whole. Wages and oxen rental rates vary considerably.

[b] In kilograms of total plant nutrients.

[c] Based on the significant interaction term only.

APPENDIX 1

LIMITATIONS OF THE DATA

A major limitation of this analysis is the inadequacy of the data on yield and production. Two approaches were used to collect this information. Farmers were asked to estimate the production of each plot they cultivate. This was supplemented by crop cuts for estimating yield from pure-stand plots. None of these approaches provided satisfactory results. Some estimated yields were abnormally high—more than two to three times higher than the estimates provided by extension workers and on-farm trials. The results of the on-farm trials conducted by the Adaptive Research and Planning Team were used as the upper limit, and all observations above this level were rejected. This substantially reduced the number of valid observations. Developing a suitable methodology for estimating yield should be considered a high priority.

Moreover, the yield of different crops grown in mixed stands were unavailable and thus could not be evaluated. Similarly, the labor data were problematical for some months in some locations. Such cases were dropped as well. Another deficiency was the lack of data on the number of hours that farmers use oxen. All households using oxen were resurveyed in April 1988, and data on the use of oxen were collected for the current season. These were then adjusted for 1986-87 acreage.

APPENDIX 2

ESTIMATED LINEAR PRODUCTION FUNCTIONS FOR LOCAL MAIZE, HYBRID MAIZE, AND GROUNDNUTS

$$\text{LMPD} = \underset{(2.414)}{183.0683} + \underset{(4.839)}{5.5866\ \text{NPK}^{***}} + 11.5100\ \text{HOXEN}^{***} \quad (1)$$

$$+ \underset{(3.439)}{0.9780\ \text{TLAB}^{***}} + \underset{(0.737)}{249.7783\ \text{LOCATION}}$$

$R^2 = 0.3898$; $F\ (4, 52) = 9.9417^{***}$

$$\text{GPD} = \underset{(3.458)}{15.2437} + \underset{(2.509)}{21.2855\ \text{HOXEN}^{***}} + 0.4985\ \text{TLAB}^{***} \quad (2)$$

$$- \underset{(1.369)}{240.8099\ \text{RISK}^{*}} + \underset{(1.777)}{212.7966\ \text{NWEED}^{**}}$$

$$- \underset{(0.408)}{56.4215\ \text{D2}} - \underset{(1.693)}{304.0156\ \text{D6}^{**}}$$

$$- \underset{(2.690)}{433.5404\ \text{D5}^{***}}$$

$R^2 = 0.3876$; $F\ (7, 35) = 4.7979^{***}$

$$\text{HMPD} = - \underset{(0.283)}{462.1385} + \underset{(1.1000)}{5.7840\ \text{HOXEN}} - 1.2137\ \text{TLAB} \quad (3)$$

$$+ \underset{(5.557)}{18.6589\ \text{NPK}^{***}} + \underset{(1.451)}{0.0508\ \text{HLAB}^{*}}$$

$$+ \underset{(1.662)}{1449.6678\ \text{REGION}^{*}}$$

$R^2 = 0.8059$; $F\ (5, 31) = 30.9096^{***}$

VARIABLES AND DEFINITIONS

LMPD	=	production of local maize (kilograms),
GPD	=	production of groundnuts (kilograms),
HMPD	=	production of hybrid maize (kilograms),
HOXEN	=	hours of oxen use,
TLAB	=	hours of human labor,
NPK	=	total plant nutrients (kilograms),
RISK	=	incidence of damage (0 = no, 1 = yes),
NWEED	=	number of weedings,
HLAB	=	hours of oxen x total labor hours, and
REGION, LOCATION, D2, D5, D6	=	location dummies.

REFERENCES

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11
The Effects of Adopting Technology on the Household Use of Labor

Rafael Celis and Cindy Holleman[1]

In Chapter 9, Jha, Hojjati, and Vosti demonstrated that smallholder farmers in Eastern Province have accepted technological changes such as the use of oxen, hybrid maize, and fertilizer. In Chapter 10, Jha examined the relative profitability of these changes and verified empirically that they were in fact profitable. This paper examines the effects of adopting new technology on the use of labor and argues that the changes in relative profitability encourage households to use more labor and to reallocate types of laborers among activities. More specifically, it poses two hypotheses. First, households allocate more labor to activities that are the most profitable. Second, the adoption of improved technology stimulates changes in the mixture of crops, enhances marketing activities, and spurs new activities, and these changes encourage households to reallocate the labor of individual household members, as well as that of exchange workers and hired laborers.

Simple descriptive tables are used to explore how labor is allocated and how that use is associated with different technologies. A multivariate analysis is then used to isolate the role that specific technological and other factors play in determining patterns of labor use.

THEORETICAL BACKGROUND

Technological changes can increase productivity in agriculture as well as production and employment in other sectors (Mellor 1976; Mellor and Lele 1973). For various physical and socioeconomic environments, it is important to investigate which activities are more likely to be affected by a technological change and to estimate the direction and magnitude of that effect. It is also important to identify what other factors encourage or restrain the expected effect. Factors

[1] The authors are grateful to Jorge Wong-Valle for his assistance in preparing this paper.

such as the education, health, nutrition, age, and gender of the family members, the size, composition, and assets of the family, and rural infrastructure play an important role in determining the direction and magnitude of changes in labor use that are prompted by technological change.

Several economists have recognized that various decisions within the household interact and often occur simultaneously. They have developed simultaneous models of production decisions that include agricultural production, consumption, and leisure. Examples of this type of application are found in the work of Barnum and Squire (1979), and Singh, Squire, and Strauss (1986). The limitations of this type of model have been extensively surveyed by Horton (1982), and alternative linear programming solutions have been devised (Celis 1989; Duloy and Norton 1975).

Much simpler techniques for studying the determinants of labor use have been developed by Horton (1982). These single-equation models assume that utility is a function of a composite commodity, G, and leisure, L. The possible trade-offs between goods and leisure vary depending on the nature of the returns realized by different activities. These models assume that the trade-off frontiers depend on individual and household characteristics and on assets, which can be both private and public. For instance, the existence and condition of public roads, storage facilities, and irrigation facilities may affect the returns to work on a given farm and indirectly affect wage labor.

This analysis adapts Horton's model by explicitly considering major technological variables such as the use of hybrid maize, the use of fertilizer, and the choice of cultivation method (hoe or oxen). This type of model is specified for a single period, for example, one year, and does not allow for the accumulation of assets such as human resources or physical investments. Nevertheless, it does specify current levels of education and assets.

In this study, the work performed by adult males and females is estimated separately for different types of activities. The equations are estimated using predetermined (exogenous and implicitly lagged) explanatory variables. To account for variations in household size, a per capita formulation is also used. In each case, the variable used is the hours worked by each worker during a period of one year. For example, the hours that males in a given household perform a particular activity are added and then expressed as the average number of hours spent per male worker in that household. The model can then be specified as:

$$H_i = H_i(T,A,Z,H_j),$$

where

H_i = total per capita hours worked by household member of group i,
i = adult males or adult females,
T = a set of technology variables,
A = household and community assets (infrastructure),
Z = family and institutional characteristics,
H_j = total hours worked by the household members of group j, and
j = i.

The same model is used to estimate the household's employment of hired and exchange labor, which is measured in absolute hours rather than hours per capita.

The model has some limitations. First, each equation is partial, and even though it encompasses interactions among human resource variables, it does not account for simultaneity. Second, the model does not, but should, explicitly consider the investment decision. Third, being a model of household behavior, it is not based on the characteristics of individual workers and is thus less applicable to households in which husbands and wives have separate incomes. Finally, the data set used means that the model is specific to one region and to low-income rural households. Thus, estimated parameters may well serve for comparisons, but should not be applied to other regions or households with higher levels of income.

DESCRIPTIVE ANALYSIS

The first part of this analysis is based on the classification of households into two major categories corresponding to the cultivation method used: hoe or a combination of oxen and hoe. Each category is further divided into three subcategories that correspond to the cropping technology adopted: use of neither hybrid maize nor fertilizer; use of fertilizer, but not hybrid maize; and use of both hybrid maize and fertilizer. Although the sample households fall into all three categories, the contrast is more apparent between the two extreme situations: households that cultivate with hoes and do not use either hybrids or fertilizers (the lowest level of adoption, that is, the traditional method) and households that cultivate with oxen and use both hybrids and

fertilizers (the highest level of adoption, that is, the modern method). Furthermore, these extreme cases have the largest sample sizes and thus produce the most robust conclusions.

One obvious conclusion is that the adoption of technology affects the use of labor and land. Farmers who use oxen save labor, as Jha points out in Chapter 10, and thus cultivate a larger area. Farmers who adopt the highest level of technology cultivate 3.5 times more land than farmers who adopt the lowest level (see Table 11.1).

This has some effect on income. The use of hybrid maize and fertilizer is more profitable and associated with higher and more permanent income (Jha, Chapter 10 of this volume). When permanent income is estimated using total expenditure per person as a proxy, persons who use hoes increase their average income 33 percent when they adopt improved technology, while persons who use oxen earn an extra 56 percent when they do so.

Table 11.1—Average area cultivated and per capita labor of households in Eastern Province, Zambia, by technology package used

Technology Package	Area Cultivated	Index of Spending per Capita
	(hectares)	
Hoe cultivation		
Without hybrids or fertilizers	1.23	1.00
Without hybrids, with fertilizers	1.15	1.19
With hybrids and fertilizers	1.67	1.33
Ox and hoe cultivation		
Without hybrids or fertilizers	2.31	1.00
Without hybrids, with fertilizers	2.26	1.33
With hybrids and fertilizers	4.34	1.56

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

Another finding is that households who use oxen have larger families than those who use hoes (see Table 11.2). Interestingly enough, those who use oxen and adopt hybrid maize and fertilizer have the largest families. One argument is that having more labor available helps households adopt new technology, particularly because households that adopt technology seem to have more adults than those that do not. They also have more children, however, which suggests that the increased income gained by adopting new technology increases the survival rate of children. Because the data set is cross-sectional and family size prior to adoption cannot be established, none of these possibilities can be concluded with certainty.

Changes in the Use of Labor

Households that have adopted the highest level of technology use more family labor than households that have adopted the lowest. This is invariably true for all family labor (see Table 11.3). After correcting for family size, the input of labor per capita displays the same pattern: households use 53 percent more male labor, 20 percent more female labor, and 80 percent more child labor (see Table 11.4).

In addition, a dramatic increase occurs in the use of exchange and hired labor. Households using a high level of technology employ 37 times more hired labor and 11 times more exchange labor than households using a low level (see Table 11.5). Households at all levels use mostly family labor, but households at the highest level of adoption use by far the most exchange and hired labor (see Table 11.6).

As observed by Milimo (1985) the use of oxen introduces new activities to cultivation, such as leading oxen, harrowing, and clearing the land of trees, roots, and stumps, most of which are performed by males. Among ethnic groups, women in Eastern Province traditionally do not walk behind oxen. At the highest level of technology adoption, women work more hours than men, but the relative importance of male labor increases. Of all labor performed by the family, 38 percent is performed by males in households at the highest level compared with 33 percent in households at the lowest level (estimated from Table 11.3).

A caveat to the preceding analysis is that the figures do not include domestic chores, which means that the use of female time is underestimated. Similarly, no information has been recorded on leisure activities, which means that how much the additional use of labor corresponds to leisure forgone or to labor shifted from domestic chores is not estimated.

Table 11.2—Cultivation method and cropping technology adopted in Eastern Province, Zambia, by family composition

Technology Package	Total	Adults More than 12 Years Old		Children	
		Men	Women	More than 5 Years Old	Less than 5 Years Old
Hoe cultivation					
Without hybrids or fertilizers	5.62	1.56	1.84	1.24	0.98
Without hybrids, with fertilizers	4.78	1.19	1.74	0.93	0.93
With hybrids and fertilizers	5.75	1.75	1.75	1.50	0.75
Ox and hoe cultivation					
Without hybrids or fertilizers	5.47	1.65	1.65	1.41	0.76
Without hybrids, with fertilizers	6.24	1.86	1.90	1.10	1.38
With hybrids and fertilizers	6.13	1.80	1.67	1.39	1.24

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

Table 11.3—Average annual hours worked per household by family laborers in Eastern Province, Zambia, by technology package adopted and activity

Technology Package	Tending Crops	Postharvest Activities	Nonfarm Activities	Tending Livestock	Off-Farm Agriculture	Off-Farm Nonagriculture	Total
Hoe cultivation							
Without hybrids or fertilizers (n = 45)							
Males	557.60	12.60	220.53	72.80	80.33	181.69	1,125.56
Females	1,000.84	377.00	672.24	36.56	20.27	0.53	2,107.44
Children	68.80	37.06	68.73	33.60	0.27	0.09	208.54
Without hybrids, with fertilizers (n = 27)							
Males	533.56	11.48	119.78	193.20	130.52	237.11	1,225.65
Females	900.98	408.02	729.94	47.89	32.33	7.44	2,126.61
Children	106.15	17.70	71.44	67.52	2.19	0.00	265.00
With hybrids and fertilizers (n = 8)							
Males	1,192.13	34.50	62.50	249.38	154.13	169.63	1,862.25
Females	1,086.00	465.50	693.25	61.75	10.25	38.75	2,355.50
Children	133.63	18.13	24.88	268.50	0.00	0.00	445.13

(continued)

Table 11.3—Continued

Technology Package	Tending Crops	Postharvest Activities	Nonfarm Activities	Tending Livestock	Off-Farm Agriculture	Off-Farm Nonagriculture	Total
Ox and hoe cultivation							
Without hybrids or fertilizers (n = 17)							
Males	1,203.88	45.29	294.00	273.65	60.65	68.06	1,945.53
Females	1,371.76	525.76	780.47	93.47	80.29	0.65	2,852.41
Children	198.06	98.82	139.24	292.59	0.00	0.00	728.71
Without hybrids, with fertilizers (n = 21)							
Males	872.19	69.33	133.71	819.14	232.81	284.29	2,411.48
Females	1,028.67	639.36	946.45	87.71	31.14	1.71	2,735.05
Children	61.81	55.67	51.86	363.10	30.48	2.67	565.57
With hybrids and fertilizers (n = 46)							
Males	996.70	171.37	155.33	421.05	51.30	97.50	1,893.25
Females	1,058.11	624.15	818.91	89.62	21.76	39.52	2,652.08
Children	54.59	65.52	112.40	149.20	12.30	0.39	394.40

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

Table 11.4—Average annual hours worked per capita by family laborers in Eastern Province, Zambia, by technology package adopted and activity

Technology Package	Tending Crops	Postharvest Activities	Nonfarm Activities	Tending Livestock	Off-Farm Agriculture	Off-Farm Nonagriculture	Total
Hoe cultivation							
Without hybrids or fertilizers (n = 45)							
Males	374.83	9.00	168.25	72.03	79.63	181.42	742.54
Females	573.05	224.74	428.00	33.97	19.10	0.53	1,216.98
Children	55.80	29.37	53.82	33.00	0.27	0.09	150.33
Without hybrids, with fertilizers (n = 27)							
Males	444.12	9.06	100.57	133.72	125.11	220.33	884.67
Females	528.42	270.63	474.20	39.57	30.56	7.44	1,269.27
Children	78.57	14.96	58.03	62.81	2.19	0.00	201.76
With hybrids and fertilizers (n = 8)							
Males	730.90	30.00	47.00	238.25	128.25	146.88	1,010.94
Females	634.38	270.23	404.65	56.19	8.50	0.00	1,261.13
Children	117.63	18.13	24.88	183.13	0.00	0.00	251.14

(continued)

Table 11.4—Continued

Technology Package	Tending Crops	Postharvest Activities	Nonfarm Activities	Tending Livestock	Off-Farm Agriculture	Off-Farm Nonagriculture	Total
Ox and hoe cultivation							
Without hybrids or fertilizers (n = 17)							
Males	820.58	33.18	244.69	232.91	59.59	68.06	1,232.37
Females	938.32	349.88	533.58	91.79	66.18	0.53	1,899.34
Children	151.79	64.03	95.74	292.59	0.00	0.00	442.50
Without hybrids, with fertilizers (n = 21)							
Males	629.75	46.31	115.52	557.54	209.29	249.21	1,436.33
Females	634.12	425.44	632.26	74.52	25.10	1.71	1,673.15
Children	42.52	42.83	43.17	358.95	30.48	2.67	471.58
With hybrids and fertilizers (n = 46)							
Males	676.62	106.26	115.68	264.71	40.73	89.54	1,134.17
Females	659.05	328.19	470.18	75.53	16.26	33.17	1,463.19
Children	45.06	50.89	81.27	124.53	9.70	0.20	269.93

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

Table 11.5—Average annual hours worked per capita by hired and exchange laborers in Eastern Province, Zambia, by technology package adopted and activity

Technology Package	Tending Crops	Postharvest Activities	Nonfarm Activities	Tending Livestock	Total
Hoe cultivation					
Without hybrids or fertilizers (n = 45)					
Hired	18.42	0.36	3.40	0.00	22.18
Exchange	30.24	11.18	20.09	2.40	63.91
Without hybrids, with fertilizers (n = 27)					
Hired	22.85	0.22	3.63	132.44	159.15
Exchange	26.30	6.15	22.00	99.11	153.56
With hybrids and fertilizers (n = 8)					
Hired	0.00	0.75	0.00	60.00	60.75
Exchange	40.25	3.75	2.25	12.13	58.38

(continued)

Table 11.5—Continued

Technology Package	Tending Crops	Postharvest Activities	Nonfarm Activities	Tending Livestock	Total
Ox and hoe cultivation					
Without hybrids or fertilizers (n = 17)					
Hired	76.29	0.47	9.00	93.53	179.29
Exchange	28.06	10.18	1.35	81.18	120.76
Without hybrids, with fertilizers (n = 21)					
Hired	56.43	0.33	76.71	220.24	353.71
Exchange	73.38	24.52	52.67	482.00	632.57
With hybrids and fertilizers (n = 46)					
Hired	150.11	23.04	58.02	58[illegible].22	812.39
Exchange	186.76	55.00	25.20	436.61	703.57

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

Table 11.6—Allocation of activities to household and other laborers in Eastern Province, Zambia, by technology package adopted

Technology Package	Tending Crops	Postharvest Activities	Nonfarm Activities	Tending Livestock	Off-Farm Agriculture	Off-Farm Nonagriculture
			(percentage of total work)[c]			
Hoe cultivation						
Without hybrids or fertilizers (n = 45)						
Males	33.27	2.76	22.39	50.08	79.64	99.66
Females	59.72	82.63	68.25	25.15	20.09	0.29
Children	4.11	8.12	6.98	23.12	0.26	0.05
Exchange	1.80	2.45	2.04	1.65	...	...
Hired	1.10	0.08	0.35	0.00	...	...
Without hybrids, with fertilizers (n = 27)						
Males	33.56	2.46	12.65	35.77	79.08	96.96
Females	56.67	87.52	77.10	8.87	19.59	3.04
Children	6.68	3.80	7.55	12.50	1.32	0.00
Exchange	1.65	1.32	2.32	18.35	...	...
Hired	1.44	0.05	0.38	24.52	...	...
With hybrids and fertilizers (n = 8)						
Males	48.62	6.61	7.98	38.26	93.76	81.40
Females	44.29	89.20	88.55	9.47	6.24	18.60
Children	5.45	3.47	3.18	41.20	0.00	0.00
Exchange	1.64	0.72	0.29	1.86	...	...
Hired	0.00	0.14	0.00	9.21	...	...

(continued)

Table 11.6—Continued

Technology Package	Tending Crops	Postharvest Activities	Nonfarm Activities	Tending Livestock	Off-Farm Agriculture	Off-Farm Nonagriculture
Ox and hoe cultivation			(percentage of total work)[a]			
Without hybrids or fertilizers (n = 17)						
Males	41.83	5.99	24.02	32.80	43.03	99.06
Females	47.66	69.51	63.76	11.20	56.97	0.94
Children	6.88	13.07	11.37	35.07	0.00	0.00
Exchange	0.97	1.35	0.11	9.73	...	...
Hired	2.65	0.06	0.74	11.21	...	...
Without hybrids, with fertilizers (n = 21)						
Males	41.68	8.20	10.60	41.53	79.07	98.48
Females	49.16	75.64	75.03	4.45	10.58	0.59
Children	2.95	6.59	4.11	18.41	10.35	0.92
Exchange	3.51	2.90	4.18	24.44	...	...
Hired	2.70	0.04	6.08	11.17	...	...
With hybrids and fertilizers (n = 46)						
Males	40.74	16.07	13.28	25.10	60.10	70.95
Females	43.25	58.54	70.00	5.34	25.49	28.76
Children	2.23	6.15	9.61	8.89	14.41	0.28
Exchange	7.63	5.16	2.15	26.02	...	...
Hired	6.14	2.16	4.96	34.64	...	...

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

[a] Weighted averages and percentages for the row.

Changes in the Allocation of Labor among Activities

Technological change also fosters changes in the way that households allocate labor among activities. Tending crops remains the major activity of all adults, but as households adopt modern technologies, the participation of the sexes changes. Males begin to work more on tending crops and animals and less on nonfarm and off-farm tasks, while women begin to spend less time tending crops and more time on activities that follow the harvest and, to a lesser extent, animal husbandry and off-farm employment outside agriculture. The concentration of child labor shifts dramatically from tending crops to tending animals (see Table 11.7). Similarly, exchange and hired labor begin to be used for tending crops and animals. The portion of time that each type of labor spends on a given activity is illustrated in Table 11.6. The most apparent change is that male relatives are reallocated to work that becomes more profitable with the introduction of improved technology.

Changes in Seasonality

Technological change also brings about changes in the seasonal pattern of labor use. In cropping activities, males and females whose households use traditional technology work the hardest in March and use progressively less labor until July; farmers whose households use modern technology work relatively little in March, use progressively more labor until May, and use less through August-September (see Figures 11.1 to 11.4).

The adoption of technology dramatically increases the household use of hired and exchange labor during practically all months (see Figures 11.5 and 11.6). This, and the changes noted for males and females, reflects changes in how labor is allocated to cultivation, weeding, and harvesting activities.

These observations confirm what other researchers have reported about the effects of animal traction on the use of labor in the African environment: as the peak demand for labor shifts from preparing the land to weeding or harvesting, the overall labor requirements may rise rather than fall (for a thorough discussion of this issue, see Pingali, Bigot, and Binswanger 1987). In Eastern Province, Zambia, the introduction of hybrid maize and fertilizers further modifies the pattern of labor use.

Table 11.7—Allocation of household and other labor to activities in Eastern Province, Zambia, by technology package adopted

Technology Package	Tending Crops	Postharvest Activities	Nonfarm Activities	Tending Livestock	Off-Farm Agriculture	Off-Farm Nonagriculture
			(percentage of total work)[a]			
Hoe cultivation						
Without hybrids or fertilizers (n = 45)						
Males	49.54	1.12	19.56	6.47	7.14	16.14
Females	47.49	17.89	31.90	1.73	0.96	0.03
Children	32.99	17.77	32.96	16.11	0.13	0.04
Exchange	47.32	17.49	31.43	3.76	...	...
Hired	83.07	1.60	15.33	0.00	...	...
Without hybrids, with fertilizers (n = 27)						
Males	43.53	0.94	9.77	15.76	10.65	19.35
Females	42.37	19.19	34.32	2.25	1.52	0.35
Children	40.06	6.68	26.96	25.48	0.82	0.00
Exchange	17.12	4.00	14.33	64.54	...	...
Hired	14.36	0.14	2.28	83.22	...	...
With hybrids and fertilizers (n = 8)						
Males	64.02	1.85	3.36	13.39	8.28	9.11
Females	46.10	19.76	29.43	2.62	0.44	1.65
Children	30.02	4.07	5.59	60.32	0.00	0.00
Exchange	68.95	6.42	3.85	20.77	...	...
Hired	0.00	1.23	0.00	98.77	...	...

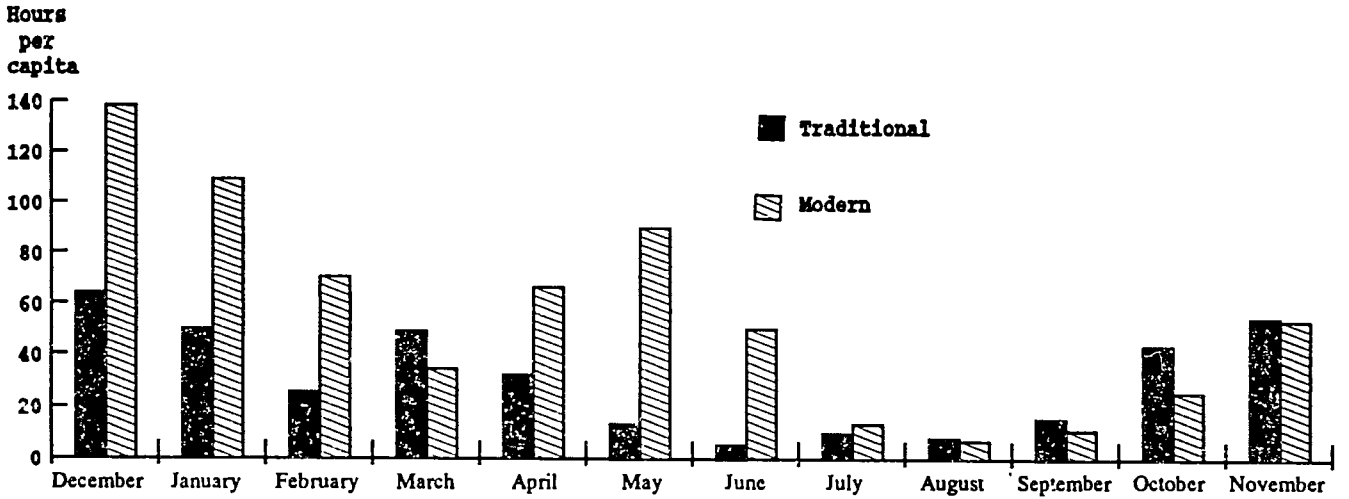
(continued)

Ox and hoe cultivation						
Without hybrids or fertilizers (n = 17)						
Males	61.88	2.33	15.11	14.07	3.12	3.50
Females	48.09	18.43	27.36	3.28	2.81	0.02
Children	27.18	13.56	19.11	40.15	0.00	0.00
Exchange	23.23	8.43	1.12	67.22	...	...
Hired	42.55	0.26	5.02	52.17	...	...
Without hybrids, with fertilizers (n = 21)						
Males	36.17	2.88	5.54	33.97	9.65	11.79
Females	37.61	23.38	34.60	3.21	1.14	0.06
Children	10.93	9.84	9.17	64.20	5.39	0.47
Exchange	11.60	3.88	8.33	76.20	...	...
Hired	15.95	0.09	21.69	62.26	...	...
With hybrids and fertilizers (n = 46)						
Males	52.64	9.05	8.20	22.24	2.71	5.15
Females	39.90	23.53	30.88	3.38	0.82	1.49
Children	13.84	16.61	28.50	37.83	3.12	0.10
Exchange	26.54	7.82	3.58	62.06	...	...
Hired	18.48	2.84	7.14	71.54	...	...

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

[a] Simple averages and percentages for the column.

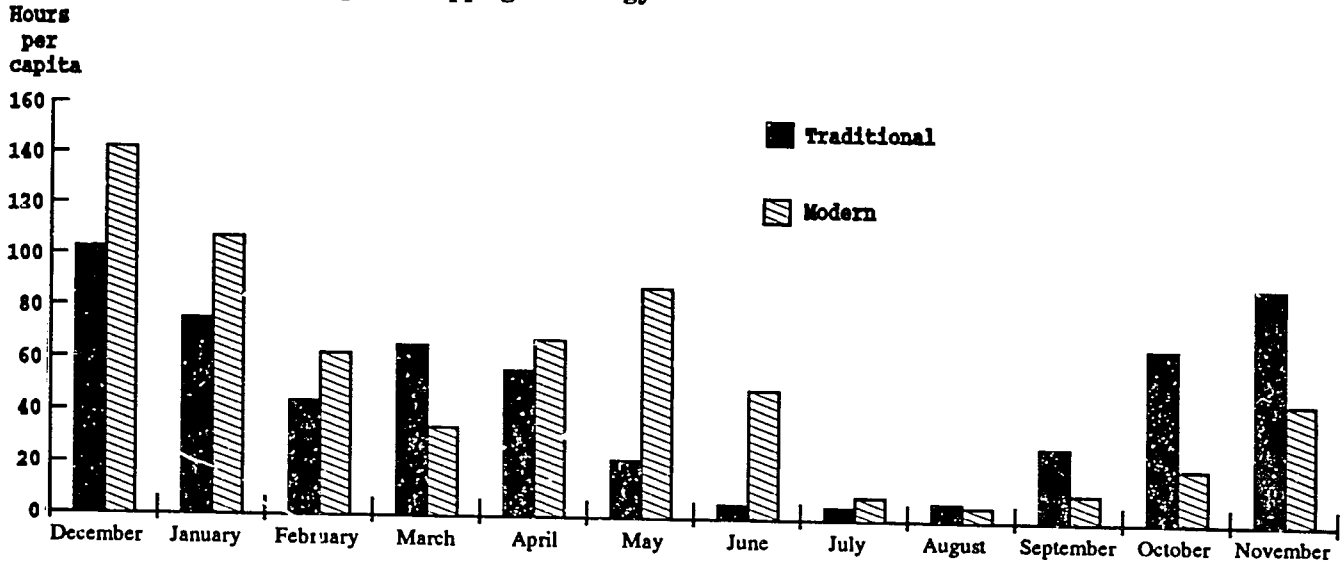
Figure 11.1--Average monthly hours that male family laborers work in cropping activities in Eastern Province, Zambia, by type of cropping technology



Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

Note: Traditional households use hoe cultivation without hybrid maize or fertilizer; modern households use oxen cultivation with hybrid maize and fertilizer.

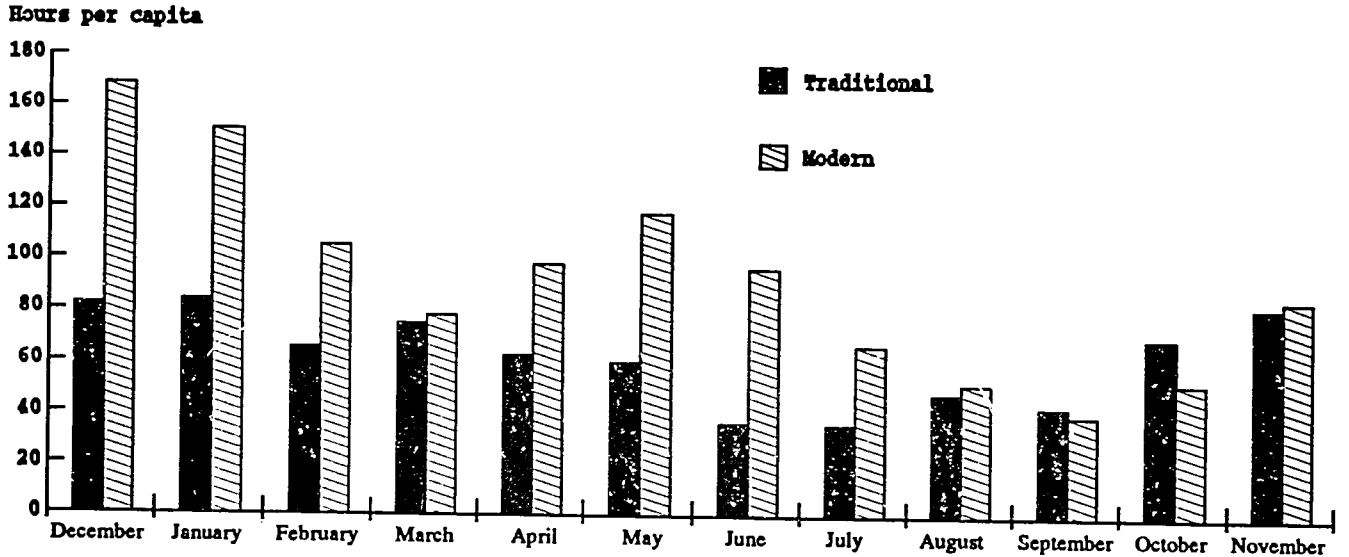
Figure 11.2--Average monthly hours that female family laborers work in cropping activities in Eastern Province, Zambia, by type of cropping technology



Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

Note: Traditional households use hoe cultivation without hybrid maize or fertilizer; modern households use oxen cultivation with hybrid maize and fertilizer.

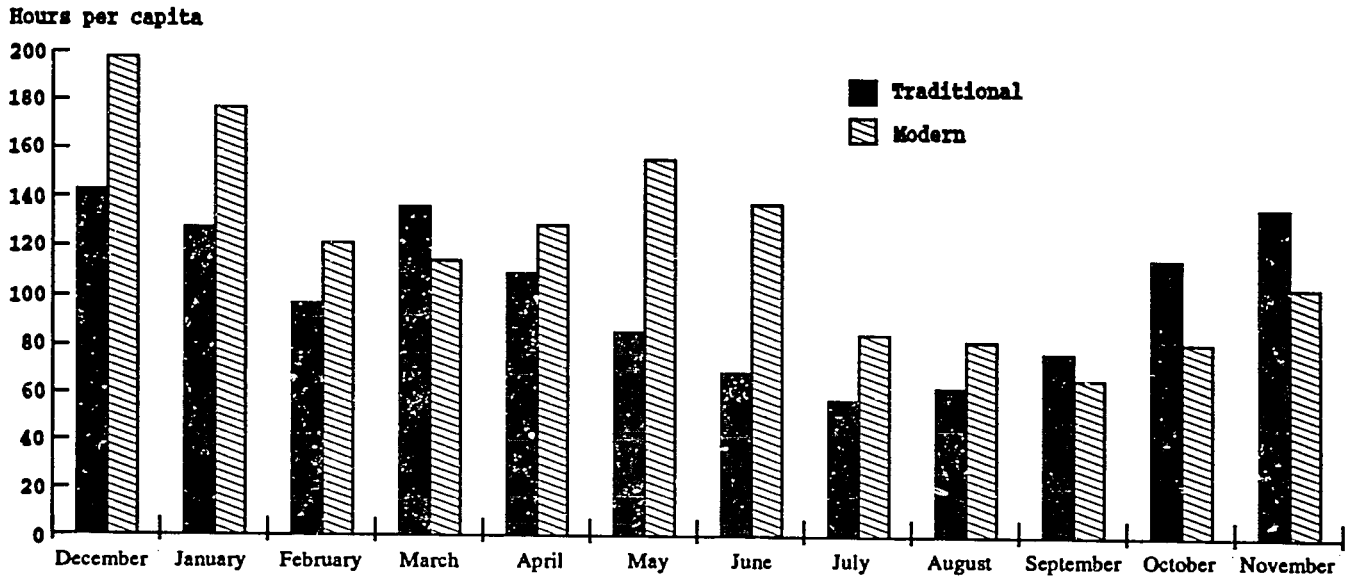
Figure 11.3--Average monthly hours that male family laborers work in Eastern Province, Zambia, by type of cropping technology



Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

Note: Includes cropping, postharvesting, livestock care, and nonfarm and off-farm employment. Traditional households use hoe cultivation without hybrid maize or fertilizer; modern households use oxen cultivation with hybrid maize and fertilizer.

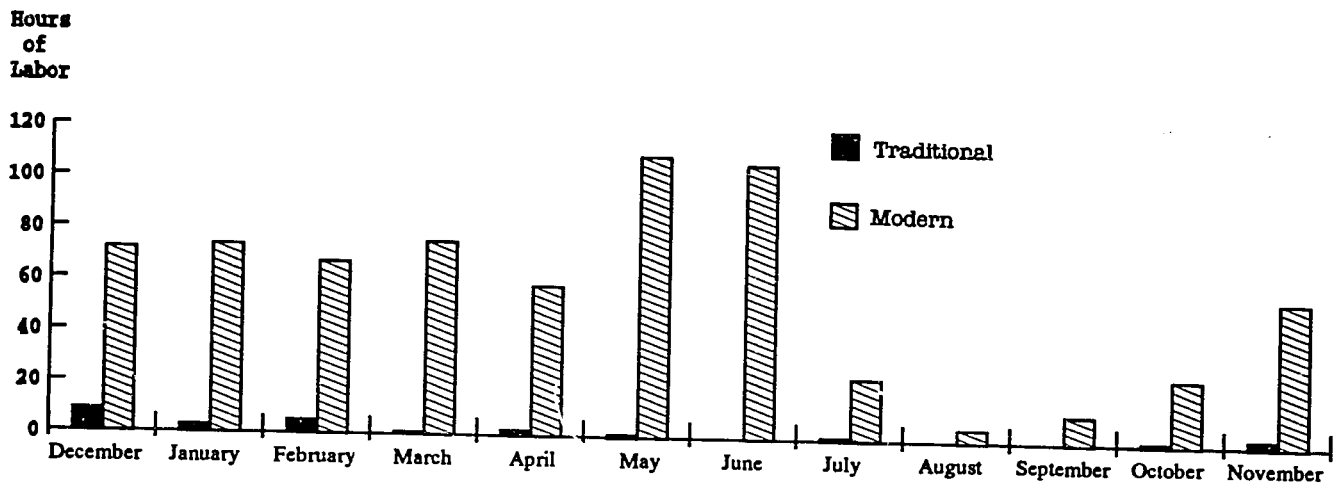
Figure 11.4--Average monthly hours that female family laborers work in Eastern Province, Zambia, by type of cropping technology



Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

Note: Includes cropping, postharvesting, livestock care, and nonfarm and off-farm employment. Traditional households use hoe cultivation without hybrid maize or fertilizer; modern households use oxen cultivation with hybrid maize and fertilizer.

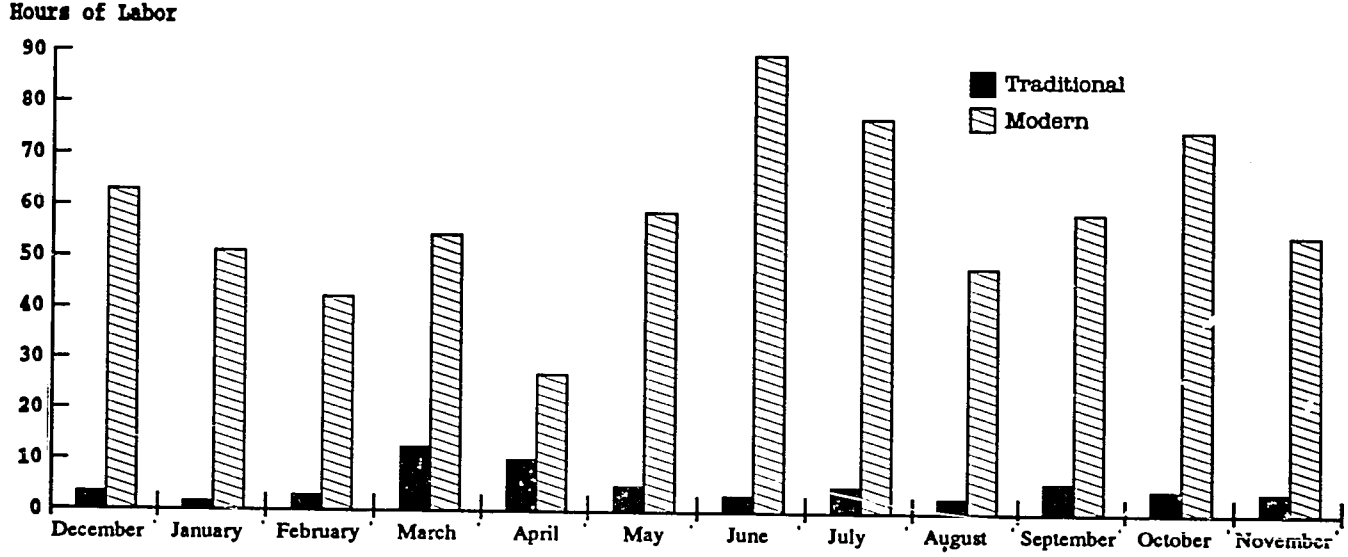
Figure 11.5--Average monthly use of hired labor in households of Eastern Province, Zambia, by type of cropping technology



Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

Note: Includes cropping, postharvesting, livestock care, and nonfarm activities. Traditional households use hoe cultivation without hybrid maize or fertilizer; modern households use oxen cultivation with hybrid maize and fertilizer.

Figure 11.6--Average monthly use of exchange labor in households of Eastern Province, Zambia, by type of cropping technology



Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

Note: Includes cropping, postharvesting, livestock care, and nonfarm activities. Traditional households use hoe cultivation without hybrid maize or fertilizer; modern households use oxen cultivation with hybrid maize and fertilizer.

The transformation spurred by technological change does not preclude the heavy use of family labor during the agricultural season (October-May). Instead, technological change exacerbates the already high demand for labor during the month of December. This feature conforms to previous observations reported by Delgado and Ranade (1987) for rural households in Zimbabwe, Nigeria, and Burkina Faso.

ECONOMETRIC ANALYSIS

The preceding descriptive analysis is limited because the changes in patterns of labor use that are due to technological changes cannot be separated from the changes due to household and community characteristics. This limitation can be overcome by applying the econometric analysis described in the section on theoretical background. Equations are estimated for males and females by aggregating all hours of work and then grouping the hours under five major activities.[2] The estimation procedure is conducted independently for each equation, and not all activities are included; therefore, the estimated coefficients accurately capture the direction of the effects, but do not sum up across equations. The results are presented in Tables 11.8, 11.9, and 11.10.

Technology

Technological change (the adoption of oxen, fertilizers, or hybrid maize) increases the amount of male labor (that is, the number of hours worked per male worker) used to tend crops and perform postharvest activities and decreases the amount used to tend livestock and perform activities other than farming. For females, it decreases the amount of time spent performing cropping, postharvest activities, and nonfarming activities, but the use of oxen alone significantly increases the amount of time spent per capita in off-farm agricultural activities. As discussed, these changes are associated with the introduction of oxen, which is accompanied by gender-specific, cultural expectations. Technological change also significantly increases the amount of hired and exchange labor employed by households, although the pure effect of using oxen is to decrease the amount of hired labor used (Table 11.10).

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[2] Equations were also estimated for children and off-farm activities outside agriculture, but the F-values were too poor to be reported here.

Table 11.8—Determinants of hours that males work per capita in households of Eastern Province, Zambia, by technology package adopted and activity

Variable	Total	Tending Crops	Postharvest Activities	Tending Livestock	Nonfarm Activities	Off-Farm Agriculture
Technology						
Oxen	-51.20	127.51*	7.92	-74.29	5.98	-72.17
Fertilizer	251.51*	106.17*	42.79*	1.31	-63.64	84.53
Fertilizer and hybrid maize	82.24	203.89*	86.18*	-187.46*	-101.35*	2.83
Number of plots	72.01*	24.74*	3.08	27.77	12.63	21.86
Wealth						
Working oxen	138.58*	-25.29	4.64	161.30*	14.36	-3.56
Farm size	-45.95	-41.72*	0.38	5.69	-6.48	-4.29
Consumer expenditures	-0.14	-0.01	0.06*	-0.06	0.04	-0.13
Family characteristics						
Number of males	96.86*	59.60*	11.60*	114.19*	5.15	56.34*
Number of females	-41.78	-9.54	0.61	4.98	3.58	28.45
Number of children, 5-11 years old	-92.89*	-10.75	-3.60	-33.03	-10.56	-40.60
Number of children, 0-5 years old	-2.34	-15.15	-1.21	-4.13	20.27	1.00
Age of head of household	-5.18*	2.04	0.29	3.01E-03	-1.91*	-3.93*
Proportion in school	0.72	-1.88	0.01	-1.24	2.28*	-0.89

(continued)

Table 11.8—Continued

Variable	Total	Tending Crops	Postharvest Activities	Tending Livestock	Nonfarm Activities	Off-Farm Agriculture
Maximum education						
Males	27.06*	1.25	-0.88	1.46	2.41	-10.29
Females	1.03	17.39*	0.67	5.08	-4.05	-12.04
Average days ill	-4.15*	-1.42	-0.04	0.77	0.14	-0.47
Patrilocal	-247.12*	-1.00	-89.92*	127.49	-65.07	-59.46
Infrastructure, distance to						
Plots	-6.51	-3.24	1.93	6.74	-5.14	-2.28
Water	-0.11	-0.03	-0.01	-0.01	-0.11*	-0.07
Nearest town	-2.34	-0.06	-0.51*	-1.37	0.42	-1.34
Work by other family members						
Children	-0.01	-0.03	0.15*	0.18*	0.18	0.59
Females	0.43*	0.79*	0.10*	0.16	0.12	0.03
Institutional factors						
Contact farmer	-223.04	18.46	43.00*	198.04	23.48	20.10
Cooperative member	135.45	-33.00	-3.40	228.58*	63.19	1.88
Constant	637.58*	-189.83*	-56.54	-86.30	131.41	408.43*
Adjusted R^2	0.45	0.71	0.57	0.35	0.09	0.11
F-value	6.73	17.45	9.90	4.62	1.70	1.80
Degree of freedom	139	139	139	139	139	139

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

* Significant at the 5 percent level.

Table 11.9—Determinants of hours that females work per capita in households of Eastern Province, Zambia, by technology package adopted and activity

Variable	Total	Tending Crops	Postharvest Activities	Tending Livestock	Nonfarm Activities	Off-Farm Agriculture
Technology						
Oxen	47.09	-108.55*	33.21	3.44	40.44	27.46*
Fertilizer only	-256.25*	-144.10*	-34.32	9.51	-29.39	-19.85
Fertilizer and hybrid maize	-331.73*	-195.04*	-110.48	25.05	-139.43*	-21.38
Number of plots	57.62*	0.72	25.32*	4.28	30.71*	-2.32
Wealth						
Working oxen	-52.23*	16.74	-5.09	12.13*	-4.86	-1.88
Farm size	-6.68	25.77*	-5.93	-7.46*	-15.21	-2.90
Consumer expenditures	-0.02	0.09	-0.11*	0.03*	-0.19*	-0.04*
Family characteristics						
Number of males	-13.30	-25.10	1.08	-1.88	-24.54	-1.64
Number of females	25.20	28.32*	9.16	3.50	8.47	2.16
Number of children, 5-11 years old	-25.45	-10.16	-9.84	-6.09	-19.85	-2.12
Number of children, 0-5 years old	41.32	34.33*	-2.12	5.49	-4.57	-0.36
Age of head of household	-0.16	-1.85*	-1.04	1.06*	0.27	0.11
Proportion in school	-1.20	1.41	-0.58	-0.05	-1.45	0.51

(continued)

Table 11.9—Continued

Variable	Total	Tending Crops	Postharvest Activities	Tending Livestock	Nonfarm Activities	Off-Farm Agriculture
Maximum education						
Males	17.24	4.12	0.98	-0.30	19.37*	0.60
Females	-12.64	-15.62*	0.74	-0.03	-0.21	-2.07
Average days ill	1.54	0.09	0.44	-0.14	1.10	1.51*
Patrilocal	-246.48*	-189.54*	96.45*	-99.29*	124.45*	29.66*
Infrastructure, distance to						
Plots	2.26	1.96	0.06	-1.50	9.26	2.57
Water	0.15*	0.05	9.22E-04	-5.01E-03	0.10*	0.01
Nearest town	-11.96*	-4.41*	-1.41*	-1.54*	-1.70*	-0.09
Work by other family members						
Children	0.17*	0.27*	0.19	0.01	0.10	-0.18
Males	0.23*	0.62*	0.51*	-5.27E-03	0.10	1.60E-03
Institutional factors						
Contact farmer	-15.32	-71.81	-43.07	19.58	-30.03	-6.17
Cooperative member	69.64	23.29	23.45	24.64*	82.43*	-2.61
Constant	1,529.96*	560.70*	342.09*	71.74*	436.01*	21.77
Adjusted R^2	0.59	0.76	0.43	0.47	0.36	0.20
Degree of freedom	139	139	139	139	139	139
F-value	11.10	23.00	6.18	6.92	4.89	2.72

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

* Significant at the 5 percent level or below.

Table 11.10—Determinants of household use of hired and exchange labor in Eastern Province, Zambia

Variable	Hired	Exchange
Oxen cultivation	-223.63*	252.47*
Fertilizer only	280.08*	123.68
Fertilizer and hybrid maize	284.82*	140.22
Number of plots	37.81	93.04*
Wealth		
Working oxen	134.68*	-43.06
Farm size	122.63*	-21.32
Total consumer expenditure	0.57*	-0.07
Family characteristics		
Number of males	5.03	-121.09*
Number of females	-14.05	-50.43
Number of children, 5-11 years old	-47.21	-13.47
Number of children, 0-5 years old	33.86	-25.51
Age of head of household	3.88	3.06
Proportion in school	2.36	1.34
Maximum education		
Males	2.39	38.52*
Females	9.52	-33.87*
Average days ill	-0.16	1.26
Patrilocal	-570.06*	37.43
Infrastructure, distance to		
Plots	40.81	14.69
Water	-0.04	0.08
Nearest town	-7.24*	-2.44
Work by other family members		
Males	-0.01	0.10
Females	9.97	-0.07
Institutional factors		
Contact farmer	147.91	94.59
Cooperative member	393.67*	456.73*
Constant	-383.12	-56.61
Adjusted R^2	0.36	0.24
Degree of freedom	139	139
F-value	4.90	3.17

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

* Significant at the 5 percent level.

An additional variable is the number of plots cultivated by a given household. This variable captures the extent to which increases in the number of plot increases the time spent planning, managing, and undertaking field tasks and start-up activities. As the area cultivated becomes increasingly fragmented, adults in the family work more hours and the demand for exchange labor and the time required to travel between plots, which was not measured, grow.

Wealth

As a household's production assets increase, each person must work more hours because the scale of farming rises. This is the case with working oxen, which require both males and females to work significantly more hours per capita in animal husbandry. Farm size has the reverse effect on the per capita labor of males and females.

Higher permanent income, measured by total consumer expenditure, seems to affect the per capita allocation of female labor by making work on the family's farm more attractive for women and reliance on outside employment less necessary.

Family Characteristics

Household characteristics do affect the use of labor. Households that have more men than women use more hours of adult male labor per worker than hours of adult female labor. Households with more women use more hours of adult female labor. The presence of small children affects female labor in an unexpected way, and school attendance does not significantly affect adult labor per capita, except to have a possibly spurious positive influence on male activities outside agriculture. Older farmers tend to assign more female labor per capita to livestock and less to cropping and to assign more male labor per capita to all activities (particularly to activities other than farming and off-farm agricultural activities).

The education of males significantly increases the total amount of labor that men work per capita and increases the hours that women spend on activities unrelated to farming. The education of females, however, decreases the amount of time that women spend on cropping activities and increases the amount of time that men spend on them. Education, then, seems to integrate women into activities not directly related to cultivation. Moreover, the impact that education has on exchange labor varies depending on who in the household has the most education. The negative sign associated with female education suggests

that women participate in exchange labor arrangements more often than men; when women get more education and devote more time to nonfarming activities, the demand for exchange labor declines.

Illness within the family adversely affects the amount of labor performed by males and pushes women into agricultural activities outside their own farms (or, reversing the causality, perhaps when women work outside the home, or men work less, family health suffers). Illness does not, however, significantly affect the demand for exchange or hired labor.

Households that observe the patrilocal tradition behave significantly differently from those that follow the matrilocal tradition. As indicated by Celis and Bliven (Chapter 13 of this volume), this topic merits an in-depth analysis in future studies.

Infrastructure

Distance to the source of water increases the average demand that nonfarming activities place on a woman's time and decreases the demand on a man's. Women collect most of the water required by the household, which is a sizable component of nonfarming activities, and some of the nonfarming activities performed by men (such as fishing) are optional and not performed when water is too distant or inaccessible. When water is far, both women and men spend less time on more profitable activities. The distance to a source of water, if far, can limit the gains realized from technological change. Consequently, the distributional effects of distance reduce the welfare of women and of the household.

Distance to the nearest town measures the relative isolation of households and serves as a proxy for infrastructure development. Women are affected the most negatively by long distances and allocate significantly less time to practically all activities as the distance to town grows. Distance also reduces the amount of labor hired, and isolation and lack of infrastructure limit the extent to which technological change promotes the full use of laborers.

Work by Other Family Members

The positive sign displayed by the significant coefficients for this group of variables corroborates the hypothesis that work performed by each adult member of a household complements rather than substitutes the work performed by children or adults of the opposite sex. This was expected because labor is relatively scarce in Eastern Province and high

levels of skill development are not required. Cooperation among family members is not only possible, it is necessary.

Institutional Factors

The households of persons who are members of cooperatives behave very differently from the households of persons who are not: they use more hired and exchange labor in general, more female labor in nonfarming activities, and more labor of both sexes in animal husbandry. Cooperatives apparently help integrate workers with the market and stimulate the development of activities that achieve a high return for each hour of labor performed (Celis and Bliven, Chapter 13 of this volume, demonstrate the high returns gained from labor in livestock).

POLICY ISSUES AND RECOMMENDATIONS

The empirical evidence confirms that technological change has a substantial, positive impact on the demand for labor among smallholder farmers. At the same time, it suggests important policy issues that deserve attention. The most salient issue is that technological change not only intensifies the seasonal peak in labor demand that occurs at the beginning of the cropping season in traditional agriculture in vast areas of Africa, but also promotes a second peak during the harvest and postharvest seasons. The improved technology that is available in Zambia should be developed further so that scarce labor is used more efficiently. For instance, nontillage agriculture should be tried because it reduces weeding and labor requirements. Moreover, the labor-saving components of the new technology, such as the use of oxen, should be improved and disseminated more broadly. Irrigation schemes that support more than one cropping season and prolong the rainfed cropping season could further reduce the seasonal peaks in labor demand. Technological improvements could also benefit the processing that takes place before marketing, such as husking, shelling, and bagging crops.

Technological change also stimulates growth by increasing the demand for hired and exchange labor; this effect is significantly reduced, however, in areas isolated by poor infrastructural development. Investments in road construction and transportation facilities could have a noticeable impact on the development of labor markets and therefore ease labor constraints. The low density of

population in Eastern Province means that building basic infrastructure in a cost-effective way requires innovative approaches. At the same time the role of cooperatives should be strengthened and expanded to enhance the use of nonfamily laborers.

The relevance of the number of plots to the demands placed on an individual's labor should be examined further. Eastern Province has abundant land, and factors such as the quality of the soil or cultural constraints may be more influential than scarcity of land in fragmenting the land cultivated by each household.

Given the significance of education in supporting the growth of labor markets and the integration of women into nonfarming activities, the government of Zambia must urgently address the scarcity of school buildings and teachers. In Eastern Province, a single team of teachers runs three shifts of three hours each. In each shift, only two hours are devoted to academic instruction. The long-term effects of this situation on growth and equity could be disastrous for Zambia.

In sum, the government still has a key role to play in supporting the efficient use of labor among smallholders. More public monies should be spent on research, public investment, institution building, and institution strengthening. Furthermore, the government should play a major role in creating the conditions that would encourage farmers to adopt the available, improved agricultural technologies and researchers to develop new ones. Among the new technologies that should be explored are new minor crops, especially crops that could take advantage of seasonal labor surpluses.

Specific policy actions would include developing special credit schemes, reforming the current policy on prices, valuing foreign exchange properly, and reforming the law to encourage the private sector to participate in transportation and marketing. These actions are consistent with the government's declared agenda for structural adjustment. One note of caution exists, however. Because structural adjustment emphasizes spending cuts and some of the actions suggested here would require expenditures, the government must establish a clear set of priorities from the beginning.

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12
The Effects of Technological Change on Food Consumption and Nutritional Status in Eastern Province

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This paper examines the food consumption and nutritional status of the population living in Eastern Province, Zambia, and assesses the impact that the use of improved agricultural technology has on the level and adequacy of both. Using surveys carried out in 1986, the analysis seeks (a) to identify the differences in these conditions between areas and households that use a high level of agricultural technology and those that use a low level; (b) to document the characteristics of the primary factors determining nutritional status, such as decisionmaking and the prevalence of disease within the household; and (c) to identify the significance of alternative factors determining the consumption of food and nutritional status and assess the significance of technological change in these relationships.

ANALYTICAL FRAMEWORK

The main direct determinants of nutritional status are dietary intake and incidence of disease. The need for food is determined by the body's physiological need to maintain itself, grow, and perform work. During illnesses, the nutrient needs of the body increase even though intake usually decreases. For this reason, the incidence of disease has an important negative impact on an individual's nutritional status. The time available for child care and the access of women to resources and decisionmaking are additional determinants of the nutritional status of young children, whose care is time-intensive and the responsibility of women.

These direct factors are themselves determined by a host of characteristics of the household and its geographic location, which can be influenced by development policies and programs that bring about

[1] The assistance of Emelia Elson and Lyndon Naverra in analyzing food consumption and disease patterns is gratefully acknowledged.

changes, such as technological improvements in agriculture. These characteristics include changes in the level, composition, and distribution of income and employment; the production, availability, and price of food; the demand for labor, pattern of employment, and allocation of time; the availability of and access to markets; the availability and seasonal distribution of food and the resulting pattern of expenditure; the access to and use of health services; and the quality and supply of water and sanitation facilities.

In this paper the level of nutritional status in Eastern Province and its direct determinants are examined, followed by its indirect determinants—that is, factors influenced by the process of technological change. The adoption of hybrid maize in the area or the household, which is often accompanied by the use of fertilizers and plows, is used to indicate technological change. Finally, a desirable course of technological change is suggested to further the policy goal of improved nutrition.

NUTRITIONAL STATUS

The nutritional status of all household members was surveyed four times during the study, in February, May, September, and December of 1986. For both children and adults, nutrition is at its worst in February, improves somewhat in May and again in September, and begins to worsen again in November. These periods coincide with (a) the late planting and weeding period, (b) the pre- or early harvest period, (c) the postharvest period, and (d) the period of land preparation and early planting. Just before or during the early harvest, the nutrition of children is at its best: the prevalence of malnutrition, as measured in weight-for-age, drops from about 30 percent in February to less than half that in May, before rising in September and again in November (see Table 12.1). This probably reflects the improved availability of food between February and May, when fresh legumes and vegetables are abundant and the diet is at its best. Adults gain weight between February and May, and this increase continues until November, when it begins to slide again. In January-February, 15 percent of adults have a body mass index of less than 18, representing moderately severe wasting, and an additional 29 percent show mild wasting. Both figures decline in April-May and again in September to reach the lowest level of the year. In November, they start to climb again. On average, adults lose about 2.5 kilograms of body weight between September and February. More females are underweight than

Table 12.1—Seasonal prevalence of undernutrition in children and adults in Eastern Province, Zambia, 1986

Indicator and Group	February	May	September	November
		(percent)		
Children (5 years and under)				
Indicator				
Weight/age[a]				
< 60	3.3	0.8	1.7	2.2
60-80	26.4	15.7	17.5	21.8
80-100	47.8	49.8	48.6	51.1
> 100	22.5	33.7	32.2	24.9
Adults (15-70 years)				
Indicator				
Body mass index[b]				
< 16	4.2	0.2	0.9	1.9
16-18	10.9	8.6	5.5	9.7
18-20	29.3	25.2	18.6	24.3
20-25	47.5	58.9	62.6	56.1
> 25	8.1	7.1	12.4	8.0

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985-86.

[a] Percent of NCHS (U.S. National Center for Health Statistics) Reference Standards.

[b] Weight/height^2.

males, and this is true for all areas regardless of ecological site and degree of technology adopted by both the area and the individual household.

The prevalence of malnutrition among preschool children is similar in the valley and in the areas of the plateau that have adopted a high level of technology. Both areas have less malnutrition than the low-adoption areas of the plateau, which have the highest rates of malnourished children. For all children, nutrition is better in the valley than in the plateau, where the level of malnutrition is lower in the low-adoption than in the high-adoption areas (see Table 12.2).

Table 12.2—Nutritional status of children under 10 in Eastern Province, Zambia, by ecological zone, level of adoption of hybrid maize, and month, 1986

Season and Indicators[a]	Eastern Province Percent	Plateau Percent	Valley Percent	Level of Hybrid Maize Adoption: Plateau, Low Adoption Percent	Plateau, High Adoption Percent	Valley, Low Adoption Percent
February						
Weight-for-age	25.9	27.9	9.1	26.8	29.2	9.1
Height-for-age	55.7	57.4	42.4	54.2	60.8	42.4
Weight-for-height	5.2	5.5	3.0	6.3	4.6	3.0
May						
Weight-for-age	13.3	12.5	17.5	9.1	16.5	17.5
Height-for-age	47.7	49.7	36.5	42.5	58.2	36.5
Weight-for-height	2.5	2.3	3.2	2.2	2.5	3.2
September						
Weight-for-age	15.3	14.5	18.9	8.9	19.9	18.9
Height-for-age	40.9	41.9	36.5	41.1	42.7	36.5
Weight-for-height	1.5	1.2	2.7	1.2	1.2	2.7

(continued)

Table 12.2—Continued

Season and Indicators[a]	Eastern Province Percent	Plateau Percent	Valley Percent	Level of Hybrid Maize Adoption: Plateau, Low Adoption Percent	Plateau, High Adoption Percent	Valley, Low Adoption Percent
November						
Weight-for-age	15.8	17.4	10.7	15.2	19.4	10.7
Height-for-age	39.6	42.9	28.6	42.8	43.1	28.6
Weight-for-height	2.7	1.4	7.1	0.7	2.1	7.1

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission quarterly anthropometric survey, Eastern Province, Zambia, 1986.

[a] Data from the U.S. NCHS (National Center for Health Statistics) are used as the reference Z-scores for nutritional indicators. Figures presented are the percent of children below a Z-score of –2, which denotes malnutrition. Nutritional status is expressed as the percentage of children that are malnourished according to the indicator given. Both valley areas are categorized as low adopters of technology.

The nutritional status of children is different in households headed by males than in households headed by females. In low-adoption areas, children in female-headed households are fed as well as or better than children in male-headed households. In high-adoption areas, the nutrition of preschool children who have been weaned is worse in female- than in male-headed households and malnutrition becomes more prevalent (see Table 12.3). Although the incidence of child malnutrition may improve overall with the adoption of improved technologies, it appears to worsen in female-headed households.

THE LEVEL AND ADEQUACY OF FOOD CONSUMPTION

The difference in the food consumption of households that adopt modern technology and those that do not is much smaller than the difference between high- and low-adoption areas. At the aggregate level, the per capita consumption of calories for the year as a whole is about 30 percent higher in high-adoption than in low-adoption areas (see Table 12.4). Moreover, the level of food consumption and the magnitude of difference between small and large farms are similar for adopters and nonadopters. The differences between small and large farms reflect the differences between high- and low-adoption areas at the aggregate level. Large farms have a 25 percent higher intake of calories per capita than small farms in both high- and low-adoption areas. Given the differences in each area's aggregate level of consumption, large farms in low-adoption areas consume less than small farms in high-adoption areas. Intake levels for female-headed and male-headed households are quite similar when farm size is controlled.

This suggests either that better-off areas are able to adopt improved technologies easier than worse-off areas or that widespread adoption of improved agricultural technologies helps distribute benefits broadly and improve diets overall. At the level of the area, differences in dietary intake are not, however, consistent with differences in the nutritional status of preschool children. In the plateau region, the prevalence of malnutrition among children is the same in both high- and low-adoption areas. When children of all ages are considered, the valley has better nutrition than the plateau, where low-adoption areas do somewhat better than high-adoption ones.

The explanation for this apparent anomaly may be that the level of employment and therefore the amount of calories required differ for the valley and the plateau and for high- and low-adoption areas. The adoption of improved agricultural technologies substantially raises the

Table 12.3—Nutritional status of children (January-February 1986) in Eastern Province, Zambia, by gender of the head of household and hybrid maize adoption

Head of Household and Age of Child	Plateau, Low Adoption		Plateau, High Adoption		Valley, Low Adoption	
	Malnourished	Nourished	Malnourished	Nourished	Malnourished	Nourished
Male-headed household						
Less than 36 months						
Number	24	16	32	18	5	3
Percent	60.0	40.0	53.8	46.2	62.5	37.5
37-60 months						
Number	10	14	15	8	3	2
Percent	41.7	58.3	65.2	34.8	60.0	40.0
61-120 months						
Number	29	11	27	11	6	8
Percent	72.5	27.5	71.1	28.9	42.9	57.1

(continued)

Female-headed household						
Less than 36 months						
Number	5	8	4	...	4	...
Percent	38.5	61.5	60.0	...	100.0	...
37-60 months						
Number	3	47	1	...	1	...
Percent	42.9	57.1	12.5	...	100.0	...
61-120 months						
Number	6	12	7	...	1	...
Percent	33.3	66.7	58.3	...	100.0	...

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission quarterly anthropometric survey, Eastern Province, Zambia, 1986.

Notes: Data from the U.S. NCHS are used as the reference Z-scores for nutritional indicators. Z-score values below -2 denote malnutrition. Both valley sites are categorized as low adopters of technology.

Table 12.4—Daily per capita consumption of nutrients in high- and low-adoption areas of the plateau, Eastern Province, Zambia, by farm size, 1986

Nutrient	High-Adoption Areas		Low-Adoption Areas	
	Small Farms	Large Farms	Small Farms	Large Farms
Energy[a]	2,299.71	2,772.78	1,770.78	2,035.67
	(1,204.06)	(1,224.87)	(620.83)	(850.15)
Protein[b]	65.23	78.34	47.80	57.62
	(33.21)	(32.38)	(16.06)	(23.56)
Fat[b]	36.41	39.16	20.53	27.18
	(24.57)	(23.33)	(8.70)	(11.98)
Carbohydrates[b]	403.50	494.11	328.58	381.03
	(211.00)	(230.98)	(117.93)	(158.09)
Calcium[c]	383.42	444.55	278.41	434.04
	(221.06)	(208.82)	(145.36)	(271.44)
Iron[c]	18.39	21.13	13.48	18.02
	(10.48)	(9.10)	(4.60)	(7.76)
Thiamine[c]	1.15	1.26	0.72	1.14
	(0.70)	(0.64)	(0.36)	(0.62)
Riboflavin[c]	1.09	1.32	0.93	1.06
	(0.60)	(0.64)	(0.41)	(0.51)
Niacin[c]	15.62	16.68	9.34	12.41
	(9.94)	(8.48)	(3.76)	(5.62)

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission quarterly anthropometric survey, Eastern Province, Zambia, 1986.

Note: Figures in parentheses are standard deviations.

[a] Calories.

[b] Grams.

[c] Milligrams.

demand for labor and employment. The differences in caloric intake may therefore be more apparent than real. Other factors important for child nutrition are the health environment, diseases, education, maternal care, and the role of the mother in household decisionmaking. If these are poor, deteriorating, or failing to improve, they may offset an improvement in diet.

Households that do not grow hybrid maize rely much more on purchased mealie meal than households that do. Small and large farmers purchase roughly the same amount of mealie meal per capita, although small farmers purchase a larger percentage of the cereal they consume. In both absolute numbers and percentage shares, small farmers who do not grow hybrid maize are more dependent on purchased cereal than any other group of farmers. This is relevant for considering the impact of the government's structural adjustment program, which is considering eliminating the consumer subsidy for maize. Net buyers of mealie meal would be particularly hurt by the elimination of this subsidy.

The valley (Mambwe and Chama) resembles the low-adoption areas of the plateau in its aggregate level of consumption of food and adoption of technology. The valley areas are therefore atypical. Although their aggregate consumption levels are relatively low and resemble those of low-adoption areas of the plateau, their nutritional status resembles that of the high-adoption areas of the plateau. In the plateau, the patterns of food consumption and nutritional status among children are consistent.

The seasonal pattern of food consumption is different in areas of high and low adoption of technology. Again, the patterns in the valley and low-adoption areas of the plateau are relatively similar to each other, but different from the pattern of the high-adoption areas of the plateau. In the low-adoption areas, the levels of intake are lowest in the period from March through June and rise until around January, when they begin to fall again. In high-adoption areas, consumption is lowest in January-February and highest in the period immediately following the harvest (July-August); it declines from August until December (see Table 12.5).

The diversity of the diet is significantly better in the valley and the low-adoption areas of the plateau than in the high-adoption areas of the plateau during the two most critical months, January and February (see Table 12.6). For the rest of the year, the quality of the diet is not significantly different from one region to the next.

PREVALENCE OF DISEASES

The survey of the number of episodes and duration of diseases revealed the following patterns: (a) diarrhea is generally more prevalent in the valley than in the plateau, and it is most prevalent among children under three years of age; (b) malaria is somewhat more

Table 12.5—Daily per capita consumption of nutrients in high- and low-adoption areas of the plateau, Eastern Province, Zambia, by season, 1986

Nutrient	High-Adoption Areas					
	January-February	March-April	May-June	July-August	September-October	November-December
Energy[a]	2,160.23	2,233.84	2,623.40	2,795.69	2,716.72	2,649.95
	(1,310.94)	(1,135.60)	(1,336.32)	(1,486.30)	(1,544.05)	(1,581.19)
Protein[b]	60.51	64.50	79.25	79.81	75.02	76.71
	(38.10)	(32.59)	(39.87)	(41.06)	(44.14)	(45.06)
Fat[b]	25.40	25.93	47.59	44.38	43.67	43.44
	(25.05)	(16.23)	(37.95)	(34.61)	(38.12)	(36.61)
Carbohydrates[b]	425.77	440.58	437.85	476.49	458.42	441.29
	(264.81)	(229.94)	(244.01)	(260.84)	(256.00)	(258.26)
Calcium[c]	474.24	192.40	476.51	378.02	340.53	342.93
	(370.21)	(270.62)	(307.81)	(243.96)	(265.39)	(240.89)
Iron[c]	18.50	20.84	19.78	19.80	20.49	20.05
	(12.99)	(10.67)	(11.34)	(11.42)	(13.09)	(16.95)
Thiamine[c]	1.08	1.22	1.38	1.29	1.19	1.16
	(1.06)	(0.72)	(0.98)	(0.90)	(0.95)	(0.25)
Riboflavin[c]	0.88	0.98	1.28	1.32	1.35	1.39
	(0.70)	(0.69)	(0.82)	(0.82)	(0.86)	(0.91)
Niacin[c]	10.79	14.15	20.68	19.08	16.76	16.43
	(7.97)	(8.39)	(14.55)	(12.96)	(12.51)	(13.18)

(continued)

Table 12.5—Continued

Nutrient	Low-Adoption Areas					
	January-February	March-April	May-June	July-August	September-October	November-December
Energy[a]	1,998.73	1,696.56	1,621.52	1,716.81	1,914.80	2,133.80
	(893.06)	(863.95)	(826.63)	(671.68)	(1,071.06)	(1,370.57)
Protein[b]	56.86	50.67	48.37	47.39	53.52	56.34
	(27.59)	(26.65)	(26.50)	(18.64)	(27.42)	(31.44)
Fat[b]	26.99	28.14	24.32	21.25	22.59	26.67
	(21.78)	(24.08)	(14.42)	(16.84)	(12.56)	(19.54)
Carbohydrates[b]	389.37	312.96	296.65	315.70	351.80	394.11
	(166.45)	(171.00)	(156.13)	(125.24)	(203.68)	(266.13)
Calcium[c]	606.58	509.76	387.21	268.40	265.10	257.16
	(347.50)	(382.83)	(296.82)	(151.75)	(240.78)	(211.34)
Iron[c]	17.08	13.71	15.13	15.05	16.26	16.55
	(7.44)	(7.70)	(9.25)	(7.31)	(9.75)	(9.27)
Thiamine[c]	1.06	0.97	1.00	0.86	0.89	1.00
	(0.59)	(0.76)	(0.72)	(0.60)	(0.72)	(0.74)
Riboflavin[c]	1.09	0.96	0.67	0.85	1.11	1.15
	(0.63)	(1.06)	(0.40)	(0.41)	(0.89	(0.76)
Niacin[c]	13.04	12.94	11.17	9.41	9.87	10.79
	(8.41)	(10.00)	(6.49)	(4.33)	(5.47)	(6.22)

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission quarterly anthropometric survey, Eastern Province, Zambia, 1986.

Note: Figures in parentheses are standard deviations.

[a] Calories. [b] Grams. [c] Milligrams.

Table 12.6—Food diversity in Eastern Province, Zambia, by month and regional level of technology adoption

	Plateau, Low-Adoption Areas			Plateau, High-Adoption Areas			Valley, Low-Adoption Areas		
Months	Total	Grown	Purchased	Total	Grown	Purchased	Total	Grown	Purchased
January	6.56*	5.02*	1.86*	5.27	4.30	1.22	6.58	5.35	1.63
February	6.98*	5.14	2.18*,**	6.16	4.95	1.57	7.16	6.20**	1.48
March	6.97	5.22	1.96**	6.93	5.67	1.63	6.73	6.14**	0.79
April	7.33	5.69	2.02**	7.62	6.21	1.70	7.89	7.43**	0.68
May	8.18**	5.96	2.62*,**	7.62	6.36	1.57	7.22	6.63**	0.75
June	8.43	6.13	2.81*,**	8.05	6.35	2.13	7.69	6.70	1.39
July	8.77**	5.85	3.43*,**	8.34	6.66*	2.04	7.59	6.24	1.84
August	8.15	5.20	3.42**	7.76	5.70	2.49	7.59	5.71	2.63
September	7.83**	5.23**	3.09**	7.91	5.80	2.56	6.32	4.47	2.34
October	7.63**	5.16	3.13**	8.20	5.89*	2.90	6.47	4.95	2.21
November	7.18**	4.88	2.89**	7.48	5.46*	2.53	5.89	4.41	1.86
December	7.64**	5.83**	2.61**	7.44	5.52	2.40	5.86	4.53	1.56
Annual	15.64	11.41	7.93*,**	15.94	13.18*	6.05	18.56**	15.83**	6.32

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission quarterly anthropometric survey, Eastern Province, Zambia, 1986.

Note: Food diversity is measured by counting the number of food categories present in the diet out of 42 possible categories. One week's diet was recorded each month.

* Significantly higher at the 0.05 level when comparing the low- and high-adoption areas of the plateau.

** Significantly higher at the 0.05 level when comparing the low-adoption areas of the plateau and the valley.

prevalent in the plateau, especially in low-adoption areas; (c) respiratory infections and fevers are relatively higher in the valley and low-adoption areas of the plateau than in the high-adoption areas; (d) for most age groups the prevalence of water-related diseases—diarrhea and malaria—is somewhat lower in households that grow hybrid maize than in those that do not (see Table 12.7). There is no discernible pattern by sex of the head of household.

Improved supplies of water (a protected well or borehole) and sanitation are generally more available in areas that have adopted hybrid maize even though no significant difference exists within each area among households that have or have not done so (see Table 12.8). This suggests that certain characteristics distinguish the areas that adopt technology from those that do not. It is not clear whether these differences were present prior to the adoption of technology or are a result of it.

WOMEN'S ROLE IN AGRICULTURAL DECISIONMAKING

The role of women in household decisions about crop management and agricultural transactions is associated with their access to resources and a reduction in the amount of work they perform, both of which favorably affect the nutrition of young children. Since mothers are the primary caretakers of children, the time and material resources under their control should benefit children by improving the quality of child care, the availability and preparation of foods for children, and the ability of the household to use health and nutrition education and services.

In this study, women's role in making agricultural decisions about hiring labor, purchasing inputs, and selling produce was studied to a limited extent. Since Eastern Province has two predominant ethnic groups, the results were analyzed by ethnic group as well as by level of adoption of agricultural technology.

Women are more involved in agricultural decisionmaking in the valley and low-adoption areas of the plateau than in high-adoption areas. In low-adoption areas, women are closely involved in 40-50 percent of all decisions about hiring labor, including payment. Women make more than 50 percent of the decisions about purchasing inputs in households in the valley and about 20 percent in low-adoption areas of the plateau. Overall, women make about 25 percent of the decisions about hiring labor, 15 percent of the decisions about purchasing inputs, and 45 percent of the decisions about selling produce, when such

Table 12.7—Average monthly number of episodes and duration of illness in Eastern Province, Zambia, by ecological region, hybrid maize adoption at area and household level, and age of individuals

Illness and Age Group	Plateau, Low-Adoption Areas				Plateau, High-Adoption Areas				Valley, Low-Adoption Areas			
	No Hybrid Use	Number	Hybrid Use	Number	No Hybrid Use	Number	Hybrid Use	Number	No Hybrid Use	Number	Hybrid Use	Number
Birth to 3 years												
Diarrhea												
Episodes	0.8333	33	0.5000	1	0.2553	47	0.1852	18	0.5000	29	0.2857	49
Duration (days)	5.7424	33	9.0000	1	3.0035	47	1.2963	18	4.0517	29	1.6599	49
Malaria												
Episodes	0.7677	33	1.0000	1	1.1844	47	0.9722	18	0.6149	29	0.3878	49
Duration (days)	2.6515	33	7.5000	1	8.0780	47	6.1759	18	3.5057	29	2.2959	49
Respiratory infections and fever												
Episodes	1.0556	33	0.0000	1	0.7092	47	0.8148	18	0.4828	29	0.6224	49
Duration (days)	10.5859	33	0.0000	1	7.4291	47	11.3796	18	5.4034	29	5.0374	49
3 to 5 years												
Diarrhea												
Episodes	0.2281	19	...	...	0.0441	34	0.0909	11	0.2941	17	0.0667	30
Duration (days)	1.1228	19	...	...	0.2500	34	0.6364	11	1.7647	17	0.2000	30
Malaria												
Episodes	0.1053	19	...	...	0.6618	34	0.3182	11	0.3529	17	0.4167	30
Duration (days)	0.4737	19	...	...	4.0735	34	1.2727	11	3.3824	17	1.9500	30
Respiratory infections and fever												
Episodes	0.5614	19	...	...	0.2206	34	0.3182	11	0.4118	17	0.3333	30
Duration (days)	4.3509	19	...	...	1.9412	34	2.0000	11	8.2647	17	3.4333	30

(continued)

5 to 14 years												
Diarrhea												
Episodes	0.2148	45	0.4500	2	0.0226	59	0.0000	17	0.0958	40	0.0938	48
Duration (days)	1.0185	45	1.3750	2	0.1073	59	0.0000	17	0.3042	40	0.3872	48
Malaria												
Episodes	0.3093	45	0.1250	2	0.3791	59	0.5882	17	0.1208	40	0.1927	48
Duration (days)	1.0556	45	0.7500	2	2.6251	59	4.2696	17	0.7146	40	1.1163	48
Respiratory infections and fever												
Episodes	0.3926	45	0.3750	2	0.2771	59	0.3824	17	0.1833	40	0.2986	48
Duration (days)	4.1944	45	4.8750	2	2.5478	59	3.2255	17	1.4667	40	2.4566	48
14 years and older												
Diarrhea												
Episodes	0.3926	61	0.2000	2	0.0554	87	0.0625	24	0.0485	62	0.0875	68
Duration (days)	2.8056	61	0.6000	2	0.4705	87	0.3542	24	0.2662	62	0.5235	68
Malaria												
Episodes	0.3947	61	0.2500	2	0.3605	87	0.2972	24	0.3323	62	0.2451	68
Duration (days)	1.9087	61	1.0000	2	2.3083	87	1.7722	24	2.1483	62	1.3582	68
Respiratory infections and fever												
Episodes	1.2207	61	0.2500	2	0.6909	87	0.6264	24	0.7222	62	0.5761	68
Duration (days)	14.4341	61	7.1250	2	9.1219	87	10.1833	24	7.9337	62	5.1261	68

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission quarterly anthropometric survey, Eastern Province, Zambia, 1985.

Table 12.8—Source of water for drinking and sanitation in the plateau region of Eastern Province, Zambia, by use of hybrid maize

Source of Drinking Water and Sanitation	Low-Adoption Areas				High-Adoption Areas			
	No Hybrid Use		Hybrid Use		No Hybrid Use		Hybrid Use	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Drinking water								
February								
Shallow dug-out, river, stream, dam	39	60.9	11	61.1	20	40.8	22	45.8
Protected well or borehole, tap	25	39.1	7	38.9	29	59.2	26	54.2
May								
Shallow dug-out, river, stream, dam	41	100.0	15	100.0	29	50.0	32	55.2
Protected well or borehole, tap	0	0.0	0	0.0	29	50.0	26	44.8
September								
Shallow dug-out, river, stream, dam	61	77.2	19	86.4	32	58.2	37	59.7
Protected well or borehole, tap	18	22.8	3	13.6	23	41.8	25	40.3
December								
Shallow dug-out, river, stream, dam	61	80.3	17	85.0	31	51.7	38	56.7
Protected well or borehole, tap	15	19.7	3	15.0	29	48.3	29	43.3
Sanitation								
Latrine								
No	74	85.1	20	83.3	44	71.0	48	70.6
Yes	13	14.9	4	16.7	18	29.0	20	29.4

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission quarterly anthropometric survey, Eastern Province, Zambia, 1986.

transactions occur. The involvement of women in agricultural decisions declines markedly in high-adoption areas, particularly among patrilineal ethnic groups (Ngoni and Tumbuka).

This pattern of female involvement in decisionmaking has been observed widely in association with much of the technological change taking place in agriculture. Since this component of the study was limited to transactions, and only a fraction of households are involved in transactions, it cannot be used to analyze nutritional status. However, since this factor is important for child nutrition, it may also explain, in part, why the nutritional status of the areas and households that have adopted modern technology has not improved significantly. A closely related indicator—women's role in crop management—was used as an explanatory variable because it was available for all households.

A MULTIVARIATE ANALYSIS OF CHILD NUTRITION

The nutritional status of preschool children was analyzed for February and September. February is the worst time of the year for all indicators related to nutrition, and September is the best because food and income are relatively ample during the postharvest period. This section presents the results of the multiple regression analysis, which included both the direct and indirect determinants of nutrition. The dependent variable is the short-term indicator of child nutrition: the percentage of reference weight-for-height.

During February, the main determinants of child nutrition are health-related variables, education, and family size. Health-related variables in February include the quality of sanitation and the duration of episodes of malaria. The availability of latrines improves the nutrition of preschool children nearly 10 percent. Areas that adopt a high level of technology also have better sanitation and therefore should do better than low-adoption areas once other factors are controlled.

Education, particularly the education of women, is a significant and positive factor influencing child nutrition in February. When men have more education than women, however, education becomes a negative factor. This could reflect the role of women in decisionmaking, which may decrease when their education is substantially lower than that of men.

The size of the family is another significant factor in child nutrition. The size of the family is a significantly negative factor in preschool child nutrition during February. When the family's size

increases 1 member, child nutrition decreases 2 on the reference scale.

During September, different factors influence child nutrition. They include different health-related variables and diet. The significant health-related variables in September are distance to health services and duration of respiratory infections and fever. Respiratory infections and fevers are more prevalent, and therefore more important, during the period preceding September than during February. Since the distance to health services is a significant factor, households may use these facilities more during September than during February because traveling is easier during the dry season and households are less busy.

Diet—the household's caloric intake per adult equivalent—is a significantly positive factor in child nutrition, but only after the labor requirement of the household is controlled.

For the year overall, the most significant factors in child nutrition are the area's quality of water and sanitation, the role of women in agricultural decisionmaking, and the diversity of the diet. Thus, many of the factors that are important to improving child nutrition do not accompany the adoption of agricultural technologies.

CONCLUSIONS

For several nutrition-related characteristics, the areas that are substantial adopters of improved agricultural technologies as represented by the hybrid maize adoption, are better off. For example, levels of food consumption and the quality of water supply and sanitation are better in these areas. However, in other respects, for example, in diet diversity and women's decisionmaking and labor use, these areas may be doing relatively worse. The observed decline in women's decisionmaking role in agriculture and an increase in household labor, including women's labor, may be increasing food requirements and reducing the relative quality of diets and child care. As a result of these complex effects, the net effect on child nutrition is not an unequivocally positive one. While preschool children do relatively better in high-adoption plateau areas, for all children these areas do not appear to do any better than the low-adopting plateau areas. At the same time, the valley areas have better nutrition overall than the plateau. Although their aggregate level of caloric intake is lower, they have less seasonal variation in diets, more diverse diets, and relatively high levels of agricultural decisionmaking by women than the plateau areas. These factors may be essential to improving the nutrition of both children and adults in Zambia's Eastern Province.

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13
Household Expenditure Behavior and Household Revenue Determinants

Rafael Celis and Neal Bliven[1]

The enormous potential of smallholder agriculture to promote equitable growth has been postulated and documented in the works of Mellor and Lele (1973), Johnston and Kilby (1975), Mellor (1976), Bell, Hazell, and Slade (1982), Hazell and Röell (1983), Hazell and Ramasamy (forthcoming), and Hossain (1988). These works emphasize that many growth linkages to the nonfarm economy originate with increased household consumption expenditure. These consumption linkages generate greater income and employment in rural areas because they reflect an increase in the demand for the goods typically produced by small, labor-intensive enterprises (Hazell and Röell, 1983).

This paper examines the consumption linkages induced, in part, by incomes that increased because improved agricultural technology was adopted in Eastern Province, Zambia. The analysis is based on the estimation of Engel functions specified to determine the factors affecting the consumption of various goods and services (see Appendix 1 for a description of the approach and details concerning the data). The paper goes one step further by exploring the determinants of current household revenue (that is, the value of production and earnings) as a way to investigate the conditions under which the adoption of technology translates into increased incomes. This is accomplished by estimating the linear revenue functions for select activities (see Appendix 2 for the specifications and rationale of this estimation). Findings about the determinants of revenue and expenditures are presented, along with their implications for agricultural development policies in Eastern Province, Zambia.

HOUSEHOLD EXPENDITURE BEHAVIOR

In the average sample household, 83 percent of the total consumption expenditure is allocated to food and only 17 percent is

[1] The authors are grateful to Jorge Wong-Valle for his assistance in preparing this paper.

allocated to nonfood (see Table 13.1). The high food share coincides with the findings of Hazell and Röell (1983) for Gusau, Nigeria. Moreover, 63 percent of all consumption consists of the consumption of food produced by the household. Cash purchases of nonfood account for 99 percent of nonfood consumption, and cash purchases account for 12 percent of food consumption.

Only one-quarter of total expenditure involves the monetized economy because the villages surveyed are isolated and the infrastructure is poor and inhibits the expansion of retail trade. Another factor is the notorious weakness of credit programs that could facilitate cash transactions (see Chapter 5 of this volume). Furthermore, farm earnings from marketed produce is a small proportion of total revenue, and wage earnings from work outside the farm is limited, which restricts the cash share of revenue. This, in addition to isolation and poor infrastructure, explains why farmers rely so much on their own production and so little on outside suppliers: neither cash nor goods are available to any great extent.

The marginal changes in the budget shares are also revealing (Table 13.1). If total expenditure was increased, 75 percent of the incremental expenditure would go to food and 25 percent would go to items other than food. To satisfy the increased demand for nonagricultural products, activities outside agriculture and access to outside suppliers of nonfood products would have to be increased or a supply bottleneck would occur.

A potential bottleneck also exists among foods, since vegetables, legumes, and meats have high marginal budget shares. Previous studies on growth linkages have noted that shifting expenditures toward vegetables would have a significant linkage effect through income and employment. Since the production of vegetables, legumes, and meats is labor intensive, this potential bottleneck thus may stimulate development of more labor-intensive agriculture. For the sample households, vegetables are in many cases planted with major crops. Farmers frequently plant sweet potatoes, rape, beans, and other vegetables at the edge of maize plots and harvest them as needed for household consumption. Vegetables are also produced during the dry season, but in limited amounts due to the lack of water. Many of the vegetables are also gathered from the bush. To take advantage of the potentially high multiplier effects, current production practices would have to be changed to include, perhaps, the introduction of irrigation for dry-season gardening.

Table 13.1—Consumer expenditure behavior of sample households in Eastern Province, Zambia

Expenditure Category	Marginal Budget Share	Average Budget Share	Expenditure Elasticity
	(percent)		
Nonfood	24.72	16.75	1.48
Bought with cash	25.28	16.52	1.53
Bartered	0.19	0.23	0.83
Food	75.28	83.25	0.90
Grown or raised	56.12	63.22	0.89
Hunted and fished	1.81	1.80	1.01
Gathered	1.99	3.37	0.59
Bought with cash	12.77	9.91	1.29
Bartered	2.96	1.42	2.08
Received as a gift	0.41	3.53	0.12
Major foods			
Maize	9.26	24.54	0.38
Vegetables	10.07	13.96	0.72
Legumes	12.79	11.90	1.07
Meats	10.69	10.42	1.03

Source: Estimated using 166 valid observations from the International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

The values of the estimated expenditure elasticities are, in general, as expected for typical smallholders (Table 13.1). Nonfood purchased with cash has an elasticity greater than one. The consumption of food produced on the farm would, however, increase proportionately less than total expenditures would, whereas the consumption of food purchased with cash or barter would increase proportionately more.

The unusually high value of the expenditure elasticity for bartered food should be interpreted with caution. In the prevailing economic environment, with its incipiently monetized economy, one would expect increases in expenditures to occur in the short run in the form of bartering activities. At the initial stages of development, some linkages

do not necessarily depend on the monetization of the economy. In the medium and long term, however, as institutions and infrastructure develop, bartering becomes less important.

Classifying households by expenditure quintile and calculating the average and marginal shares using quintile means for all variables produces some interesting results (see Table 13.2). For example, the predominance of food persists across quintiles, with a difference of only 9 points in the average budget share between the lowest and highest expenditure groups. Because the nonfood share is small, the difference between the lowest and the highest quintiles is more dramatic than it is for food—the same 9-point difference is a 71 percent increase in the nonfood share. Total expenditure must be quadrupled to achieve these increases.

The marginal budget shares presented in Table 13.3 indicate that the allocation of incremental expenditure to food does not differ greatly between the lowest and highest quintiles. This overall picture is striking, since the average expenditure of the highest quintile is four times larger than the average expenditure of the lowest quintile. Richer households probably do not have many consumption alternatives, except to increase the marginal shares for food purchased with cash and for nonfood goods by decreasing the incremental share for maize. The factors determining the strength of linkages are explored in the next two sections.

The Effects of Technology Adoption

The estimated coefficients for Engel functions are presented in Tables 13.4 to 13.7. See Appendix 1 for a discussion of the use of Engel functions. The following discussion concentrates on the coefficients that are statistically significant (marked with an asterisk in the tables).

The adoption of hybrid maize, either cultivated alone or mixed with other crops (variables SHMZPCNT and MHMZPCNT), seems to have the most positive linkage effects. It reduces the average household's food share of total expenditure (see Table 13.4) and therefore increases the nonfood share. Within the category of food it encourages households to substitute meats for roots (see Table 13.5) and to shift consumption away from food produced on the farm to food obtained by purchasing with cash or barter (see Table 13.6). The adoption of hybrid maize also promotes cash transactions for nonfood products (see Table 13.7), and using oxen for cultivation increases the nonfood component of consumption expenditure (Table 13.4).

Table 13.2—Average budget shares for sample households in Eastern Province, Zambia, by quintile based upon per capita expenditure

Expenditure Type	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile
			(percent)		
Nonfood	12.54	16.20	14.18	19.38	21.51
Bought with cash	12.37	16.07	14.04	18.78	21.42
Bartered	0.17	0.13	0.14	0.60	0.09
Food	87.46	83.79	85.82	80.62	78.49
Grown or raised	65.56	65.31	64.09	58.15	62.98
Hunted or fished	1.73	2.26	2.11	2.80	0.07
Gathered	4.48	3.00	4.22	3.67	1.47
Bought with cash	8.34	8.51	10.20	10.21	12.30
Bartered	1.22	1.25	2.56	1.81	0.19
Received as a gift	6.13	3.46	2.63	3.98	1.48
Major foods					
Maize	30.24	28.28	23.28	21.51	19.41
Vegetables	16.21	12.22	13.08	12.19	16.15
Legumes	11.62	13.25	12.42	11.11	11.09
Meats	9.81	10.34	12.07	11.90	7.91
			(kwacha per capita)		
Expenditure					
Mean	334.77	508.34	659.07	889.17	1,329.38
Minimum	237.48	413.29	590.44	747.41	1,040.57
Maximum	408.38	588.95	729.60	1,032.87	1,938.30
			(number of households)		
Sample size	33	33	34	33	33

Source: Estimated using 166 valid observations from the International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

Table 13.3—Marginal budget shares for sample households in Eastern Province, Zambia, by quintile based upon per capita expenditure

Expenditure Type	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile
			(percent)		
Nonfood	19.74	23.10	25.14	26.64	29.18
Bought with cash	20.55	23.66	25.57	27.10	29.70
Bartered	-0.03	0.17	0.36	0.32	0.13
Food	80.26	76.90	74.86	73.36	70.82
Grown or raised	59.82	57.78	54.49	52.20	56.17
Hunted or fished	1.83	2.30	1.95	2.88	0.06
Gathered	3.48	1.91	2.36	2.31	-0.17
Bought with cash	11.09	11.94	13.16	13.00	14.86
Bartered	2.92	3.08	3.50	3.55	1.75
Received as a gift	2.42	1.07	0.13	0.19	-1.92
Major foods					
Maize	14.99	13.14	8.06	5.43	3.93
Vegetables	10.88	9.66	10.33	8.62	10.72
Legumes	14.03	13.24	11.84	11.75	13.20
Meats	10.10	10.91	11.87	12.21	3.38
			(kwacha per capita)		
Expenditure					
Mean	334.77	508.34	659.07	889.17	1,329.38
Minimum	237.48	413.29	590.44	747.41	1,040.57
Maximum	408.38	588.95	729.60	1,032.87	1,938.30
			(number of households)		
Sample size	33	33	34	33	33

Source: Estimated using 166 valid observations from the International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

Table 13.4—Regression results for determinants of the food share of total consumption expenditure of sample households in Eastern Province, Zambia

Variable	Description	b	t
Constant	y intercept term	155.61	8.83*
LNE	Natural log of per capita expenditure	-8.99	-4.09*
ANHUSSHR	Animal husbandry as a percent of revenue	-0.02	-0.10
WAGESHR	Wage employment as a percent of revenue	-0.41	-4.89*
HNTFSHR	Hunting and fishing as a percent of revenue	0.40	2.45*
GTHRNSHR	Subsistence food gathering as a percent of revenue	-0.28	-1.80*
OTHCOSHR	Other commercial activities as a percent of revenue	-0.07	-0.78
NONPRSHR	Nonproductive income as a percent of revenue	0.05	0.39
SHMZPCNT	Sole hybrid maize as a percent of area	-0.06	-1.12
MHMZPCNT	Mixed hybrid maize (including a mix of hybrid and local varieties) as a percent of area	-0.14	-2.71*
SLMZPCNT	Sole local maize as a percent of area	-0.07	-1.58
MLMZPCNT	Mixed local maize as a percent of area	-0.01	-0.34
FERTONLY	Use fertilizer only, no hybrids (fertilizer only = 1)	1.32	0.71
OXANDHOE	Use of oxen with hoe cultivation (oxen with hoe = 1)	-2.95	-1.72*
IMPPERHA	Number of crop implements per hectare	-1.64	-0.99
CULTSIZE	Cultivation size (hectares)	-3.02	-3.16*
PCCULTSZ	Per capita area cultivated (hectares per person)	10.66	2.03*
NUMPLOT	Number of plots	0.58	1.14
PROBAPCT	Percent of area with problems that depressed yields	0.03	1.38
NOADVICE	No specific agricultural advice received (no advice = 1)	0.52	0.34
CONTACT	Contact farmer status (contact farmer = 1)	-2.11	-0.72

(continued)

COOPMEM	Cooperative member status (cooperative member = 1)	2.58	1.27
RADIOS	Own a radio (yes = 1)	-3.78	-2.20*
OFOTHVIL	Family member works in another village (yes = 1)	0.06	0.03
CHIPATAD	Distance by road to Chipata (kilometers)	-0.00	-0.16
RDTOTOWN	Distance by road to nearest town (kilometers)	-0.04	-1.17
PATRILOC	Patrilocal community (patrilocal = 1)	-1.47	-0.69
FEMALEHH	Female head of household (yes = 1)	0.63	0.35
AGEHEAD	Age of head of household (years)	0.01	0.09
EDHEAD	Education of head of household (years)	0.57	1.51
FAMILYSZ	Family size (number)	-0.30	-0.61
AFEMALE	Fraction of adults (more than 12 years old) who are female	-5.14	-1.35
OLDCHILD	Fraction of household aged 6-11 years	-5.20	-1.06
YNGCHILD	Fraction of household aged 0-5 years	-3.39	-0.68
STILLSCH	Fraction of household still in school	2.22	0.40
AVEDM	Average education of adult males (more than 12 years old)	-0.41	-1.03
AVEDF	Average education of adult females (more than 12 years old-	-0.21	-0.60
AVILLDAY	Per capita days ill (sick days per person)	0.05	1.02
Adjusted R^2		0.48	
F		5.12	

Source: OLS regression estimated using 166 valid observations from the International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

Note: Because the estimated model complies with the Working-Lesser specification, the total nonfood regression displays the same coefficients and t-values, but opposite signs, with the exception of the constant term.

* One-tail, t-value significant at the 0.05 confidence level.

Table 13.5—Regression coefficients for determinants of the food share of total consumption expenditure of sample households in Eastern Province, Zambia, by type of food

Variable	Maize	Cereals	Legumes	Roots	Vegetables	Fruits	Meats	Others
Constant	138.53*	-23.99*	4.59	20.11*	43.31*	-12.05	-5.32	-15.08
LNE	-16.06*	3.91*	1.65	-1.73*	-4.16*	2.93	0.53	3.93*
ANHUSSHR	-0.32*	0.11	0.13	-0.11*	-0.10	-0.28	0.43*	0.12
WAGESHR	-0.08	0.05	-0.15*	-0.05*	-0.08	-0.07	0.06	-0.08
HNTFSHR	-0.29*	0.19*	-0.20*	-0.13*	-0.03	0.09	0.72*	0.15
GTHRNSHR	-0.20*	-0.09	-0.01	-0.15*	-0.16	0.19	0.16*	-0.02
OTHCOSHR	-0.01	0.04	-0.11	-0.00	-0.03	-0.03	0.09	-0.02
NONPRSHR	-0.15*	-0.01	0.08	-0.05	0.01	0.06	-0.00	0.11
SHMZPCNT	-0.05	-0.00	-0.07	-0.03	0.03	-0.00	0.05	-0.02
MHMZPCNT	-0.01	-0.02	-0.07	-0.05*	0.01	-0.04	0.08*	-0.04
SLMZPCNT	-0.04	-0.05*	0.06	0.01	0.04	0.01	0.03	-0.12*
MLMZPCNT	0.02	-0.05*	-0.01	0.00	-0.01	0.04	0.06*	-0.07*
FERTONLY	0.56	0.10	0.21	-1.65*	0.15	0.75	-0.69	1.90
OXANDHOE	0.06	-1.63*	-0.44	-0.06	-0.68	0.36	-0.07	-0.49
IMPPERHA	1.35	-0.79	-0.75	-0.36	-0.29	-0.78	0.56	-0.58
CULTSIZE	-1.59*	-0.15	-0.90	-0.19	-0.05	0.29	-0.54	0.13
PCCULTSZ	8.73*	-0.77	1.39	3.21*	0.79	-3.66	3.81	-2.85
NUMPLOT	0.75*	-0.30	0.04	-0.16	-0.67*	0.43	0.79*	-0.30
PROBAPCT	-0.01	-0.00	0.01	-0.00	-0.01	-0.02	0.02*	0.04*
NOADVICE	0.15	0.06	-0.62	-0.43	-0.53	0.87	0.48	0.53
CONTACT	1.90	0.30	-1.43	-0.93	-0.39	0.38	-2.02	-0.00
COOPMEM	-0.60	0.25	-1.32	-0.32*	-2.15	2.34	3.51*	0.87

(continued)

RADIOS	0.18	-0.30	0.18	-0.23	-0.31	1.56	-3.69*	-1.18
OFOTHVIL	0.37	-0.07	1.26	0.19	-2.38	1.93	-1.48	0.24
CHIPATAD	0.01	0.02*	0.00	-0.01*	-0.02*	-0.05*	0.00	0.04*
RDTOTOWN	-0.07*	0.00	-0.08*	0.00	0.06*	0.14*	-0.00	-0.10*
PATRILOC	8.42*	-2.22*	-0.23	-0.23	60.14*	-7.19*	-4.43*	-1.71
FEMALEHH	-0.35	-0.25	1.18	-0.27	0.19	1.76	-0.62	-1.01
AGEHEAD	-0.04	0.03	0.00	-0.01	0.05	-0.04	-0.01	-0.03
EDHEAD	-0.24	-0.09	0.33	-0.05	0.02	0.87*	-0.46*	0.17
FAMILYSZ	-1.13*	0.44	0.48	0.21	-0.38	-0.29	0.24	0.12
AFEMALE	-0.54	0.93	-0.64	-1.51	-2.37	2.98	0.04	-4.03
OLDCHILD	-0.13	1.99	-10.35*	-2.48	2.34	0.19	3.02	0.22
YNGCHILD	-10.17*	1.13	1.38	-3.13	0.79	4.18	3.01	-0.60
STILLSCH	-4.29	0.58	0.62	0.63	-4.71	10.55*	-0.78	-0.38
AVEDM	0.33	-0.04	-0.33	-0.05	-0.43	-0.38	0.33	0.16
AVEDF	0.08	0.16	-0.33	0.09	-0.25	-0.88*	0.46*	0.45
AVILLDAY	-0.04	-0.02	-0.00	-0.00	-0.02	0.05	0.02	0.06
Adjusted R^2	0.68	0.26	0.16	0.31	0.29	0.40	0.57	0.13
F	10.55	2.54	1.83	2.98	2.84	3.95	6.82	1.66

Source: OLS regressions estimated using 166 valid observations from the International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

* One-tail, t-value significant at the 0.05 confidence level.

Table 13.6—Regression coefficients for determinants of the food share of total consumption expenditure of sample households in Eastern Province, Zambia, by source of food

	Household Enterprise			Cash Purchase			Barter Purchase		Charity,
Variable	Own Farm	Hunting, Fishing	Gathering	Local Farm	Near Market	Far Market	Labor	Goods	Social Gift Receipt
Constant	141.97*	2.58*	14.98*	-9.30	3.68	-6.84	-0.64	-8.80	17.91*
LNE	-7.43*	-0.28	-1.63*	1.15	0.29	0.89	0.21	0.86	-3.05*
ANHUSSHR	-0.04	-0.00	0.02	0.08	0.03	-0.05	0.04*	-0.07	-0.02
WAGESHR	-0.68*	-0.00	-0.03	0.19	0.19*	0.03	-0.01	-0.00	0.09*
HNTFSHR	-0.70*	0.86*	0.04	0.07	-0.14*	0.04	0.02	0.10	0.11
GTHRNSHR	-1.15*	-0.01	0.71*	0.28*	-0.16*	0.03	-0.00	0.01	0.01
OTHCOSHR	-0.16	0.01	0.04	0.03	0.01	-0.02	-0.01	0.03	0.00
NONPRSHR	-0.19	0.00	0.02	0.03	0.03	0.02	0.02	-0.01	0.13*
SHMZPCNT	-0.21*	-0.00	0.01	0.03	-0.03	0.02	0.00	0.06*	0.05*
MHMZPCNT	-0.21*	0.00	0.01	0.05*	-0.09*	0.03*	-0.00	0.03	0.04*
SLMZPCNT	-0.07	0.00	-0.01	0.01	-0.01	-0.00	-0.01	0.02	0.01
MLMZPCNT	-0.06	-0.00	-0.01	0.01	0.01	0.01	-0.00	0.02	0.01
FERTONLY	-0.94	-0.07	1.07*	2.29*	-3.42*	0.90*	-0.05	0.37	1.18
OXANDHOE	-1.98	0.06	0.72	-1.82*	-0.83	-0.23	-0.17	0.86	0.84
IMPPERHA	-2.92	0.12	-0.61	1.69*	-0.02	-0.14	-0.05	-0.76	1.05
CULTSIZE	-2.07*	0.06	0.04	-0.89*	0.32	0.05	0.13	-0.62	-0.03
PCCULTSZ	5.66	-0.46	0.13	6.12*	1.97	-0.40	-1.04	-0.29	-1.02
NUMPLOT	-0.13	0.04	-0.08	0.28	-0.15	0.01	-0.10	0.71*	0.01
PROBAPCT	0.01	0.00	-0.00	0.00	0.00	-0.01	0.00	0.01	0.01
NOADVICE	-0.16	-0.06	0.31	0.23	-0.18	1.05*	0.15	0.31	-1.13
CONTACT	-3.36	-0.39	-0.10	0.61	-1.77	1.70*	0.09	1.68	-0.57

(continued)

COOPMEM	-2.18	0.12	1.00*	-0.63	1.38	0.54	-0.18	1.52*	1.02
RADIOS	-1.11	-0.16	0.12	-1.30	-1.35	0.93*	-0.02	-0.29	-0.62
OFOTHVIL	0.71	-0.17	0.17	0.29	-0.00	-0.30	0.27	-0.44	-0.45
CHIPATAD	0.01	-0.00	-0.00	-0.00	-0.02*	0.00	0.01*	0.00	0.01
RDTOTOWN	0.05	0.01*	-0.01	-0.06*	-0.00	-0.02*	-0.00	-0.02	0.01
PATRILOC	5.02*	-0.03	-1.32*	0.18	-2.46*	-0.71	-0.57	-1.64*	0.06
FEMALEHH	1.18	-0.14	0.31	1.03	-2.38*	0.24	0.15	-0.53	0.78
AGEHEAD	-0.08	-0.01*	-0.01	0.05*	-0.02	0.02	0.01	0.00	0.03
EDHEAD	0.32	-0.01	0.10	0.48*	-0.29	0.22*	0.01	-0.28*	0.00
FAMILYSZ	-0.18	-0.00	-0.23*	0.23	0.29	0.01	-0.09	0.10	-0.42*
AFEMALE	-6.17	0.16	-1.36	-0.49	1.00	-0.00	-0.32	1.31	0.72
OLDCHILD	-3.71	-0.81*	-1.41	-0.87	-1.64	0.16	-0.09	3.02	0.15
YNGCHILD	-9.59*	-0.42	-0.11	0.99	2.27	0.80	0.43	1.48	0.78
STILLSCH	-2.14	-0.55	0.16	-0.45	8.57*	0.23	-0.47	-1.59	-1.54
AVEDM	-0.65	0.04	-0.09	0.10	0.22	-0.07	0.01	0.23	-0.20
AVEDF	-0.60	-0.02	-0.11	-0.10	0.50*	-0.10	0.01	-0.07	0.28*
AVILLDAY	-0.06	-0.00	0.01	-0.03	0.01	-0.00	-0.00	0.01	0.12*
Adjusted R^2	0.65	0.98	0.83	0.41	0.49	0.23	0.20	0.05	0.44
F	9.42	192.73	22.59	4.08	5.25	2.31	2.13	1.26	4.56

Source: OLS regressions estimated using 166 valid observations from the International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

* One-tail, t-value significant at the 0.05 confidence level.

Table 13.7—Regression results for determinants of the cash purchase share of total consumption expenditure of sample households in Eastern Province, Zambia, by type of good

	Total		Food		Nonfood	
Variable	b	t	b	t	b	t
Constant	-65.81	-3.38*	-12.47	-1.12	-53.35	-3.03*
LNE	11.08	4.57*	2.32	1.67*	8.76	4.00*
ANHUSSHR	0.09	0.46	0.06	0.58	0.02	0.14
WAGESHR	0.65	7.04*	0.23	4.43*	0.41	4.99*
HNTFSHR	-0.41	-2.25*	-0.03	-0.29	-0.37	-2.31*
GTHRNSHR	0.45	2.62*	0.15	1.57	0.29	1.90*
OTHCOSHR	0.09	0.86	0.02	0.38	0.07	0.71
NONPRSHR	0.01	0.09	0.07	0.96	-0.06	-0.51
SHMZPCNT	0.07	1.20	0.02	0.50	0.05	1.01
MHMZPCNT	0.13	2.19*	0.00	-0.28	0.13	2.61*
SLMZPCNT	0.07	1.37	-0.00	-0.10	0.07	1.58
MLMZPCNT	0.03	0.82	0.03	1.03	0.01	0.25
FERTONLY	-1.76	-0.85	-0.24	-0.20	-1.52	-0.82
OXANDHOE	-0.10	-0.05	-2.88	-2.65*	2.78	1.63
IMPPERHA	3.29	1.80*	1.53	1.46	1.76	1.07
CULTSIZE	2.63	2.50*	-0.52	-0.87	3.15	3.32*
PCCULTSZ	-2.89	-0.50	7.70	2.32*	-10.59	-2.03*
NUMPLOT	-0.69	-1.23	0.14	0.42	-0.83	-1.63
PROBAPCT	-0.03	-1.55	-0.00	-0.18	-0.03	-1.60
NOADVICE	0.44	0.27	1.11	1.16	-0.66	-0.44
CONTACT	1.69	0.52	0.54	0.29	1.15	0.39
COOPMEM	-1.38	-0.62	1.28	1.00	-2.67	-1.32

(continued)

RADIOS	2.27	1.20	-1.71	-1.57	3.98	2.33*
OFOTHVIL	-0.02	-0.01	-0.02	-0.02	0.00	0.00
CHIPATAD	-0.02	-1.56	-0.02	-2.83*	0.00	0.07
RDTOTOWN	-0.03	-0.68	-0.09	-3.53*	0.06	1.48
PATRILOC	-0.96	-0.41	-2.99	-2.22*	2.03	0.96
FEMALEHH	-1.45	-0.72	-1.11	-0.96	-0.34	-0.19
AGEHEAD	0.05	0.76	0.06	1.64*	-0.01	-0.20
EDHEAD	-0.07	-0.18	0.41	1.73*	-0.49	-1.30
FAMILYSZ	0.81	1.47	0.52	1.66*	0.29	0.58
AFEMALE	5.73	1.36	0.51	0.21	5.23	1.37
OLDCHILD	2.31	0.43	-2.35	-0.76	4.67	0.95
YNGCHILD	7.75	1.40	4.07	1.29	3.68	0.74
STILLSCH	6.52	1.07	8.35	2.39*	-1.83	-0.33
AVEDM	0.60	1.38	0.25	1.00	0.35	0.89
AVEDF	0.45	1.16	0.30	1.35	0.15	0.43
AVILLDAY	-0.08	-1.54	-0.02	-0.71	-0.06	-1.26
Adjusted R^2	0.63		0.50		0.48	
F	8.66		5.48		5.19	

Source: OLS regressions estimated using 166 valid observations from the International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultrual household survey, Eastern Province, Zambia, 1985/86.

* One-tail, t-value significant at the 0.05 confidence level.

Some of the effects that adopting improved technology has on expenditure patterns, such as higher income, are already captured in the income variable (LNE), which shows that adopting technology has a statistically significant, negative effect on the food share of total expenditure. This was expected. The technology variables capture other effects accompanying the adoption of improved technology, such as changes in cropping patterns, more cash cropping, and better integration with markets.

Overall, the adoption of improved technology diverts food expenditures away from food produced at home and toward food purchased with cash. It also increases the share of expenditure for nonfood goods.

The Effects of Household Characteristics

The reason why the nonfood portion of expenditures increases only slightly with income growth may be that other factors, such as household characteristics, counter the impact of these technology-driven linkages. Some of these factors are relevant to policy.

A relationship rarely discussed in this type of study is the effect that the source of household revenue has on expenditure patterns. As the proportion of revenue that originates from animal husbandry increases, the maize share of expenditure decreases and the meat and gathered food shares of expenditure increase. The gathered food share probably increases because the household members who tend cattle also hunt, fish, and gather vegetables, fruits, insects, and honey from the bush while herding cattle. If the proportion of revenue generated by wage employment increases, the share for cash purchases, of both food and nonfood, also increases; however, the share for total food decreases. The decrease is especially apparent for food from the household's farms; also for legumes. If the proportion of revenue generated by gathering activities increases, the shares of expenditure for food in general and for maize in particular decrease, but the shares for meat (in part because of the relationship between livestock and gathering) and for nonfood purchased with cash increase. The present analysis demonstrates that the source of the revenue matters.

As the amount of area cultivated expands, the shares for food and maize decrease and the share for nonfood items purchased with cash increases. A large part of the newly cultivated land is devoted to cash crops such as cotton, tobacco, sunflower, groundnuts, and hybrid maize, which, because of milling considerations and vulnerability to insect infestation during postharvest storage, is used by households

more as a cash crop than as a food crop.

The expansion of area also means more cultivated land per household member, other things being equal, and even more land per working household member. Unless outside labor is hired, more energy is needed per household worker, and this energy must be obtained by consuming more food.[2] This offsetting effect is captured by accounting for cultivated area per capita, which exhibits positive and statistically significant effects on the shares for total food, maize, and food purchased with cash at the expense of nonfood items purchased with cash.

Another interesting result is that the head of household's level of education affects cash purchases of food. As the level of education increases, so does the share for cash purchases of food. A demonstration effect thus exists since the wage-income effect of education has been taken into account. A similar effect, which is demonstrated by a relative increase in cash purchases of nonfood, is produced by the ownership of radios. Owning a radio, in itself, would increase the purchase of items such as batteries and the use of services such as repair shops; owning a radio would also influence the expenditure pattern of households because radio broadcasts transmit information and advertisements.

To inquire about the effect of cultural factors on expenditure patterns, the variable of patrilocal culture was included in the analysis. Even though it does not seem to influence significantly the allocation of expenditure between the food and nonfood categories, it does show statistically significant effects on individual components of the food category. Households within a patrilocal community tend to allocate larger portions of their expenditure to maize, vegetables, and home-produced food, and smaller shares to foods that are gathered and foods that are purchased with cash (particularly from village markets). These effects work through the household decisionmaking process, which is not fully covered by the survey, but merits further research.

Last but not least, the variable of distance to the nearest town, which measures the relative isolation of the villages studied and serves as a proxy for infrastructure development, shows the expected results. As the distance from town increases, the shares for vegetables and hunted food increase and the share of expenditure for cash purchases

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[2] Celis and Holleman (Chapter 11 of this volume) demonstrate that the adoption of technology does, in fact, increase the use of hired labor, which somewhat mitigates the effect.

of food in general and of maize, legumes, and meat in particular decreases. The share for maize decreases presumably because mealie meal is less accessible from and less available in isolated areas.

Households are not homogeneous, and the differences among them affect consumption patterns. A household's economic activities influence what is readily available for direct consumption and determine the availability of cash for market transactions. Land size, which influences cropping patterns and energy requirements, also has an effect. Communication and education are important because they influence knowledge and tastes, as are locational differences such as type of culture and distance from town. Total revenue, generated using various technologies, is not the sole determinant of consumption patterns, but is an important factor along with household characteristics.

SOURCES AND DETERMINANTS OF HOUSEHOLD REVENUE

As illustrated in Tables 13.8 and 13.9, the majority of household revenue is generated on the farm through activities related to crops: cultivating, processing (including brewing), and marketing. The dependence on crops as a source of income occurs in all the areas sampled and ranges from 72 percent in Chaweya to 91 percent in Makangila.

The importance of other sources of income differs by locale. The contribution to income from livestock activities of the household's farm ranged from 6 percent in Makangila to less than 3 percent in Chiwizi and Mphata. For households located in Chaweya and Sinda, wages account for 7 and almost 9 percent, respectively. Even if subsistence activities put pressure on the wilderness, properly managed wildlife resources could provide a livelihood for households located in areas where the rates of new technology adoption are very low; for example, hunting and gathering represent a sizable source of income in Mphata (11 percent), Nkhoka (12 percent), and Chipili (13 percent). The category of other commercial activity includes activities other than farming, such as mat and basket weaving, brick making, carpentry, and construction, which are important only in Mphata, Chipili, and Chiwizi. Nonproduction revenue includes interest, pensions, and dowries, which are important only in Mphata, Chaweya, and Sinda.

Table 13.8—Mean annual gross revenue of households in Eastern Province, Zambia, by locale and type of activity

Branch (Agricultural District)	Cultivating, Processing, and Marketing Crops	Tending, Processing, and Marketing Animals	Wage Employment	Hunting, Fishing, and Gathering for Own Consumption	Other Commercial Activity	Non-Production	Total
				(kwacha)			
Chaweya (Lundazi)	2,882.07	157.51	144.50	269.35	40.10	304.05	3,797.59
Chipili (Chadiza)	3,243.44	112.83	201.25	379.35	362.47	66.00	4,365.35
Chiwizi (Petauke)	1,978.22	85.37	61.00	123.08	282.07	15.68	2,545.42
Kamwala (Nyimba)	1,964.23	124.30	56.63	126.96	3.53	44.53	2,320.17
Kasendeka (Lundazi)	3,255.18	203.83	123.49	10.60	54.70	20.27	3,668.06
Makangila (Chipata South)	5,216.90	343.25	53.03	0.19	3.28	100.74	5,717.38
Mphata (Mambwe)	2,924.40	97.27	90.76	438.74	150.30	205.52	3,906.98
Nkhoka (Chama)	2,942.01	225.16	140.81	442.07	12.58	57.69	3,820.33
Sinda (Katete)	2,284.68	147.21	368.74	36.54	98.59	128.48	3,064.24

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

Table 13.9—Mean share of annual gross revenue of households in Eastern Province, Zambia, by locale and type of activity

Branch (Agricultural District)	Cultivating, Processing, and Marketing Crops	Tending, Processing, and Marketing Animals	Wage Employment	Hunting, Fishing, and Gathering for Own Consumption	Other Commercial Activity	Non-Production	Total
				(percent)			
Chaweya (Lundazi)	71.58	3.88	7.16	8.42	1.07	7.89	100
Chipili (Chadiza)	71.74	3.12	4.97	12.92	5.62	1.64	100
Chiwizi (Petauke)	80.18	2.73	3.58	5.77	7.04	0.71	100
Kamwala (Nyimba)	85.01	5.84	1.81	5.44	0.21	1.68	100
Kasendeka (Lundazi)	86.84	5.14	5.11	0.51	1.78	0.62	100
Makangila (Chipata South)	91.34	6.16	1.18	0.00	0.09	1.22	100
Mphata (Mambwe)	73.59	2.74	2.04	11.49	5.01	5.13	100
Nkhoka (Chama)	76.16	5.98	4.24	11.90	0.34	1.37	100
Sinda (Katete)	77.95	4.53	8.80	1.39	3.14	4.19	100

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

Note: Totals may not add to exactly 100 percent because of rounding.

Table 13.10 contains the mean for gross household revenue per labor hour in three important categories: household's crop enterprise, household's livestock enterprise, and outside wage employment. The hourly wage earned outside the household is almost always lower than the hourly revenue generated by household, hired, and exchange labor allocated to the household's own agricultural activities.

To investigate the causes of the differences in revenue per hour, a multivariate analysis is included and the results presented in Tables 13.11 to 13.13. The use of oxen for cultivation (significant at about the 6 percent level) has a positive impact on the revenue generated per hour by the household's crop enterprise, in addition to the effect on area mentioned by Celis and Holleman (Chapter 11 of this volume). The size of area cultivated, which increases with the introduction of oxen, also has a positive effect that is consistent with findings for other African countries (see Pingali, Pigot, and Binswanger 1987). In contrast, the proportion of adults who are female has a negative influence on crop revenue per hour, which may reflect the tendency of females to concentrate on less valuable crops—less valuable in monetary terms, but perhaps more important to household nutrition. As the distance by road to Chipata increases, the per hour value of the household's crop enterprise decreases because isolation from better developed markets lessens the potential for marketing higher value crops or using labor-enhancing technologies. As the percentage of cultivated area that has yield depressing problems such as too much or too little rain or attacks by birds or monkeys increases, the revenue generated per hour decrease. In summary, the adoption of improved technology increases household revenue per hour for activities related to crops, while adverse environmental factors, long distances to Chipata, and some household characteristics tend to restrain hourly revenue for crop activities.

In animal husbandry, increasing the proportion of hours allocated to slaughtering increases the value added per hour. Likewise, as males become more educated, the household receives economic benefits. Two factors negatively affect the revenue earned per hour in animal husbandry: long distance to Chipata (the same reason that great distance negatively affects cropping) and large proportion of hired labor in livestock labor (hirelings have less at stake and are therefore less reliable than family members).

Table 13.10—Mean gross revenues generated per labor hour in Eastern Province, Zambia, by locale

Branch (Agricultural District)	Cultivating, Processing, and Marketing Crops		Tending, Processing, and Marketing Animals		Wage Employment	
	Mean	Number of Households	Mean	Number of Households	Mean	Number of Households
	(kwacha)		(kwacha)		(kwacha)	
Chaweya (Lundazi)	0.64	25	0.97	25	0.46	24
Chipili (Chadiza)	0.72	21	0.13	21	0.36	18
Chiwizi (Petauke)	0.27	23	n.a.	n.a.	0.25	11
Kamwala (Nyimba)	0.68	13	5.47	3	0.26	12
Kasendeka (Lundazi)	0.98	23	2.80	11	0.35	15
Makangila (Chipata South)	1.68	32	2.66	31	1.66	28
Mphata (Mambwe)	1.05	17	11.64	24	0.75	14
Nkhoka (Chama)	0.61	10	3.83	12	1.09	10
Sinda (Katete)	0.70	14	2.94	13	0.76	14

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

Table 13.11—Regression results for the determinants of revenue generated per hour of crop-related activities of sample households in Eastern Province, Zambia

Variable	Description	b	t
Constant	y intercept term	1.77841	1.944*
SHMZPCNT	Sole hybrid maize as a percent of area	0.00238	0.668
MHMZPCNT	Mixed hybrid maize (including a mix of hybrid and local varieties) as a percent of area	-0.00029	-0.082
SLMZPCNT	Sole local maize as a percent of area	0.00004	0.015
MLMZPCNT	Mixed local maize as a percent of area	-0.00210	-0.888
FERTONLY	Use fertilizer only, no hybrids (fertilizer only = 1)	0.06329	0.545
OXANDHOE	Use of oxen with hoe cultivation (oxen with hoe = 1)	0.17890	1.599
IMPPERHA	Number of crop implements per hectare	-0.00499	-0.040
CULTSIZE	Cultivation size (hectares)	0.10719	1.669*
PCCULTSZ	Per capita area cultivated (hectares per person)	-0.28252	-0.842
NUMPLOT	Number of plots	-0.04909	-1.471
PROBAPCT	Percent of area with problems that depressed yields	-0.00223	-1.845*
NOADVICE	No specific agricultural advice received (no advice = 1)	-0.13189	-1.366
CONTACT	Contact farmer status (contact farmer = 1)	0.12552	0.696
COOPMEM	Cooperative member status (cooperative member = 1)	-0.04213	-0.314
RADIOS	Own a radio (yes = 1)	-0.05153	-0.473
OFOTHVIL	Family member works in another village (yes = 1)	-0.03172	-0.311
CHIPATAD	Distance by road to Chipata (kilometers)	-0.00305	-3.575*
RDTOTOWN	Distance by road to nearest town (kilometers)	0.00740	2.968*
PATRILOC	Patrilocal community (patrilocal = 1)	0.32614	2.151*
FEMALEHH	Female head of household (yes = 1)	0.01832	0.152
AGEHEAD	Age of head of household (years)	-0.00232	-0.620
EDHEAD	Education of head of household (years)	0.02379	1.005
FAMILYSZ	Family size (number)	-0.00632	-0.213

(continued)

Table 13.11—Continued

Variable	Description	b	t
AFEMALE	Fraction of adults (more than 12 years old) who are female	-0.52069	-1.757*
OLDCHILD	Fraction of household 6-11 years old	0.12186	0.322
YNGCHILD	Fraction of household 0-5 years old	0.30145	0.924
STILLSCH	Fraction of household still in school	0.13600	0.397
AVEDM	Average education of adult males (more than 12 years old)	-0.03220	-1.371
AVEDF	Average education of adult females (more than 12 years old)	0.00435	0.198
AVILLDAY	Per capita days ill (sick days per person)	0.00183	0.628
CULTHRS	Total crop-related hours (cultivation and postharvest)	-0.00007	-2.167*
CHRPERHA	Cultivation hours per hectare cultivated	0.00000	0.056
FEMCPCT	Percent of family cultivation hours performed by female adults (more than 12 years old)	0.00377	0.899
KIDCPCT	Percent of family cultivation hours performed by children less than 12 years old	-0.00306	-0.396
EXCHCRPT	Exchange labor as a percent of cultivation hours	-0.00324	-0.544
HIRECRPT	Hired labor as a percent of cultivation hours	0.00034	0.041
PHRPCNT	Postharvest hours as a percent of all crop-related hours	-0.01098	-2.409*
FEMPHPT	Percent of family postharvest hours performed by female adults (more than 12 years old)	0.00198	0.229
KIDPHPT	Percent of family postharvest hours performed by children (less than 12 years old)	0.00143	0.093
EXCHPHPT	Exchange labor as a percent of postharvest hours	0.00461	0.488
HIREPHPT	Hired labor as a percent of postharvest hours	0.00873	0.681
AHFARMPT	Livestock hours as a percent of family farm hours (crops and livestock)	-0.00032	-0.101
Adjusted R^2		0.4587	
F		4.0064	

Source: OLS regression estimated using 150 valid observations from the International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

* One-tail, t-value significant at the 0.05 confidence level.

Table 13.12—Regression results for the determinants of revenue generated per hour of livestock-related activities (excluding cultivation using oxen) of sample households in Eastern Province, Zambia

Variable	Description	b	t
Constant	y intercept term	2.11789	0.633
ANIMALV	Farm animal value (kwacha)	-0.00014	-0.697
CATTLEPT	Cattle as a percent of farm animal value	0.00101	0.059
SHEEPPCT	Sheep as a percent of farm animal value	-0.00118	-0.015
GOATPCT	Goats as a percent of farm animal value	0.01057	0.488
PIGPCT	Pigs as a percent of farm animal value	-0.19383	-1.048
CULTSIZE	Size of area cultivated (hectares)	0.80574	1.370
PCCULTSZ	Area cultivated per capita (hectares per person)	-2.04066	-0.598
NUMPLOT	Number of plots	-0.26591	-1.062
LRAINPT	Percent of area with yields depressed by low rainfall	0.00190	0.077
ERAINPT	Percent of area with yields depressed by excess rainfall	-0.00193	-0.137
NOADVICE	No specific agricultural advice received (no advice = 1)	0.81779	0.987
CONTACT	Contact farmer status (contact farmer = 1)	-2.27157	-1.488
COOPMEM	Cooperative member status (cooperative member = 1)	0.35660	0.330
RADIOS	Own a radio (yes = 1)	-0.43624	-0.469
OFOTHVIL	Family member works in another village (yes = 1)	0.43142	0.493
CHIPATAD	Distance by road to Chipata (kilometers)	-0.01593	-2.543*
RDTOTOWN	Distance by road to nearest town (kilometers)	0.06487	3.265*
PATRILOC	Patrilocal community (patrilocal = 1)	-1.05957	-0.835
FEMALEHH	Female head of household (yes = 1)	-0.54480	-0.487
AGEHEAD	Age of head of household (years)	-0.02392	-0.746
EDHEAD	Education of head of household (years)	0.01100	0.055

(continued)

Table 13.12—Continued

Variable	Description	b	t
FAMILYSZ	Family size (number)	-0.14663	-0.591
AFEMALE	Fraction of adults (more than 12 years old) who are female	4.23843	1.915*
OLDCHILD	Fraction of household 6-11 years old	-1.22816	-0.387
YNGCHILD	Fraction of household 0-5 years old	1.56688	0.539
STILLSCH	Fraction of household still in school	-2.04981	-0.749
AVEDM	Average education of adult males (more than 12 years old)	0.43245	2.091*
AVEDF	Average education of adult females (more than 12 years old)	-0.20900	-1.032
AVILLDAY	Per capita days ill (sick days per person)	-0.03844	-1.085
AHUSHRS	Total livestock-related hours	0.00088	1.440
FEMAHPT	Percent of family livestock hours performed by female adults (more than 12 years old)	-0.00370	-0.198
KIDAHPT	Percent of family livestock hours performed by children (less than 12 years old)	-0.01343	-0.714
EXCHAHPT	Exchange labor as a percent of livestock hours	-0.02239	-1.005
HIREAHPT	Hired labor as a percent of livestock hours	-0.03440	-1.653*
SLMARPCT	Slaughtering and marketing as a percent of livestock hours	0.10064	3.032*
AHFARMPT	Livestock hours as a percent of family farm hours (crops and livestock)	-0.06232	-1.327
Adjusted R^2		0.3526	
F		2.7094	

Source: OLS regression estimated using 114 valid observations from the International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

* One-tail, t-value significant at the 0.05 confidence level.

Table 13.13—Regression results for the determinants of revenue generated per hour of wage employment of sample households in Eastern Province, Zambia

Variable	Description	b	t
Constant	y intercept term	0.55654	1.260
NOADVICE	No specific agricultural advice received (no advice = 1)	0.11814	0.741
CONTACT	Contact farmer status (contact farmer = 1)	-0.32157	-1.158
COOPMEM	Cooperative member status (cooperative member = 1)	0.20918	0.814
RADIOS	Own a radio (yes = 1)	0.07678	0.408
CHIPATAD	Distance by road to Chipata (kilometers)	-0.00306	-3.065*
RDTOTOWN	Distance by road to nearest town (kilometers)	0.00380	1.164
PATRILOC	Patrilocal community (patrilocal = 1)	0.38371	2.091*
FEMALEHH	Female head of household (yes = 1)	-0.13001	-0.734
AGEHEAD	Age of head of household (years)	0.00115	0.183
EDHEAD	Education of head of household (years)	-0.04907	-1.285
FAMILYSZ	Family size (number)	-0.01403	-0.426
AFEMALE	Fraction of adults (more than 12 years old) who are female	0.47373	1.158
OLDCHILD	Fraction of household 6-11 years old	0.64503	1.139
YNGCHILD	Fraction of household 0-5 years old	-0.03738	-0.076
STILLSCH	Fraction of household still in school	0.07831	0.148
AVEDM	Average education of adult males (more than 12 years old)	0.09907	2.467*

(continued)

Table 13.13—Continued

Variable	Description	b	t
AVEDF	Average education of adult females (more than 12 years old)	0.08319	2.448*
AVILLDAY	Per capita days ill (sick days per person)	-0.00151	-0.358
WAGEHRS	Total wage employment hours	-0.00031	-2.623*
FEMWPT	Percent of wage employment hours performed by female adults (more than 12 years old)	-0.00408	-1.740*
KIDWPT	Percent of wage employment hours performed by children (less than 12 years old)	-0.01073	-2.736*
LPTWMEAL	Percent of wage employment hours with meal provided	-0.00323	-1.403
LPTINOWN	Percent of wage employment hours in own village	0.00021	0.098
Adjusted R^2		0.3561	
F		3.6211	

Source: OLS regression estimated using 110 valid observations from the International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

* One-tail, t-value significant at the 0.05 confidence level.

The education of both males and females positively affects the hourly wage rate. As is the case for the two other sources of revenue, wage revenue per hour decreases as the distance by road to Chipata increases. It also decreases as the proportion of wage employment hours contributed by females or children grows, which suggests that gender or age discrimination (including structural discrimination based on the type of tasks assigned according to physically and culturally determined roles) affects the wage earned per hour.

POLICY RECOMMENDATIONS

Rural development, including the adoption of improved agricultural technology by smallholders, enhances the value of labor in Eastern Province. Farmers who adopt improved technology tend to modify their pattern of consumption in favor of nonfood goods, which could potentially stimulate growth in the nonfarm economy. Despite this, households still devote an unusually high proportion of their expenditure to food.

To increase crop-related revenues, policymakers should concentrate on encouraging farmers to adopt improved technology at a higher rate. This means that research and extension should be expanded (for specific recommendations, see Chapters 9 and 10 of this volume). Moreover, price distortions and institutional barriers should be removed, particularly in the markets for inputs and outputs and in the credit system. Improving roads and infrastructure in general would give households better opportunities for integrating their operations with the market. In particular, investment in irrigation could improve the production of vegetables, a labor-intensive category of food that displays a positive marginal budget share.

In animal husbandry, the vertical integration of raising and slaughtering animals is a critical factor for increasing the hourly revenue generated by this activity. Credit schemes or other means of providing households with capital goods for processing their animal products would be a step in the right direction. By raising the human capital and conscientiousness of labor, greater family education and participation in husbandry enterprises would increase the returns per hour.

Education, infrastructure, and social development could also improve linkages through the labor market by making wage employment more attractive.

The private sector, particularly cooperatives, should be given a

broader scope including the distribution of nonfood commodities to strengthen linkages with the nonfarm economy. The ownership of radios has such a significant impact on the pattern of consumption that exploring means to increase the access of households to radios would be worthwhile. Radios could also be used to transmit educational programs to all individuals, but especially to adults. This of course calls attention to a more fundamental problem: the poor coverage of rural Eastern Province by communication services.

In the critical period of adjustment in the Zambian economy, care should be taken to ensure that expenditures on research and extension, rural infrastructure, social services, and education are not severed purely on the grounds of stability and fiscal austerity. Policy reforms that affect input and output prices, trade, and credit should also be introduced to give farmers the incentive to adopt new technology, resulting in increased productivity and enhanced economic well-being.

APPENDIX 1: THEORY AND DATA FOR ENGEL FUNCTIONS

This paper follows the approach used in the work done for Nigeria and Malaysia by Hazell and Röell (1983). It presents estimations of the relationships between income and consumption and explores how they change depending on the socioeconomic characteristics of the household. This work explicitly includes the adoption of technology and choice of enterprise as variables, which allows assessment the impact that changes in technology and enterprises have on the expenditure behavior of households.[3] Although the variables included are not completely independent, neither are they linearly correlated; to avoid omitting relevant policy variables, they are used even though doing so may reduce the accuracy of the estimations. The analytical tool used is the estimation of expenditure share functions, applying the following modified, Working-Lesser type of equation:

$$S_i = E_i/E = \beta_i + \gamma_i \text{LogE} + \Sigma_j \lambda_{ij} Z_j, \qquad (1)$$

where S_i is the share of good or service i in total expenditure, E_i is the expenditure in good or service i, E is total consumption expenditure, β_i is the constant term, γ_i and λ_{ij} are coefficients, and Z_j is the value of a predetermined (exogenous or implicitly lagged endogenous) household characteristic, j. Equation (1) is equivalent to the Engel function:

$$E_i = \beta_i E + \gamma_i E \text{ LogE} + \Sigma_j \lambda_{ij} E Z_j. \qquad (2)$$

Following Hazell and Röell (1983) the parameters of the share equations were estimated directly rather than by employing two-stage least squares. The marginal and average budget shares for the *ith* good

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[3] This is a refinement of Massell's inclusion (1969) of a subsistence ratio variable. It recognizes that the composition of income makes a difference because an imperfect market environment exists in Eastern Province that makes it easier for a household to consume its own produce in the particular form produced than to sell it in order to buy other items. Of course, wage income is more readily converted to consumer goods and services not produced by a household.

or service (MBS_i and ABS_i, respectively) and the expenditure elasticity are as follows:

$$MBS_i = dE_i/dE = \beta_i + \gamma_i(1 + \text{Log } E) + \Sigma_j \lambda_{ij} Z_j. \quad (3)$$

$$ABS_i = S_i = \text{equation (1)}. \quad (4)$$

$$\epsilon_i = MBS_i/ABS_i. \quad (5)$$

These expressions are evaluated using the sample mean values for E and Z_j. When values for different income levels are estimated, the sample means for E and Z_j that correspond to each level are used.[4]

To permit comparisons among households, and to make this study comparable with similar studies, equation (1) is estimated for annual per capita values. Total consumption expenditure includes the foods grown and consumed by the household valued at market prices.

Valid expenditure data were compiled from survey observations of 166 households in nine branch locations covering eight agricultural districts. Households were asked about their food consumption for the week before each interview and about their nonfood consumption for the month before each interview. The survey was administered each month from December 1985 through December 1986. Annual per capita figures were calculated from the last 12 months of the survey.

Appendix Tables 13.14 to 13.19 show basic tabulations by branch, group of commodities, and individual items. Most of the items are relatively unimportant, which makes estimating Engel curves for individual items unattractive. Similarly, since only slaughtering, milling, and social activities are truly nontradable activities according to Hazell and Röell's definition (1983) and expenditures in them are small, estimation of Engel curves for tradable and nontradable goods and services is not warranted. Larger aggregations of goods and services are analyzed instead.

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[4] For a complete discussion of the econometric characteristics of Engel functions, see Cramer (1969).

Table 13.14—Mean annual per capita consumer expenditure for food and nonfood items in Eastern Province, Zambia, by locale

Branch (Agricultural District)	Food	Nonfood	Total
		(kwacha)	
Chaweya (Lundazi)	539.37	96.28	635.65
Chipili (Chadiza)	601.09	206.36	807.45
Chiwizi (Petauke)	388.44	79.03	467.47
Kamwala (Nyimba)	439.07	117.59	556.66
Kasendeka (Lundazi)	544.51	157.80	702.31
Makangila (Chipata South)	902.37	213.89	1,116.26
Mphata (Mambwe)	748.90	80.44	829.34
Nkhoka (Chama)	548.78	45.16	593.95
Sinda (Katete)	453.31	98.76	552.07

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

Table 13.15—Mean share of annual per capita consumer expenditure for food and nonfood items in Eastern Province, Zambia, by locale

Branch (Agricultural District)	Food	Nonfood
	(percent)	
Chaweya (Lundazi)	85.7	14.3
Chipili (Chadiza)	78.5	21.5
Chiwizi (Petauke)	83.9	16.1
Kamwala (Nyimba)	80.1	19.9
Kasendeka (Lundazi)	80.4	19.6
Makangila (Chipata South)	81.1	18.9
Mphata (Mambwe)	89.7	10.3
Nkhoka (Chama)	92.5	7.5
Sinda (Katete)	83.0	17.0

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

Table 13.16—Mean annual per capita consumer expenditure in Eastern Province, Zambia, by type and locale

Type of Expenditure	Mphata (Mambwe)	Nkhoka (Chama)	Chaweya (Lundazi)	Kasendeka (Lundazi)	Makangila (Chipata South)	Chipili (Chadiza)	Sinda (Katete)	Chiwizi (Petauke)	Kamwala (Nyimba)
					(kwacha)				
Food									
Home produced	588.39	387.79	360.04	478.05	765.76	324.49	351.69	314.00	340.09
Farm purchased	7.61	19.49	43.09	34.44	70.62	93.02	0.88	22.52	10.13
In-village retail	56.66	0.28	13.18	7.23	64.53	4.64	73.79	16.44	6.18
Out-village retail	4.83	8.03	20.61	3.99	0.68	29.74	0.14	0.00	4.36
Received as a gift	33.97	28.85	41.81	16.76	0.71	31.39	16.92	10.27	26.05
Bartered with labor	2.49	15.31	2.93	1.23	0.00	1.17	3.49	1.64	11.26
Bartered with a commodity	4.97	19.54	7.50	0.00	0.00	26.22	0.00	0.06	3.20
Hunted and gathered	49.98	69.48	50.23	2.82	0.06	90.41	6.39	23.50	37.80
Nonfood	80.44	45.16	96.28	157.80	213.89	206.37	98.76	79.03	117.59

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

Table 13.17—Mean share of annual per capita consumer expenditure in Eastern Province, Zambia, by type and locale

Type of Expenditure	Mphata (Mambwe)	Nkhoka (Chama)	Chaweya (Lundazi)	Kasendeka (Lundazi)	Makangila (Chipata South)	Chipili (Chadiza)	Sinda (Katete)	Chiwizi (Petauke)	Kamwala (Nyimba)
					(percent)				
Food									
Home produced	68.9	66.0	56.7	71.3	69.0	44.0	65.1	67.0	63.8
Farm purchased	0.9	3.1	6.7	4.4	6.3	10.9	0.1	5.0	1.7
In-village retail	6.8	0.1	2.1	0.9	5.7	0.6	12.7	3.5	0.9
Out-village retail	0.5	1.2	3.1	0.4	0.1	3.5	0.0	0.0	0.8
Received as a gift	4.1	4.9	7.4	2.7	0.1	3.9	3.1	2.8	4.9
Bartered with labor	0.3	2.6	0.5	0.2	0.0	0.2	0.7	0.3	1.7
Bartered with a commodity	0.8	2.9	1.2	0.0	0.0	3.3	0.0	0.0	0.6
Hunted and gathered	7.4	11.7	7.8	0.5	0.0	12.1	1.2	5.2	5.7
Nonfood items	10.3	7.5	14.3	19.6	18.9	21.5	16.9	16.0	19.9

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

Table 13.18—Mean annual per capita consumer expenditure in Eastern Province, Zambia, by item and locale

Type of Expenditure	Mphata (Mambwe)	Nkhoka (Chama)	Chaweya (Lundazi)	Kasendeka (Lundazi)	Makangila (Chipata South)	Chipili (Chadiza)	Sinda (Katete)	Chiwizi (Petauke)	Kamwala (Nyimba)
					(kwacha)				
Maize	111.75	87.06	183.38	244.91	229.10	164.20	137.46	124.40	92.40
Other cereals	40.91	106.62	5.38	1.54	26.67	6.15	6.48	3.61	8.69
Legumes	46.49	45.63	93.18	50.15	172.69	65.53	45.57	90.29	101.82
Roots	29.85	4.81	7.34	28.82	52.44	4.30	41.47	77.21	22.02
Vegetables	97.83	62.55	68.29	112.85	220.01	67.78	63.19	61.62	79.99
Fruits	270.91	13.99	32.49	0.18	24.58	86.61	54.19	18.51	10.51
Meats (including eggs)	105.70	98.79	51.08	60.51	71.01	118.11	73.36	39.26	73.13
Dairy products (excluding butter)	0.28	0.00	8.11	0.02	7.02	2.63	1.15	0.26	8.20
Alcoholic beverages	20.79	45.13	48.32	25.57	49.59	67.19	7.53	11.84	14.67
Sugars	14.69	73.34	24.01	10.75	25.59	7.25	11.67	7.10	12.31
Fats and oils (including butter)	3.50	4.53	5.64	0.03	17.74	3.68	4.05	0.85	10.83
Other beverages	0.00	0.00	0.11	0.00	0.32	0.13	0.00	0.12	0.17
Salt	3.29	3.51	2.47	5.07	4.45	3.99	3.82	3.35	3.78
Soda ash	2.91	2.84	9.55	4.11	1.75	3.53	3.35	0.00	0.54
Clothing and linens	20.49	21.60	41.14	92.38	100.03	81.23	32.89	13.24	48.70
Toiletries	8.29	6.78	11.00	11.30	21.65	23.07	15.29	14.07	9.58
Detergents	8.20	0.05	4.07	9.61	11.55	11.32	13.05	15.98	4.66

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Brushes and brooms	0.04	0.00	0.18	0.00	0.18	0.01	0.04	0.00	0.03
Tobacco products	3.33	3.[illegible]	1.03	1.01	4.59	5.16	0.93	0.32	0.43
Heating and lighting	6.96	2.21	4.73	5.63	13.97	13.58	4.99	5.31	7.61
Slaughtering	2.24	0.00	0.19	0.18	0.75	0.49	0.11	0.04	0.29
Milling	10.73	0.00	14.76	13.50	16.75	12.50	10.84	15.81	4.57
Kitchenware	1.94	0.00	3.28	1.52	3.33	1.92	0.65	0.90	3.03
Furnishings	0.00	0.00	0.01	1.91	5.19	17.29	0.00	0.00	0.55
Electrical appliances	0.00	0.00	4.39	2.41	1.47	2.40	0.00	0.64	11.05
Bicycles	2.99	4.35	1.08	4.93	5.01	8.04	0.01	3.19	19.94
Construction	2.40	0.25	0.00	8.86	5.01	4.11	0.08	2.19	0.41
Jewelry	0.30	0.00	0.00	0.00	0.26	8.99	0.30	0.91	1.06
Watches and clocks	0.16	0.42	0.13	0.00	0.16	0.00	0.00	0.42	0.00
Communications and postal orders	0.06	0.71	0.28	0.01	0.32	0.31	0.11	0.06	0.05
Education	4.29	3.65	1.53	2.75	10.70	1.11	13.03	0.72	1.28
Medical	2.28	1.28	1.50	0.64	1.15	1.94	2.97	0.66	1.89
Personal transportation	5.32	0.00	3.57	0.61	7.73	8.63	2.94	4.53	0.98
Social	0.43	0.00	3.39	0.53	4.08	4.25	0.51	0.04	1.46

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

Table 13.19—Mean share of annual per capita consumer expenditure in Eastern Province, Zambia, by item and locale

Type of Expenditure	Mphata (Mambwe)	Nkhoka (Chama)	Chaweya (Lundazi)	Kasendeka (Lundazi)	Makangila (Chipata South)	Chipili (Chadiza)	Sinda (Katete)	Chiwizi (Petauke)	Kamwala (Nyimba)
					(percent)				
Maize	14.9	15.6	29.6	37.2	20.9	21.8	26.6	28.3	17.1
Other cereals	5.0	17.7	0.8	0.3	2.4	0.7	1.0	0.7	1.6
Legumes	6.0	8.1	14.5	7.4	15.7	8.8	8.0	17.9	18.3
Roots	3.8	0.9	1.2	3.8	4.7	0.6	7.9	5.9	4.6
Vegetables	13.0	11.1	10.8	17.0	19.6	9.3	12.3	13.9	14.3
Fruits	28.1	2.7	4.9	0.0	2.1	11.	8.5	3.9	2.7
Meats (including eggs)	13.5	16.3	8.3	8.1	6.3	15.1	12.9	8.3	12.6
Dairy products (excluding butter)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alcoholic beverages	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0
Sugars	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fats and oils (including butter)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other beverages	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Salt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Soda ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Clothing and linens	2.5	3.8	5.7	11.3	8.9	8.7	5.5	2.3	8.2
Toiletries	1.1	1.1	1.7	1.4	1.9	2.5	2.7	3.0	1.8

(continued)

Detergents	1.1	0.0	0.6	1.1	1.0	1.3	2.3	3.3	1.8
Brushes and brooms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tobacco products	0.4	0.6	0.2	0.1	0.4	0.6	0.1	0.1	0.1
Heating and lighting	0.9	0.4	0.7	0.6	1.2	1.5	0.9	1.2	1.4
Slaughtering	0.2	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1
Milling	1.4	0.0	2.4	1.8	1.5	1.6	2.0	3.6	0.9
Kitchenware	0.3	0.0	0.5	0.1	0.3	0.1	0.1	0.2	0.6
Furnishings	0.0	0.0	0.0	0.4	0.5	1.2	0.0	0.0	0.1
Electrical appliances	0.0	0.0	0.5	0.4	0.1	0.2	0.0	0.1	1.7
Bicycles	0.4	0.6	0.1	0.5	0.4	0.8	0.0	0.5	2.9
Construction	0.3	0.0	0.0	1.1	0.4	0.6	0.0	0.4	0.1
Jewelry	0.0	0.0	0.0	0.0	0.0	0.6	0.1	0.2	0.2
Watches and clocks	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Communications and postal orders	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Education	0.7	0.6	0.3	0.4	1.0	0.1	2.2	0.1	0.2
Medical	0.3	0.2	0.2	0.1	0.1	0.2	0.5	0.1	0.3
Personal transportation	0.7	0.0	0.6	0.1	0.7	1.0	0.5	0.8	0.3
Social	0.0	0.0	0.6	0.1	0.3	0.5	0.1	0.0	0.3

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission agricultural household survey, Eastern Province, Zambia, 1985/86.

APPENDIX 2: METHOD FOR ESTIMATING REVENUE FUNCTIONS

A preliminary analysis of the survey data, presented at the Mfuwe seminar in October 1987, demonstrates that substantial differences in revenues exist between households that adopt the use of oxen for cultivation, the application of fertilizer, or the planting of hybrid maize and households that do not adopt any of these practices. An econometric approach is used here to explore which factors, in addition to purely technological ones, determine this difference. It is assumed that in addition to the adoption of technology, household revenue depends on assets, infrastructure, the relative allocation of labor to different activities, and household characteristics such as family size, education, and healtl..

The following linear equation is estimated using ordinary least-squares regression:

$$R_i = a_i + \Sigma_j b_{ij} Z_j,$$

where R_i is the revenue per hour generated by activity i, a_i is the constant term, b_{ij} is a coefficient, and Z_j represents the *jth* predetermined (exogenous or implicitly lagged endogenous) technology, regional, or household characteristic. The characteristics are not completely independent, but at least they are not linearly correlated. Though severe multicolinearity is unlikely, the accuracy of the estimation may be reduced somewhat.

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Part III
Determinants of Other Factors Influencing Technology Adoption

14
Determinants of Service Use Among Rural Households in Eastern Province

Sudhir Wanmali and Jane He

The analysis that follows is placed within the growing field that studies rural infrastructure and its impact on agricultural development in the developing world. Although important to agricultural development and planning, infrastructure is difficult to define. Generally, the research community refers to infrastructure as roads, telecommunications, electrification, and irrigation. Focusing solely on this so-called hard infrastructure provides a partial picture, but other elements are equally important.

Local data on climate, physiography, soil, water, vegetation, and population should be collected, stored, and analyzed by government agencies before they plan agricultural development. Normally this task is performed by national institutions in collaboration with their regional and local counterparts. When this institutional infrastructure is lacking, agricultural development is often poorly planned.

Various services are also necessary to develop agriculture: transportation (buses and trucks), finance (credit and banking), animal husbandry, input distribution (seeds, fertilizers, pesticides, and agricultural machinery), and marketing (centers for marketing agricultural and rural produce). These are called soft infrastructure. The systems that distribute these services have strong economic as well as spatial features that, depending on their pattern of availability, can improve or hinder their access to the rural population and the prospects for agricultural development (Wanmali 1987a).

The work that the International Food Policy Research Institute, among others, has undertaken in developing countries shows that investment in hard infrastructure, when coupled with simultaneous investment in soft infrastructure, facilitates the effective use of all infrastructural services for intensive agricultural development. This, in turn, leads to a rapid increase in regional economic growth (Wanmali 1983, 1985, 1989). In India, the government planned the location of soft infrastructural services after studying demographic, functional, and spatial characteristics of its regional settlement system of towns and villages (Wanmali 1983, 1985, 1989). In addition, government investment in similar services encouraged the private sector to provide complementary soft infrastructural services (Wanmali 1983, 1985).

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The use of soft infrastructural services in India was influenced not only by the income of households, but also by the distance at which these services are located from the households (Wanmali 1985, 1989). Some services, which could be categorized broadly as agricultural services, were used less by consumers who are located far from them than by those who are near. In theory, this could have had an adverse impact on overall agricultural development. Such services could be more available and accessible if they were offered in a mobile fashion. Reducing the distance between services and consumers would save both money and time, and those savings would be retained locally and used in both the productive and consumer sectors of the rural economy. This, in turn, would strengthen the service and demand linkages in the region and thus reinforce regional economic growth.

Understanding all types of infrastructure is essential to explaining their effect on agricultural development in any region. In doing so, however, national investments in hard infrastructure should not be equated with direct economic gains at the local level, and policymakers must accept that long-term economic gains cannot be achieved without simultaneous local investment in soft infrastructure.

GEOGRAPHICAL ANALYSIS AND RURAL INFRASTRUCTURE

Locational analysis is useful for studying the distribution of infrastructure and people over space and time, and particularly the access of people to infrastructure. In using locational analysis, the geographer begins by dividing infrastructure and people into categories, which simplifies relationships. For example, infrastructure is categorized as hard, institutional, or soft; and people are categorized as urban or rural, agriculturalists or nonagriculturalists, skilled or unskilled, rich or poor, males or females, adults or children, and literate or illiterate. Distance, which separates them, is categorized not only as distance in space (kilometers), but as distance in time and cost.

Infrastructure and people are located in towns and villages, and access to them varies depending on where a specific settlement is located in the wider system of settlement. Towns provide better access than villages, and locating services properly over a region is crucial to improving their access to the farming population. Making services available in distant towns does not greatly improve access locally.

All activities, for example, agriculture, mining, manufacturing, trade, services, transportation, finance, and governance, are located in the settlement system of a region. Analyzing the settlement system can

therefore clarify the patterns of relationships that exist between a region's population and its infrastructural services.

Services are also located in settlements, and their location is a result of the capacity of the settlement to sustain them. Once established, services tend to be used not only by the population of their own settlement, but also by that of surrounding settlements. Understanding the basic relationship that exists between a center offering a particular service, or group of services, and its dependent territory can provide useful information on the spatial characteristics of the settlement system. This relationship has, of course, many implications for how services are used at both the village and the household level.

Further properties of access, which are fundamentally related to distance, are worth noting. Geographical studies of the spatial impact of development recognize that access varies directly with income and social status and declines as the distance from towns and cities increases. Further, any development effort decays as it moves away from the center and toward the periphery. The analysis of the relationship between the center and the periphery, particularly the relationship between infrastructure and people, is fast becoming a centerpiece of the current literature on regional development planning in the developing world (Mabogunje 1980; Wanmali 1987b).

Current economic analysis of the relationship between infrastructure and people and their impact on each other tends to use indicators such as income and cost. A geographical analysis of access, along the lines noted above, would complement this economic analysis admirably and produce a fuller understanding of the problem. The theoretical underpinning of such an analysis is the theory of central place, which has been useful in many areas of the developed, and the developing, world (Christaller 1966).

Because data on the supply of all types of infrastructural services are lacking in Eastern Province, Zambia, the present analysis uses data collected from the sample households in the study region to analyze the patterns of household demand for soft infrastructural services.

SCOPE OF THE STUDY

This paper examines the patterns of availability and use of services in Eastern Province, Zambia. The analysis of the determinants of service use at the household level addresses broad policy issues related to the impact that access has on the demand of households for rural

service infrastructure and thus on efforts to plan the distribution of goods and services in rural areas.

Based on data collected by the field survey, Eastern Province has 12 main groups of services made up of 84 constituent services. The main groups of services are health, communications, credit and finance, buses and other transportation, the purchase, service, and rental of agricultural implements, agricultural inputs, veterinary services, agricultural extension, agricultural marketing, and retail establishments. The constituent services of these main groups are given in Appendix 1.

The data relate to variables such as the number of trips made to use a particular service, the distance traveled per trip, the time taken to cover that distance, and the mode of transportation used. The data on distances, which were collected only once (in May of 1986), were checked for consistency in the manner noted below.

Data on the distance traveled to services were checked for consistency by identifying the service center that was used the most for a particular service or group of services. For example, a given household within a settlement (or administrative branch) sometimes reported that its members traveled different distances to the same destination in order to use different services. Such differences were corrected by using the distance that the household reported the most often for that destination.

Even within a settlement, sample households that were located separately were grouped in identifiable clusters, and the out-of-line distances to the same destination (from within a cluster) were corrected in the above manner.[1] Thus, out of 330 sample households, corrected and verified distances could only be obtained for 245 households located throughout 10 settlement locations in the province.

For the econometric analysis of the impact of distance (access) on household purchases, access was measured as the distance to the nearest service center providing a particular group of services (consumer goods and services, production factors, and output markets). The sample of households was reduced to 197 because 48 households yielded unsatisfactory data on purchases. The data on purchases were collected from the sample households every month for one year.

To value any selection bias caused by reducing 330 cases to 197, a t-statistic check was performed to test the significance of differences

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[1] Since the service centers that were used the most were not likely to move during the year, it was assumed that the distances obtained by the May 1986 survey would hold for the rest of the year.

in the means of the two sample groups. Thus, the t-statistics for homogeneity of variances were calculated (Table 14.1). The results show that the differences between the two groups are fairly small in most cases. Only cultivated land has a t-value significant at the 0.05 level, and the rest hold low t-values with a two-tail probability greater than 0.10. Reducing the number of observations is therefore not likely to imply significant bias in the sample.

Table 14.1—Results of test for homogeneity of variances

Variable	Mean of Sample Not Selected	Mean of Sample Selected	Two-Tailed t-test
Family size	1.6628	1.6524	0.17
Gender of head of household (male=1, female=0)	1.2823	1.2959	-0.26
Number of household members			
0-5 years old	1.1935	1.2821	-0.66
6-14 years old	1.7097	1.5692	0.79
More than 15 years old and female	1.6694	1.5846	0.78
Credit received	30.6073	23.6523	1.61
Education of head of household	3.8065	3.5744	0.61
Cultivated land	2.1897	2.4897	-1.98*
Valley and plateau (valley=1, plateau=0)	2.1770	1.8370	0.74

* Significant at the 0.05 level.

Since the data on the distance (traveled) to services were collected only once during the survey period, if a household did not use a service or its component during this single survey exercise the distance traveled to that service was not recorded for that particular household. From the survey of expenditure patterns, however, it was possible to note whether or not a household used a service or its component during the year (see Appendix 2).

The problem of no recorded distance was resolved in the following way. When some households from a settlement used a particular service in the month when the data on distance were collected, an average value of the distance traveled was assigned to the households not using the service that month. It was assumed that the household not using the service in the survey month would go to the same service center as households from the same settlement.

The data obtained by the survey were also cross-checked with the distances by road according to a map. The reported distances correspond well with those measured on the map, as shown in Table 14.2.

Table 14.2—Reported distances by road compared with actual

Administrative Branch	Agricultural District Headquarters	Distance by Road	Distance Reported
		(kilometers)	(mean kilometers)
Chaweya	Lundazi	15	21
Makangila	Chipata	20	21
Chipili	Chadiza	15	12
Sinda	Katete	35	43
Chiwizi	Petauke	5	10
Mphata	Mambwe	10	10
Nkhoka	Chama	60[a]	36

[a] The map shows a cross-country distance of 35 kilometers.

A DESCRIPTIVE ANALYSIS OF ACCESS TO AND USE OF SERVICES

Three major characteristics of access to, and use of, services describe the relationships among distance, travel time, and number of trips made. In the study sample, a negative relationship exists between distance and the number of trips made and between travel time and the number of trips made (see Table 14.3). The correlation coefficients are -0.18 and -0.19, respectively, and, although weak, the correlations are significant at 0.001 level.

This basic relationship also appears to be true when analyzed for services and branches separately; for example, services that are the farthest from a household are used the least, and those that are nearest to a household are used the most. Marketing, which is the most accessible service, is used the most (see Figures 14.1 and 14.2), and the highest use of services occurs in Sinda, which has the most accessible set of services (see Figures 14.3 and 14.4). Since factors other than distance might be clouding the relationship for other branches and services, multivariate regression analysis was used to sort out their effects.

Of the trips that the study sample as a whole made to services, 54 percent were reached on foot; 24 percent by bicycle; 10 percent by oxcart; 6 percent by car or taxi; and the rest by bus, truck, motorcycle, or boat (including canoe). The most common system of transport—walking—is very rudimentary.

Households in the study region are located in one of two ecological environments (the plateau and the valley). These two environments influence the adoption of new agricultural technology as well as the use of oxen. Moreover, the production and income characteristics of households in the plateau are better than those of households in the valley. The provision and use of services in these two ecological regions also differ, and households on the plateau travel an average of 9.71 kilometers per visit to use services, while households in the valley travel 16.25 kilometers per visit (see Table 14.4).

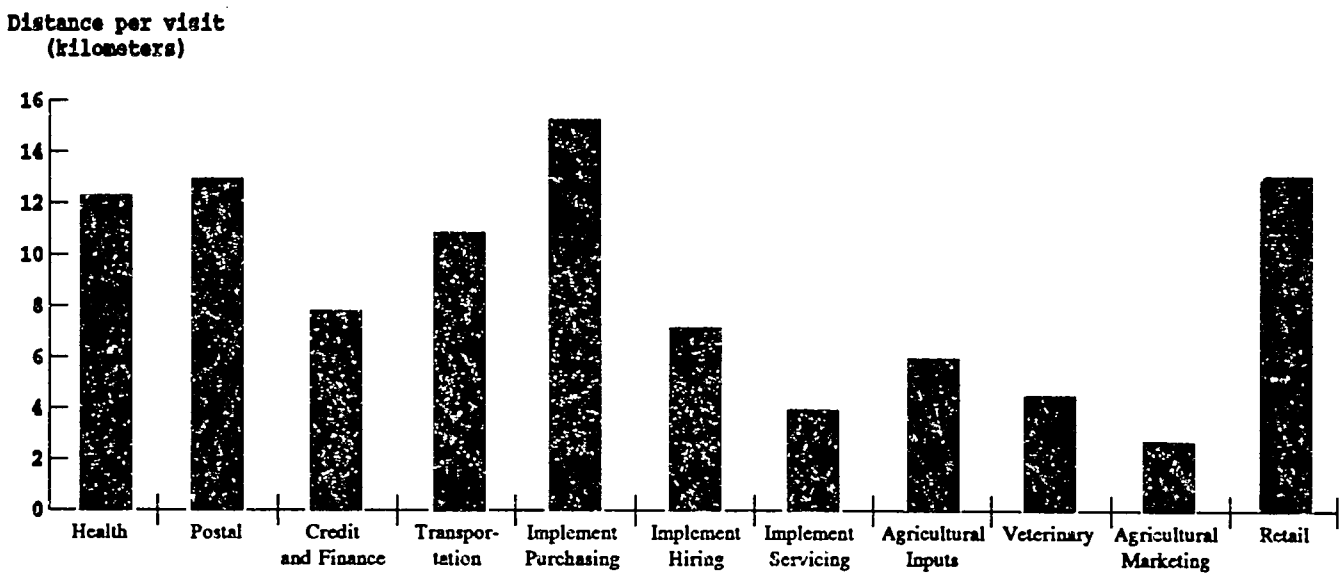
The demand for services is influenced not only by the socioeconomic characteristics of the household, but also by the distance that services are located from the households (Wanmali 1985, 1987b, 1989).

Table 14.3—Pattern of service use in Eastern Province, Zambia, by type of service and mode of transportation

Service	Number of Trips	Travel Distance	Travel Time	Mode of Transportation							
				Foot	Oxcart	Bicycle	Motorcycle	Car	Bus	Lorry	Boat
	(kilometers per trip)	(hours per trip)	(percent)								
Health	155.00	11.19	1.68	71.61	0.65	25.16	...	2.58	...	...	...
Postal communications	4.00	17.93	1.55	52.94	...	41.18	...	5.88	...	...	...
Credit and finance	87.00	6.94	1.11	50.57	16.09	28.74	...	4.60	...	...	...
Bus and other transportation	52.00	12.30	1.39	57.69	11.54	1.92	1.92	17.31	1.92	7.69	...
Agricultural implement											
Purchase	55.00	15.67	2.24	58.18	...	41.82	...	...	...	...	...
Rent	11.00	9.33	1.17	54.55	36.36	9.09	...	...	...	...	...
Service	6.00	3.97	0.82	66.67	16.67	16.67	...	...	...	...	...
Agricultural input	165.00	5.20	1.01	25.45	32.73	22.42	3.03	2.42	...	...	13.94
Veterinary	5.00	4.40	1.72	100.00	...	...	...	...	...	...	...
Agromarketing	228.00	1.95	0.54	42.98	15.35	26.75	...	...	...	...	14.92
Retail	589.00	9.40	1.35	71.82	1.36	20.37	0.17	5.77	0.51	...	...

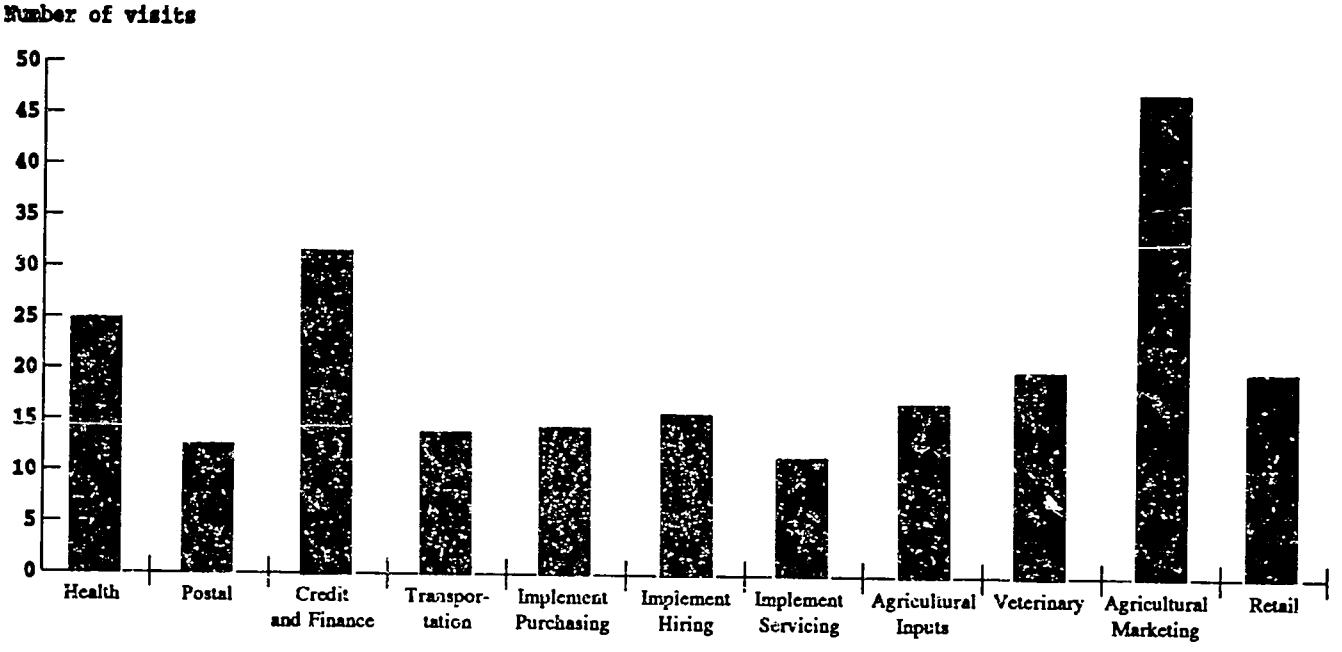
Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission regional service use survey in Eastern Province, Zambia, May 1986.

Figure 14.1--Average distance traveled to use services in Eastern Province, Zambia



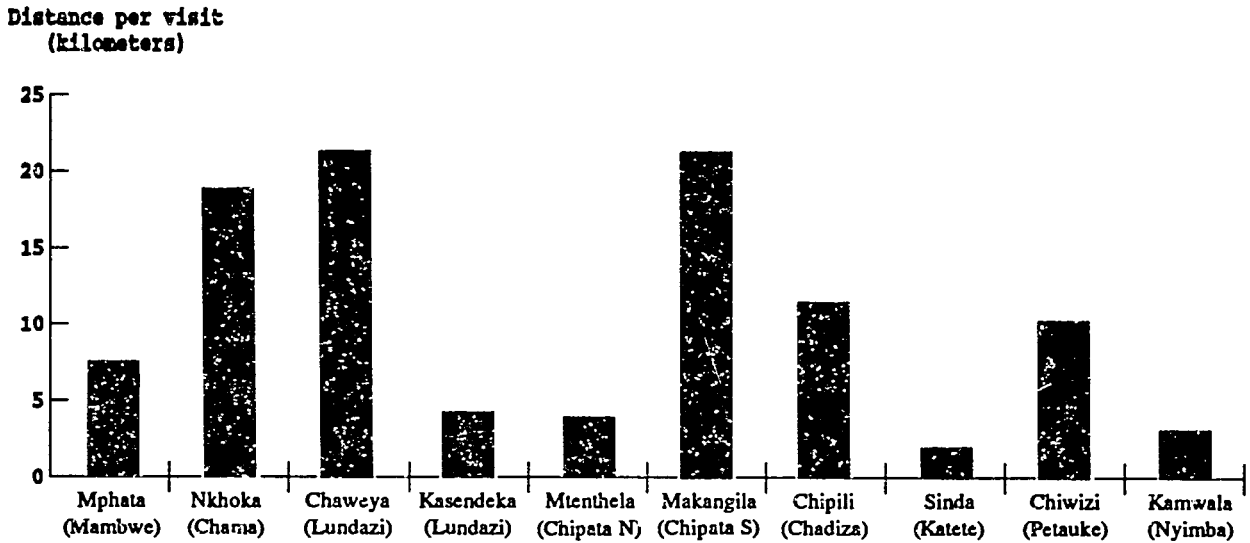
Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission regional service use survey, May 1986, Eastern Province, Zambia.

Figure 14.2--Number of visits per household to use services in Eastern Province, Zambia



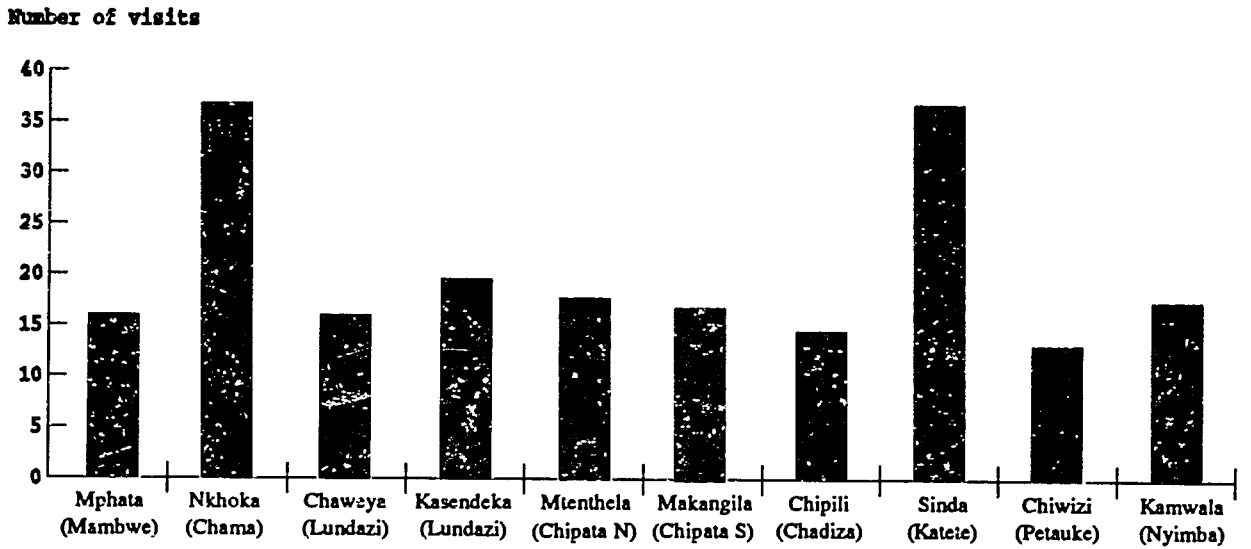
Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission regional service use survey, May 1986, Eastern Province, Zambia.

Figure 14.3--Average distance traveled per visit to use services in Eastern Province, Zambia, by agricultural branch



Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission regional service use survey, May 1986, Eastern Province, Zambia.

Figure 14.4--Number of visits per household to use services in Eastern Province, Zambia, by agricultural branch



Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission regional service use survey, May 1986, Eastern Province, Zambia.

ACCESS TO SERVICES AND PATTERNS OF CONSUMER PURCHASES

The following descriptive analysis of patterns of household purchases forms the basis of the econometric analysis that follows. The two most important areas of consumer purchases are consumer goods (K 91.11 per capita or 59 percent of all purchases) and purchased food (K 38.82 per capita or 25 percent). Transportation, building and construction, fuel and energy, health, postal communications, and education account for the rest (see Table 14.5).

As noted, the mean distance traveled per visit to all services is 9.71 kilometers for households in the plateau and 16.25 kilometers for households in the valley. Differences in the distance and time needed to reach a service are reflected in the overall patterns of per capita consumer purchases (Table 14.5).

The household use of services can also be disaggregated by the size of farm operated. Households with more than 2 hectares of land are defined as rich, and households with less than 2 hectares are defined as poor. Rich households travel an average of 9.77 kilometers per visit, and poor households travel 11.53 kilometers (see Table 14.6). Due to the differences in access as well as economic status, rich and poor households have significantly different patterns of per capita consumer purchases (see Table 14.7).

Households in the plateau spend 232 percent more per capita on purchased food, 60 percent more on consumer goods, 56 percent more on fuel and energy, 352 percent more on health services, and 39 percent more on bus and other transportation services than households in the valley, which, however, spend 160 percent more on postal communications and 38 percent more on education (Table 14.5).

Rich households spend the same amount per capita on purchased food as poor households, but 63 percent more on consumer goods, 21 percent more on fuel and energy, 150 percent more on building and construction, 58 percent more on health services, and 18 percent more on transportation. The poor, however, spend 45 percent more on postal communications and 88 percent more on education than the rich (Table 14.7).

A regression model was used to estimate the impact that access to services has on patterns of consumer purchases. The details of the model are given below.

Table 14.4—Pattern of service use in Eastern Province, Zambia, by region and type of service

Service	Percent of Household Using the Service		Travel Distance per Visit		Travel Time per Visit		Number of Times Used per Household		Number of Service Sites Used per Average Settlement	
	Plateau	Valley	Plateau	Valley	Plateau	Valley	Plateau	Valley	Plateau	Valley
			(kilometers)		(hours)					
All services	100.00	100.00	9.71	16.25	1.31	3.35	649	121	1.50	1.00
Health	53.25	48.49	7.95	14.34	1.17	3.66	56	18	0.63	1.00
Postal communications	13.85	4.17	10.85	37.25	1.36	4.50	30	2	0.50	0.50
Credit and finance	24.24	46.96	10.15	1.35	1.40	0.62	23	10	1.00	1.00
Bus and other transportation	21.21	4.55	10.81	36.67	1.24	3.77	43	2	0.75	0.50
Agricultural implement										
Purchase	19.48	15.15	12.59	29.53	1.67	4.82	37	9	0.50	1.00
Rent	4.76	...	9.33	...	1.17	...	8	0	0.88	0.00
Service	0.87	6.06	9.50	1.20	1.10	0.67	2	4	0.50	0.50
Agricultural input	54.55	59.09	5.60	5.33	0.99	1.30	98	16	1.00	0.50
Veterinary	2.16	...	4.40	...	1.72	...	3	0	0.38	0.00
Marketing	36.80	100.00	3.68	0.71	0.57	0.53	41	17	1.13	0.50
Retail	100.00	84.85	7.99	22.78	1.02	4.49	308	43	1.20	1.00

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission regional service use survey in Eastern Province, Zambia, May 1986.

Table 14.5—Per capita consumer purchases in Eastern Province, Zambia, by type of service and region, 1985/86

Service	Total Mean Amount	Plateau Mean Amount	Plateau Share of Total	Valley Mean Amount	Valley Share of Total
	(kwacha)	(kwacha)	(percent)	(kwacha)	(percent)
Purchased food	38.82	44.53	26.28	13.43	14.01
Consumer goods	91.11	98.42	58.06	61.52	64.19
Fuel and energy	8.61	9.27	5.46	5.94	6.20
Building and construction	4.03	4.06	2.39	3.93	4.10
Postal communications	1.99	1.51	0.89	3.92	4.10
Education	0.28	0.26	0.15	0.36	0.38
Health	2.53	2.98	1.76	0.66	0.69
Bus and other transportation	7.97	8.44	4.98	6.07	6.33
Total	155.34	169.47	100.00	95.83	100.00

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission monthly survey, 1985/86.

Note: The sample consisted of 318 households: 255 in the plateau and 63 in the valley.

Table 14.6—Pattern of service use in Eastern Province, Zambia, by farm size, 1985/86

Service	Percent of Households Using the Service		Travel Distance per Visit		Travel Time per Visit		Number of Times Used per Household		Number of Service Sites Used per Average Settlement	
	0-2 Hectares	More than 2 Hectares	0-2 Hectares	More than 2 Hectares	0-2 Hectares	More than 2 Hectares	0-2 Hectares	More than 2 Hectares	0-2 Hectares	More than 2 Hectares
			(kilometers)		(hours)					
All services	100.00	100.00	11.53	9.77	1.97	1.21	434	336	...	...
Retail	100.00	100.00	13.62	11.89	2.25	1.32	205	146	1.76	2.39
Health	75.22	84.43	13.91	10.19	2.63	1.62	46	28	1.32	1.44
Postal communications	13.27	22.89	14.77	11.73	2.07	1.26	15	17	1.02	1.20
Bus and other transportation	29.20	22.89	10.94	11.43	1.55	0.95	30	15	0.88	1.44
Credit and finance	42.48	46.99	7.36	8.25	1.25	0.98	18	15	1.02	1.44
Agricultural implement										
Purchase	26.55	30.12	16.72	13.69	2.77	1.81	25	21	1.17	1.44
Rent	5.31	6.02	11.28	3.25	1.40	0.44	4	4	0.44	0.48
Service	4.42	1.21	2.76	10.00	0.73	1.25	5	1	0.44	0.24
Agricultural input	76.11	95.18	6.47	5.50	1.38	0.90	56	58	1.61	1.91
Veterinary	2.65	2.42	4.50	4.50	1.65	2.00	2	1	0.15	0.24
Marketing	100.00	100.00	1.04	4.17	0.46	0.75	28	30	0.73	1.91

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission monthly survey, Eastern Province, Zambia, 1985/86.

Table 14.7—Per capita consumer purchases in Eastern Province, Zambia, by type of service and farm size, 1985/86

Service	Total Mean Amount	More than 2 Hectares		Less than 2 Hectares	
		Mean Amount	Percent of Total	Mean Amount	Percent of Total
	(kwacha)	(kwacha)		(kwacha)	
Purchased food	39.08	39.08	21.04	39.08	29.31
Consumer goods	88.90	117.16	63.08	71.99	53.98
Fuel and energy	8.22	9.20	4.95	7.63	5.72
Building and construction	4.08	6.53	3.50	2.61	1.96
Postal communications	2.00	1.56	0.84	2.26	1.69
Education	0.26	0.17	0.01	0.22	0.24
Health	2.58	3.35	1.80	2.12	1.59
Bus and other transportation	7.84	8.67	4.67	7.34	5.50
Total	152.96	185.72	100.00	133.35	100.00

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission monthly survey, Eastern Province, Zambia, 1985/86.

Note: The survey consisted of 310 households: 194 with more than 2 hectares and 166 with less. Eight households were excluded from the total because of lack of information on land holdings.

The variable for distance—which represents the closest consumer service center for the branch—was expected to be the most important independent variable for the models. The variables measuring average number of vehicles owned per household were also expected to be important factors affecting the use of services. Five vehicles are considered in the regression equation: motor car, tractor, motorcycle, oxcart, and bicycle. All other independent variables are described in Table 14.8; the main groups of services used for these analyses are listed in Appendix 1.

A semi-log ratio function was adopted to form the following Engel, budget-share equation:

$$CP_i/CP = a + b\,LOGCP + c\,LOGN + d\,SEX + e\,CHILD + f\,YOUTH + g\,WOMEN15 + h\,EDUCHH + i\,FARM + j\,CONSERVD + k\,MOTORCAR + l\,TRACTOR + m\,MCYCLE + n\,OXCART + o\,BICYCLE.$$

Coefficient b and coefficient j were used to calculate two marginal values: (1) the marginal consumer item purchase share with reference to total consumer purchase = a + b (1+LOGCP) + c LOGN + d SEX + e CHILD + f YOUTH + g WOMEN15 + h EDUCHH + i FARM + j CONSERVD + k MOTORCAR + l TRACTOR + m MCYCLE + n OXCART + o BICYCLE, and (2) the marginal consumer item purchase with reference to distance = j CP.

The average and marginal shares of purchased items are shown in Table 14.9, regression results in Table 14.10, and the elasticity and marginal value of items purchased with respect to distance in Table 14 11.

AN ECONOMETRIC ANALYSIS OF ACCESS TO SERVICES AND PATTERNS OF PURCHASES

Purchased food and consumer goods form a major part of household consumer purchases (Table 14.9). Similarly, they figure prominently in the incremental effect that permanent income (measured as the current level of consumer purchases) has on purchases. Since only part of these goods are produced locally, no major demand linkages appear between the farm and nonfarm economy. Health and education receive a particularly low share of spending for consumer purchases, perhaps because they are heavily subsidized in Zambia.

Table 14.8—Description of independent variables used in consumer purchase share regressions

Variable	Definition	Mean
CP	Per capita consumer purchasing (kwacha)	168.52
LOGCP	Natural log of per capita consumer purchasing	5.13
LOGN	Natural log of family size	1.65
SEX	Gender of head of household (male=1, female=0)	0.70
CHILD	Proportion of household members less than 5 years old	0.20
YOUTH	Proportion of household members 6-14 years old	0.23
WOMEN15	Proportion of household members more than 15 years old who are female	0.31
EDUCHH	Education of head of household (1-7 years)	3.57
FARM	Cultivated land (hectares)	2.49
CONSERVD	Distance to the nearest consumer service center	10.00
MOTORCAR	Average number of motor cars owned by households in the branch	0.01
TRACTOR	Average number of tractors owned by households in the branch	0.01
MCYCLE	Average number of motorcycles owned by households in the branch	0.01
OXCART	Average number of oxcarts owned by households in the branch	0.16
BICYCLE	Average number of bicycles owned by households in the branch	0.63

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission monthly survey, Eastern Province, Zambia, 1985/86.

Table 14.9—Average and marginal shares and elasticity of consumer purchases in Eastern Province, Zambia

Type of Service	Mean per Capita	Average Share	Marginal Share	Elasticity
	(kwacha)		(percent)	
Purchased food	38.82	23.04	31.34	1.36
Consumer goods	103.05	61.15	53.89	0.88
Fuel and energy	9.32	5.53	8.02	1.45
Building and construction	4.67	2.77	2.02	0.73
Postage	1.75	1.04	3.64	3.50
Education	0.18	0.11	0.24	2.18
Health	3.44	2.04	-2.19	-1.07
Bus and transportation	7.29	4.33	2.95	0.68
Total	168.52	100.00	...	...

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission monthly survey, Eastern Province, Zambia, 1985/86.

Note: The sample size was 196 households.

Budget Shares

Nine agricultural branches covering 197 households were included in the regression analysis. The estimated regression coefficients with t-scores and R^2 with F values for each of the budget share regressions are given in Table 14.10 (for the definitions of independent variables, see Table 14.8).

The level of education attained by the head of the household has a positive and significant effect on the share that purchased food services have in the household budget, but a negative and significant effect on the share that buses and other modes of transportation have.

Table 14.10—Regression coefficients for consumer purchase share equations in Eastern Province, Zambia, by type of service

Variable	Purchased Food		Consumer Goods		Fuel and Energy		Building and Construction	
	b	t	b	t	b	t	b	t
Constant	47.106*	3.000	36.125*	2.033	6.510	1.532	-4.335	-0.462
LOGCP	-2.730*	-1.874	1.837	1.115	-0.594	-1.507	0.505	0.581
LOGN	-3.285	-0.972	-0.369	-0.097	-0.097	-0.107	3.970*	1.965
SEX	7.027*	2.287	-4.667	-1.343	0.693	0.833	-3.072*	-1.673
CHILD	-11.698	-1.264	19.108*	1.824	1.484	0.592	-11.156*	-2.016
YOUTH	1.009	0.109	-6.758	-0.645	-1.423	-0.568	0.828	0.150
WOMEN15	15.659	1.530	-6.680	-0.577	-0.940	-0.340	-6.926	-1.132
EDUCHH	0.688	1.633	-0.117	-0.247	0.038	0.334	-0.140	-0.558
FARM	-1.366	-1.270	0.946	0.777	0.232	0.798	-0.322	-0.501
CONSERVD	0.300	0.855	-0.282*	-1.709	-0.225*	-2.369	0.429*	2.045
MOTORCAR	-150.476*	-2.601	202.058*	3.087	-38.440*	-2.455	29.906	0.865
TRACTOR	728.539*	6.612	-441.599*	-3.542	-103.032*	-3.454	-138.172*	-2.098
MCYCLE	-190.575	-1.620	189.140	1.421	32.963	1.035	96.272	1.369
OXCART	5.527	0.306	26.106	1.275	9.825*	2.006	-21.448*	-1.983
BICYCLE	-29.436*	-2.485	22.932*	1.711	5.295*	1.651	9.300	1.314
R^2	0.38567		0.22660		0.25761		0.19926	
F	7.981		3.725		4.4119		3.1638	
Sig	0.0000		0.0000		0.0000		0.0001	

(continued)

Table 14.10—Continued

Variable	Purchased Food b	Purchased Food t	Consumer Goods b	Consumer Goods t	Fuel and Energy b	Fuel and Energy t	Building and Construction b	Building and Construction t
Constant	7.111*	2.062	0.888	1.157	-7.779	-1.510	14.379*	1.808
LOGCP	-0.604*	-1.888	-0.019	-0.271	1.183*	2.477	0.420	0.570
LOGN	-1.708*	-2.299	0.106	0.644	0.964	0.870	0.430	0.251
SEX	-0.969	-1.436	-0.088	-0.590	-0.919	-0.912	1.995	1.282
CHILD	1.930	0.949	-0.552	-1.219	1.971	0.649	-1.091	-0.233
YOUTH	0.421	0.207	0.179	0.395	4.861	1.600	0.846	0.180
WOMEN15	-1.684	-0.749	-0.511	-1.021	3.733	1.111	-2.644	-0.510
EDUCHH	-0.009	-0.105	0.005	0.259	-0.041	-0.301	-0.421*	-1.973
FARM	0.304	1.289	-0.063	-1.201	-0.196	-0.555	0.459	0.843
CONSERVD	0.005	0.071	0.007	0.432	-0.048	-0.474	-0.187*	-1.750
MOTORCAR	-0.065	-0.005	4.877*	1.772	7.439	0.392	-55.225*	-1.884
TRACTOR	-47.949*	-1.981	-4.642	-0.861	22.180	0.613	-15.246	-0.273
MCYCLE	18.274	0.707	3.098	0.538	10.286	0.267	-159.556*	-2.678
OXCART	-3.966	-0.998	-1.389	-1.569	1.624	0.274	-16.277*	-1.776
BICYCLE	1.673	0.643	-0.410	-0.709	1.146	0.295	-10.509*	-1.751
R^2	0.12286		0.09496		0.8603		0.11960	
F	1.78091		1.334		1.1968		1.72717	
Sig	0.0445		0.1913		0.2813		0.0537	

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission monthly survey, Eastern Province, Zambia, 1985/86.

Note: b is the regression coefficient; t is the t-statistic.

* Significant at the 0.05 level.

The size of the household has a positive and significant effect on the share of building and construction in the budget, but a negative effect on the share of postage.

The proportion of children between the ages of 5 and 14 has a negative and significant effect on the share of the budget that goes to building and construction and a positive and significant effect on the share that goes to consumer goods.

Within a settlement, the average number of motorcars owned per household has a negative effect on the share of purchased food, fuel and energy, and transportation. It has a positive effect, however, on the share of education. The negative relation between number of cars and transportation might occur because households generally prefer to ride in private cars than to take public transportation.

The average number of tractors owned has a positive impact on the share of the budget going to purchased food, but a negative impact on the share going to building and construction, consumer goods, fuel and energy, and postage. The average number of motorcycles owned has a negative impact, similar to the impact of the number of motorcars, on the share going to purchased food and transportation. Owning an oxcart also has a negative relationship with transportation and with building and construction. A majority of households own bicycles, and regressions show that the number of bicycles owned has a positive and significant effect on purchases of consumer goods and fuel and energy, but a negative and significant effect on purchases of food and transportation.

As expected, the variable of distance to the nearest consumer service center has a negative and significant effect on the share of consumer goods, fuel and energy, and transportation services. If the nearest consumer service center were less accessible, however, more of the household's cash would be spent on building and construction, rather than on other goods and services.

Marginal Consumer Item Purchases with Respect to Distance

To evaluate the impact that the distance between the household and the nearest consumer service has on consumer purchases, purchase elasticities and marginal purchases with respect to distance were calculated for the type of services that exhibited negative and significant relationships between distance and purchase.

An increase in the distance to the nearest consumer service center was expected to produce a decrease in the purchases of some items; this appears to be true for the services reported in Table 14.11. An

increase of 1 kilometer in distance would decrease the purchase of consumer goods by K 0.47 per capita, fuel and energy by K 0.38 per capita, and transportation by K 0.31 per capita. All the elasticities are considerably less than 1.

Demand for Nonlabor Production Factors

With these equations an attempt was made to estimate the impact that distance (access) and mode of transportation have on the demand for those agricultural services that sell inputs, rent implements, and provide credit.

The value of a purchased production factor is modeled by the formula a + b LOGN + c SEX + d CHILD + e YOUTH + f WOMEN15 + g EDUCHH + h FARM + i PRODIST + j MOTORCAR + k TRACTOR + l MCYCLE + m OXCART + n BICYCLE. Table 14.12 describes the variables used in the input and output regressions, and Table 14.13 contains the coefficients for the three equations.

Table 14.11—Elasticity and marginal consumer purchases with respect to distance in Eastern Province, Zambia

Type of Service	Elasticity	Marginal Consumer Purchase per Capita
	(percent)	(kwacha per kilometer)
Consumer goods	-0.046	-0.474
Fuel and energy	-0.416	-0.378
Bus and transportation	-0.430	-0.314

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission monthly survey, Eastern Province, Zambia, 1985/86.

Table 14.12—Description of variables used in regressions for inputs and output in Eastern Province, Zambia

Variable	Definition	Mean
Dependent		
OUTPUT	Maize marketing by household (kwacha)	910.36
INPUT	Purchase of agricultural inputs by household (kwacha)	314.54
TOOL	Rental of agricultural implements by household (kwacha)	23.26
CREDIT	Borrowing of agricultural credit by household (kwacha)	47.51
Independent		
LOGN	Natural log of family size	1.65
SEX	Gender of head of household (male=1, female=0)	0.70
CHILD	Proportion of household members less than 5 years old	0.20
YOUTH	Proportion of household members 6-14 years old	0.23
WOMEN15	Proportion of household members more than 15 years old who are female	0.31
EDUCHH	Education of head of household (1-7 years)	3.57
FARM	Cultivated land (hectares)	2.49
PRODIST	Distance to nearest production factor service center (kilometer)	11.96
OUTDIST	Distance to nearest output market center (kilometers)	9.88
MOTORCAR	Average number of motor cars owned per household in the branch	0.01
TRACTOR	Average number of tractors owned per household in the branch	0.01
MCYCLE	Average number of motorcycles owned per household in the branch	0.01
OXCART	Average number of oxcarts owned per household in the branch	0.16
BICYCLE	Average number of bicycles owned per household in the branch	0.63

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission monthly survey, Eastern Province, Zambia, 1985/86.

Table 14.13—Regression coefficients for purchases of inputs, rental of agricultural implements, and demand for loans equations in Eastern Province, Zambia

Variable	Purchase of Agricultural Inputs		Rental of Agricultural Implements		Demand for Agricultural Loans	
	b	t	b	t	b	t
Constant	-1657.425	-2.946*	-27.949	-0.346	174.668	1.431
LOGN	69.665	0.516	-24.052	-1.242	12.997	0.444
SEX	59.108	0.486	9.565	0.549	-0.47	-0.018
CHILD	309.159	0.833	9.693	0.182	83.366	1.035
YOUTH	67.844	0.184	34.863	0.660	-11.510	-0.144
WOMEN15	86.700	0.212	-22.869	-0.389	47.510	0.535
EDUCHH	8.386	0.514	3.761	1.608	5.243	1.482
FARM	212.400	5.028*	17.015	2.808*	8.872	0.968
MOTORCAR	-5085.818	-2.223*	-309.557	-0.943	-984.099	-1.982*
TRACTOR	2827.864	0.626	-33.047	-0.051	4025.730	4.106*
MCYCLE	-6879.215	-1.625	1793.271	2.954*	-1561.868	-1.701*
OXCART	2534.701	3.433*	203.750	1.924*	-441.624	-2.757*
BICYCLE	781.672	1.862*	3.524	0.059	-186.477	-2.047*
PRODIST	-31.359	-3.780*	-0.615	-0.517	-3.214	-1.786*
R^2	0.31011		0.15863		0.18992	
F	6.120		2.567		3.192	
Sig	0.0000		0.0028		0.0002	

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission monthly survey, Eastern Province, Zambia, 1985/86.

Note: b is the regression coefficient; t is the t-statistic.

* Significant at the 0.05 level.

Demand for Purchased Inputs, Rented Implements, and Financial Loans

R^2 is 0.310 for the input demand equation, 0.159 for the implement demand equation, and 0.190 for the credit demand equation, with F values of 6.120, 2.567, and 3.192, respectively. The amount of cultivated land held by the household positively and significantly influences the level at which it purchases inputs and rents implements. As expected, the distance to the nearest producer service center negatively and significantly influences the household's level of purchasing inputs and borrowing credit. The average number of motorcycles owned has a positive effect on the rental of implements, but a negative effect on the amount of credit demanded. The average number of oxcarts owned shows a positive effect on the demand for inputs and implements, but a negative effect on the demand for credit. The number of bicycles owned has a positive and significant impact on the demand for inputs, but a negative one on the demand for credit. The average number of motorcars owned has a negative influence on the demand for input and credit.

Demand for Output Services

The demand for output services equation estimates the impact that distance (access) to output market and the availability of particular modes of transportation have on the demand for output services such as agricultural marketing. In this equation, gross revenue equals a + b LOGN + c SEX + d CHILD + e YOUTH + f WOMEN15 + g EDUCHH + h FARM + i OUTDIST + j MOTORCAR + k TRACTOR + l MCYCLE + m OXCART + n BICYCLE. Total gross revenue refers to the income from the sale of maize; independent variables are similar to those in the input demand equations. See Table 14.12; Table 14.14 contains the coefficients for the equation.

The dependent variable in the equation measuring the demand for output marketing services is income from the sale of maize. Higher gross revenue would, it is argued, indicate the existence of greater demand for output marketing services.

The level of education attained by the head of household influences marketing in a positive and significant manner; both the size of the landholding cultivated and the average number of tractors owned per household have a positive and significant impact on the sale of maize, as expected. The distance to the nearest marketing service influences the sale of maize negatively and significantly. For some unexplained reason, the average number of motorcars owned is also negative and significant.

Table 14.14—Regression coefficients for output equation, Eastern Province, Zambia

Independent Variable	b	t
Constant	-1,013.71850	-0.999
LOGN	26.38902	0.097
SEX	44.28347	0.174
CHILD	-59.64259	-0.074
YOUTH	22.13963	0.028
WOMEN15	-326.54100	-0.368
EDUCHH	72.01554	2.136*
FARM	336.10308	6.589*
OUTDIST	-52.38934	-3.568*
MOTORCAR	-19,730.19800	-3.246*
TRACTOR	25,294.05119	2.665*
MCYCLE	-12,035.86938	-1.353
OXCART	2,188.61816	1.497
BICYCLE	79.59955	0.113
R^2	0.24175	
F	7.13675	
Sig	0.0000	

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission monthly survey, Eastern Province, Zambia, 1985/86.

Note: b is the regression coefficient; t is the t-statistic.

* Significant at the 0.05 level.

Nonlabor Production Factors, Output, and Distance

To evaluate how the demand for production factors and the supply of maize output respond to a marginal change in distance, elasticities and marginal values of these variables with respect to distance were calculated and listed in Table 14.15 for the regressions whose

coefficients for distance are negative and significant. With the exception of renting implements, the demands for production factors and output marketing are negatively and significantly influenced by distance. A 1-kilometer increase in distance decreases the value of agricultural input purchasing by K 31.36, credit borrowing by K 3.21, and maize marketing by K 52.39. Input purchasing, with an absolute value of 1.19, has the highest elasticity.

POLICY IMPLICATIONS AND RECOMMENDATIONS

The analyses in the preceding pages clearly demonstrate that a negative and significant relationship exists between access to and use of certain services. For these services, improved access would increase the amount of household purchases.

Improving the availability of vehicles would influence the use of production factors, the sale of output, and the demand for goods and services such as purchased food, consumer goods, fuel and energy, building and construction, postage, education, and bus transportation.

Households that are in the plateau and have more land spend more of their current cash income on most consumer services than households that are in the valley and have less land.

Table 14.15—Elasticity and marginal factor purchases of services with respect to distance, Eastern Province, Zambia

Type of Service	Elasticity	Marginal Consumer Purchases per Household
	(percent)	(kwacha per kilometer)
Purchases of agricultural inputs	-1.192	-31.359
Demand for agricultural credit	-0.809	-3.214
Marketing of maize	-0.569	-52.389

Source: International Food Policy Research Institute, Rural Development Studies Bureau, Eastern Province Agricultural Development Project, and National Food and Nutrition Commission monthly survey, Eastern Province, Zambia, 1985/86.

Demand linkages of rural households are weak, and the total rural economy is poorly integrated in Eastern Province. Improving access to rural service infrastructure does, however, have a role to play in strengthening these household demand linkages.

The access of rural households to specific groups of goods and services as well as to infrastructural services related to agriculture should be improved in Eastern Province, Zambia. Furthermore, improving the modes of transportation currently available in rural areas should be planned to encourage rural households to become active participants in the regional economy. The findings of this study also have implications for improving the system of distributing goods and services in the region.

Policy interventions to improve the efficiency of public expenditures are a major plank of the Zambian government's structural adjustment program, and rural service infrastructure is a major area of public expenditure in Zambia. Making these public investments more efficient by making them more available and better managed would help address the issues of structural adjustment.

A full analysis, which would study the supply of goods and services, would provide a more complete picture not only of what is needed and where, but of what is available and where. The analysis of supply could then be juxtaposed with the analysis of demand and used to identify the locational priorities of public sector investments in rural service infrastructure. This would help make those investments more effective and efficient.

APPENDIX 1: MAIN GROUPS OF SERVICES USED IN EASTERN PROVINCE, ZAMBIA

Health
- Clinic
- Other

Postal communication
- Postage
- Other

Credit and finance
- Cooperative union
- Zambia National Bank
- Post Office Bank
- Agriculture Finance Corporation
- Zambia Agriculture Development Bank
- Barclays Bank
- Other

Bus and transportation
- To board a bus
- To board a car or private truck
- Other

Agricultural purchases
- Tools and implements
- Sprayers
- Dusters
- Threshers
- Hand millers
- Tractors
- Other

Hiring of agricultural implements
- Tools and implements
- Sprayers
- Dusters
- Threshers
- Hand millers
- Tractors
- Scotch carts or vehicles
- Other

Servicing of agricultural implements
- Tools and implements
- Sprayers
- Dusters
- Threshers
- Hand millers
- Tractors
- Scotch carts or vehicles
- Other

Agricultural inputs
- Fertilizer
- Pesticide
- Seed
- Other

Veterinary
- Veterinary dispensary
- Dips and quarantine
- Other

Agricultural extension

Marketing and sales
- Maize
- Rice
- Cotton
- Groundnuts
- Sunflower
- Other oilseed
- Other

Retail services
- Blacksmiths
- Carpenters
- Retail cloth and ready-made garments
- Household utensils
- Pharmacies
- China and glassware
- Charcoal braziers
- Electrical goods and repair

Footwear
Bicycle purchase
Bicycle repair
Timber and planks
Wood for fuel
Whitewash
Hardware and fences
Wooden furniture
Stationery, books, and school uniforms
Watch purchase and repair
Photo studios
Auto and tractor repair
Paraffin, petrol, diesel, and other lubricants
Beds, mattresses, and linens
Soft drinks
Local brew
Mosi (beer)
Purchase of
    Vegetables
    Fruits
    Poultry products
    Dairy products
    Meat products
    Tobacco
Other

APPENDIX 2: ITEM OR SERVICE USED AND THE NUMBER OF HOUSEHOLDS MAKING THE PURCHASE AND REPORTING DISTANCE IN EASTERN PROVINCE, ZAMBIA

Service and Item Used	Number of Households: Making the Purchase	Number of Households: Reporting the Distance to Related Services
Purchased food	193	181
Other consumer goods	187	181
Clothes		
Cloth and sewing supplies		
Repairs to clothes		
Linens and towels		
Blankets		
Other cloth and wool		
Shoes		
Repairs		
Purchases		
Tobacco and cigarettes		
Abattoir costs		
Jewelry		
Stationery		
Toothbrush and toothpaste		
Soap		
Detergents		
Disinfectants		
Creams and vaseline		
Razor blades		
Cosmetics		
Glassware and china		
Kitchen utensils		
Repairs		
Purchases		
Brushes and brooms		
Wooden furniture		
Repairs		
Purchases		

(continued)

APPENDIX 2—Continued

Service and Item Used	Number of Households: Making the Purchase	Number of Households: Reporting the Distance to Related Services
Metal furniture		
Repairs		
Purchases		
Radios		
Repairs		
Purchases		
Other electrical appliances		
Repairs		
Purchases		
Bicycle		
Repairs		
Purchases		
Bed mattresses		
Watches and clocks, repairs		
Photographs		
Small tools		
Repairs		
Purchases		
Automobile and tractor repairs		
Other machinery repairs		
Fuel and energy services	178	154
Candles		
Paraffin		
Charcoal		
Firewood		
Matches		
Stoves and braziers		
Fuel, oils, and lubricants		
Education	92	40
Schooling, fees, travel		

(continued)

APPENDIX 2—Continued

Service and Item Used	Number of Households: Making the Purchase	Number of Households: Reporting the Distance to Related Services
Health services Clinics and hospitals Medicines	101	69
Postal services Postage	182	29
Building and construction Timber and planks Whitewash and paints Hardware, nails, and wire Bricks Thatch Ropes Payments to others to repair or construct a home	118	93
Transportation Bus and minivan fare	146	43
Inputs Fertilizers Maize seeds	145	95
Rental of implements Oxen Tractors Lorries Other machines Machinery services	122	38
Credit services Cooperative fees Repayment of loans	60	31

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15
Improving Agricultural Extension to Small Farms

Neal Bliven

The following analysis of data collected by the International Food Policy Research Institute, the Rural Development Studies Bureau, the Eastern Province Agricultural Development Project, and the National Food and Nutrition Commission is intended to suggest policies that extension administrators and policymakers should consider for improving agricultural extension to small farms in Eastern Province, Zambia. Particular attention is given to the training and visit (T&V) extension system in light of the goals of the government's new economic recovery program, which seeks, among other things, to balance the budget by freezing government employment and improving administrative efficiency.

INTRODUCTION OF THE TRAINING AND VISIT SYSTEM TO EASTERN PROVINCE

In 1978 the Ministry of Agriculture and Water Development adopted a new model for providing extension services to small farms: the training and visit system. The Eastern Province Agricultural Development Project, which became operational in 1982 and whose functions were absorbed by the Ministry's Provincial Planning Unit in 1988, introduced T&V into Zambia's Eastern Province.

During the 1982/83 agricultural season, the project made overall assessments and plans. In 1983/84 it introduced T&V to Chipata South and Katete agricultural districts. The new system was implemented in Chipata North, Chadiza, and Lundazi districts in 1984/1985; and in Chama, Mambwe, Petauke, and Nyimba in 1985/86. By 1986/87 Eastern Province was officially covered by the new system.

The province's 9 agricultural districts are divided into 33 blocks, which are subdivided into 147 camps. Overall control is exercised by a provincial agricultural officer, who is a staff member of the Ministry of Agriculture and Water Development. District agricultural officers are in charge at the district level.

The system comprises several levels. At the top is a team of subject matter specialists who have been trained at graduate school and

are stationed at the provincial headquarters in Chipata. This provincial team advises district training teams, which, in turn, advise block supervisors. Block supervisors then relay the material to extension workers in camps, and each of these extension workers organizes and advises approximately eight contact farmer groups. Contact farmer groups consist of around 12 members, who presumably pass the information on new technology to their friends and neighbors. Some information might be lost as the information passes through the levels, but intermediate communicators are supposed to make the information more understandable to the intended audience (Leonard 1977, 138).

The information transmitted through the system is supposed to address the priorities of small farmers and the constraints that they face. Recommendations are generated from on-farm testing of appropriate technologies and, as appropriate for the time of year, are included in monthly bulletins produced by subject matter specialists. Ideally, every two weeks, extension workers spend a day meeting with their contact farmer groups to discuss these recommendations. The responses and concerns of the farmers are then transmitted back up the communication ladder, if all works as planned.

According to the project's estimates (Eastern Province Agricultural Development Project, Research and Evaluation Unit 1985, 5), in 1985 Eastern Province had approximately 1 contact farmer group for every 900 farm families, or theoretically up to 1 contact farmer for every 75 small farms. In contrast the ratio of extension field staff to farm families was probably around 1:300. These ratios vary by district, especially for contact farmer groups since they had not been formed as of 1985 in Chama, Mambwe, Petauke, and Nyimba agricultural districts.

Information on the technical assistance received each month by 314 sample farmers during November 1985 through November 1986 was collected for this study. More in-depth questions were asked of 83 members of contact-farmer groups in May and June 1986. A similar one-time survey was administered to 288 noncontact farmers. Moreover, an inventory of household resources was conducted in September 1985.

Monthly samples were drawn from 10 clusters of villages, called branches, in Eastern Province's nine agricultural districts; contact farmers appeared in half of the branches (Mphata in Mambwe agricultural district, Chipili in Chadiza, Mtenthela in Chipata North, Makangila in Chipata South, and Chaweya in Lundazi). Additional contact farmers were randomly sought to increase the number of observations for the May and June analysis, which increased the

number of branches with contact farmer observations by two (Kasendeka in Lundazi and Sinda in Chadiza). Contact farmers were not found in the three remaining sample branches (Nkhoka in Chama, Chiwizi in Petauke, and Kamwala in Nyimba).

Contact farmers had become members of contact farmer groups only recently. The highest mean length of membership was 22 months for Chaweya, which is significantly higher than that of the six other branches.

Contact farmers were mostly selected by extension workers or elected by village residents; the remaining farmers were selected by village heads or in some unspecified way. The method of selection is statistically significant by branch.

Binary choice, logit analysis[1] reveals that distance from the provincial headquarters in Chipata affects the probability that a farmer will become a contact farmer. Farmers who are located far from the provincial headquarters are less likely to become contact farmers than farmers who are located near the headquarters (see Table 15.1). Also more educated farmers are slightly more likely to be recruited. The influence of distance is not statistically significant when other influences in the branch are also considered (by including dichotomous, explanatory variables to capture the general effect of each branch and to check the validity of making inference from a stratified, clustered sample). The influence of education is more certain and parallels the findings in Botswana about the effect of schooling on farmers volunteering to participate in a pupil-farmer scheme (Lever 1970). For a typical farmer in Kasendeka branch (who is, incidentally, a female), the impact of increasing her education to achieve the Eastern Province's goal of nine years (Shula 1988) or of decentralizing the administration of T&V from the provincial headquarters to the agricultural district headquarters would be minimal according to simulations based upon the regression results (see Table 15.2).

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[1] R. S. Pindyck and D. L. Rubinfeld (1981, Chap. 8) present a clear introduction to binary choice theory, including logit models. On the right-hand side of the models specified for Eastern Province, no variables are linearly correlated to a high degree, but theoretically neither are they completely independent of one another. Even the variables that are not completely independent are included to avoid omitting relevant, predetermined (exogenous and implicitly lagged endogenous) explanatory variables. This may affect the accuracy of the estimations.

Table 15.1—Regression results for the probability that a farmer will become a contact farmer

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Coefficient	t-ratio
Farmer's age (years)	0.009	0.612
Farmer's education (years)	0.208	2.547*
Farmer's sex (1 = female, 0 = male)	-0.451	-0.657
Branch culture (1 = patrilocal, 0 = matrilocal)	-0.842	-1.099
Number of years T&V has been in the district	-0.315	-0.409
Access of the branch to the district headquarters by road (kilometers)	-0.092	-1.018
Access of the branch to the provincial headquarters by road (kilometers)	-0.015	-3.172
Prediction accuracy (percent)	94	
Sample size (number)	302	
Log-likelihood	-51.989	
Restricted log-likelihood (slopes = 0)	-65.425	
Chi-squared (6)	26.871	
Level of significance	0.000	

* Statistically significant at the 0.05 level in general and branch explicit equations.

The estimation of ordinary-least-squares models for a set of 75 contact farmers suggests that the method of selection is not a statistically significant determinant of the level of education at which farmers are more likely to be recruited (four years of education contrasted with three years for a typical noncontact farmer). Because of equitability and compatibility considerations, recruiters should, perhaps, be instructed to recruit typical farmers. The tendency for more educated farmers to join contact farmer groups is, however, only slight,

Table 15.2—Simulation results for the probability that a farmer will become a contact farmer in Kasendeka Branch (Lundazi Agricultural District)

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Typical x	Typical bx
Farmer's age (years)	40	-0.3740932
Farmer's education (years)	3	0.6238920
Farmer's sex (1 = female, 0 = male)	1	-0.4509830
Branch culture (1 = patrilocal, 0 = matrilocal)	1	-0.8416840
Number of years T&V has been in the district	2	-0.6305480
Access of the branch to the district headquarters by road (kilometers)	30	-2.7550920
Access of the branch to the provincial headquarters by road (kilometers)	195	-3.1321095
BX	-7.5606177	
Sample size (number)	30[a]	

Probability	Scenario
0.0005	typical
0.0018	typical, but education increased to nine years
0.0073	typical, but provincial administration is decentralized to district headquarters
0.0250	typical, but education is increased and administration is decentralized

[a] Used to calculate means or modes as appropriate for a typical case.

and education may actually enhance the communication process more than education disparities harm it.[2]

Most noncontact farmers surveyed during May and June 1988 were not even aware that contact groups were forming and members were being selected. The pattern by branch is statistically significant. Logit analysis indicates that noncontact farmers are more likely to be aware that farmer groups are being formed if they live closer to Chipata or in a patrilocal community than if they live farther or in a matrilocal community (see Table 15.3); however, the sign changes for patrilocal communities when branch effects are included. The effect of patrilocal culture (communication channels, land tenure, and decision-making, for example) needs to be researched further and other branch-specific factors need to be separated out before all the implications for policy can be discerned. But it seems clear that greater ease of communication,[3] supervision, or both enhance the community's knowledge about extension initiatives such as the formation of contact groups. A simulation exercise suggests, for example, that decentralizing the functions of T&V administration from the provincial to the district headquarters would increase the probability that a typical Kasendeka farmer would know that a group is forming from 10 percent without decentralization to 22 percent with decentralization (see Table 15.4). Substantial, early participation in an extension program would not be expected if awareness about a program's introduction was limited.

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[2] A study by Leonard (1977, 25, 102), which focused primarily on extension workers, found that Kenyan extensionists put forth more "visit effort" as their level of education rises until a peak corresponding to five years of schooling is reached. Since a school day in Eastern Province consists of only two hours of academic instruction, years of schooling probably cannot be compared in Kenya and Zambia. Although the method of selection does not seem to affect the level of education represented, some selection methods may fit better with the traditional African value of "collective progress" than others (Belloncle 1989, 38).

[3] Ownership of a radio or bicycle may also be a proxy for ease of communication. Since some groups were forming before September 1985, when the inventory of household resources was conducted, the criterion of time priority for causality precludes testing with the survey data for the effect of bicycles or radios on awareness.

Table 15.3—Regression results for the probability that a noncontact farmer will become aware in a timely fashion that a group of contact farmers is forming

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Coefficient	t-ratio
Farmer's age (years)	0.002	0.255
Farmer's education (years)	0.065	1.242
Farmer's sex (1 = female, 0 = male)	-0.613	-1.497
Branch culture (1 = patrilocal, 0 = matrilocal)	1.102	2.537
Number of years T&V has been in the district	-0.294	-0.956
Access of the branch to the district headquarters by road (kilometers)	-0.042	-1.859
Access of the branch to the provincial headquarters by road (kilometers)	-0.006	-2.485*
Prediction accuracy (percent)	79	
Sample size (number)	268	
Log-likelihood	-115.460	
Restricted log-likelihood (slopes = 0)	-133.270	
Chi-squared (6)	35.623	
Level of significance	0.000	

* Statistically significant at the 0.05 level in general and branch explicit equations.

MAIN SOURCES OF EXTENSION

The formation of T&V contact farmer groups does not preclude the use of other extension methods (Benor and Harrison 1977, 31). Other channels available to farmers in Eastern Province include radio, friends or relatives, cooperatives, parastatal extensionists, demonstrations, as well as direct contact with extension workers from the Ministry of Agriculture and Water Development.

Table 15.4—Simulation results for the probability that a noncontact farmer will become aware in a timely fashion that a group of contact farmers is forming in Kasendeka Branch (Lundazi Agricultural District)

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Typical x	Typical bx
Farmer's age (years)	40	0.0951176
Farmer's education (years)	3	0.1950807
Farmer's sex (1 = female, 0 = male)	1	-0.6132670
Branch culture (1 = patrilocal, 0 = matrilocal)	1	1.1024200
Number of years T&V has been in the district	2	-0.5882080
Access of the branch to the district headquarters by road (kilometers)	30	-1.2641190
Access of the branch to the provincial headquarters by road (kilometers)	195	-1.1378581
BX	-2.2108338	
Sample size	30[a]	

Probability	Scenario
0.0005	typical
0.0018	typical, but education increased to nine years
0.0073	typical, but provencial administration is decentralized to district headquarters
0.0250	typical, but education is increased and administration is decentralized

[a] Used to calculate means or modes as appropriate for typical cases.

Logit analysis does not reveal statistically significant influences on a contact farmers' choice of a principal source of information. The percentage of contact farmers who have an extension worker as their main source of information is comparable to the 80 percent reported for T&V regions in India (Feder, Slade, and Sundaram 1985, 24). Over half of the contact farmers in each of the seven branches where contact farmers were found identify meetings with the ministry's extension workers as the principal source of information. Differences among the branches are not statistically significant. Although some rely principally on the extension worker's visits to his or her plot, radio broadcasts,

and conversations with other farmers or parastatal employees, as a whole contact farmers receive most of their agricultural extension in group meetings.

Noncontact farmers, on the other hand, report a variety of main sources, and these differ significantly by branch. In Chiwizi and Makangila more than 90 percent of noncontact farmers receive information, and the majority report friends and relatives as being the main source of that information. Radio is the most important source in Mtenthela and Sinda. Friends and relatives, other extensionists, and radio are the chief sources in Nkhoka. Extension workers, followed by friends and relatives, are the major sources for noncontact farmers in Chaweya. Only one-quarter of the noncontact farmers in Mphata have received information on improved agricultural practices, mostly from the radio and the contact farmers. In the other three branches noncontact farmers rely mainly on friends and relatives. In India, by way of contrast, 54 percent of noncontact farmers in states with a T&V system of extension reportedly rely on extension workers, 20 percent on other farmers, and 8 percent on other sources; 18 percent have no main source of information (Feder, Slade, and Sundaram 1985, 24).

Among noncontact farmers, females tend to have a lower probability of receiving agricultural extension than males, and more educated farmers have a higher probability of receiving information than less educated ones (see Table 15.5). Radio ownership and education contribute to the choice of radio as the main source of extension (see Table 15.6). Owning a radio has, however, a negative impact on the probability that contact farmers will be the chief source, which suggests that competition exists between T&V extension and radio broadcasts;[4] owning a bicycle encourages farmers to rely primarily on contact farmers (Table 15.6), which probably indicates that improved forms of personal transportation are important for improving use of local communication systems. Other statistically significant variables that may influence a farmer to choose a contact farmer or a radio as the main source of information seem to capture

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[4] Feder, Slade, and Sundaram (1985, 21) view the consistent share that radio has as a main source of information in both a T&V and non-T&V area of India to indicate that radio extension complements T&V. In the less densely populated Zambian setting radio appears to be the preferred alternative to at least one aspect of T&V, specifically, the channeling of communication through contact farmers.

Table 15.5—Regression results for the probability that a non-contact farmer will receive information on improved agricultural practices from any source

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Coefficient	t-ratio
Noncontact farmer's sex (1 = female, 0 = male)	-0.587	-2.047*
Noncontact farmer's age (years)	-0.010	-1.136
Noncontact farmer's education (years)	0.101	2.208*
Household size (number of persons)	0.017	0.298
Number of sick days per household member from November through April	-0.018	-0.883
Branch culture (1 = patrilocal, 0 = matrilocal)	0.088	0.269
Number of years T&V has been in the district	0.198	0.966
Access of the branch to the district headquarters by road (kilometers)	0.008	0.686
Access of the branch to the provincial headquarters by road (kilometers)	-0.001	-0.484
Household ownership of a bicycle (1 = yes, 0 = no)	-0.141	-0.474
Household ownership of a radio (1 = yes, 0 = no)	0.230	0.679
Prediction accuracy (percent)	63	
Sample size (number)	252	
Log-likelihood	-162.570	
Restricted log-likelihood (slopes = 0)	-174.030	
Chi-squared (10)	22.927	
Level of significance	0.011	

* Statistically significant at the 0.05 level in general and branch explicit equations.

Table 15.6—Regression results for the probability that a noncontact farmer will have a contact farmer or a radio as the main source of information on improved agricultural practices

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Contact Farmer Coefficient	Radio Coefficient
Noncontact farmer's sex (1 = female, 0 = male)	0.361	-1.030*
Noncontact farmer's age (years)	-0.022	-0.027
Noncontact farmer's education (years)	-0.111	0.200**
Number of persons in the household	-0.116	0.205*
Number of sick days per household member from November through April	-0.100	0.061*
Branch culture (1 = patrilocal, 0 = matrilocal)	0.499	-0.202
Number of years T&V has been in the district	0.098	-1.759*
Access of the branch to the district headquarters by road (kilometers)	-0.026	0.063*
Access of the branch to the provincial headquarters by road (kilometers)	-0.010*	-0.020*
Household ownership of a bicycle (1 = yes, 0 = no)	2.004**	0.820
Household ownership of a radio (1 = yes, 0 = no)	-2.389**	1.172**
Prediction accuracy (percent)	94	90
Sample size (number)	252	252
Log-likelihood	-42.790	-62.990
Restricted log-likelihood (slopes = 0)	-56.865	-91.986
Chi-squared (10)	28.150	57.992
Level of significance	0.002	0.000

* Statistically significant at the 0.05 level in general equation only.
** Statistically significant at the 0.05 level in general and branch explicit equations.

branch-specific information, so their influence is uncertain. Regressions do not show statistically significant results for the choice of extension workers, parastatal workers, friends and relatives, or demonstration plots as the primary source of agricultural extension.

In Kasendeka branch 40 percent of the households receive extension information from some source, and simulating the probability that a typical Kasendeka household will receive information generates a value of 42 percent. Simulations also suggest that if females could be more effectively included in the extension process or education could be increased to nine years the probability of receiving extension information would rise to 56 or 57 percent. If both could be achieved, a typical Kasendeka farmer might have a 70 percent chance of receiving extension information.

Radio is not a main source of information in Kasendeka, but simulation shows that a typical farmer might have a 2 percent likelihood of having a radio as her main source if her level of education were improved or radios were provided. The combined effect would increase the probability to 7 percent.

Providing radios to typical Kasendeka noncontact farmers would probably, however, reduce their reliance on contact farmers from 12 to 1 percent, and one-third already own radios. Just over half of the Kasendeka households have bicycles, but a typical farmer without a bicycle would have only a 2 percent chance of using contact farmers as the main source of extension information. The presence of bicycles and radios have important ramifications for the training and visit system of extension in branches like Kasendeka.

Governments should consider implementing extension systems that are less demanding than T&V in their use of human and financial resources (Chivunda 1986, 28), particularly in areas with low farm densities (Stevens and Jabara 1988, 315-316). Logit analysis suggests that, when selecting among the available extension services, farmers also consider personal resources that might lessen the costs of communication (such as radios and bicycles) or increase their ability to communicate (such as education). The results support the expectation that education generally encourages and facilitates a person's desire to learn ways to improve his or her standard of living (Lever 1970, 18).

Stevens and Jabara (1988, 317) suggest that some communication systems discriminate against certain groups of receivers and that biases can be alleviated by employing less discriminatory channels of communication. For the branches studied in Eastern Province, less discriminatory channels do not exist. Although the majority of Zambian subsistence farmers who receive advice from extension services

oriented to cash crops are female (Nkole 1986, 43), logit analysis does not show that females favor cash-crop parastatals or any other source of information.[5] Concerns that a T&V approach excludes women from receiving general extension services (Chivundi 1986, 28; Phiri 1986, 49) probably should be broadened to a concern that extension systems in general are not used by the one-third of Zambian farm families headed by women (Chivunda 1986, 35).

Education levels should be increased to encourage greater use of available extension services, and the acquisition of bicycles or radios facilitated, depending on the method of extension preferred by policymakers (and perhaps farmers). Above all, females should be more effectively included in the extension process.

QUANTITY AND QUALITY OF EXTENSION CONTACT

Contact farmers—20 in all—appeared in only 5 of the 10 sample branches. Between November 1985 and October 1986 each contact farmer only met a maximum of 13 times with extensionists, including agents from the Lint Company (cotton and soybeans) and the National Tobacco Company (tobacco), as well as agricultural extension workers from the Ministry of Agriculture and Water Development. Most met with extension workers a few times, but in one branch, five of the six contact farmers never met with any worker, and the one who did, met with him only once.

These findings indicate that extension workers and contact farmers meet less often than is envisioned under the T&V model, even though the percentage of contact farmers meeting with extensionists, with the exception of Chipili, compares favorably with that of other countries, where two-thirds to almost all contact farmers meet with extension agents (Feder, Slade, and Sundaram 1985, 8).

During the months of November 1985 through October 1986 only a small fraction of the 294 noncontact farmers sampled met with contact farmers, and those visits occurred in only 6 of the 10 branches and during less than half the months. What appears to be a seasonal phenomena could be a start-up lag except that visits were observed in November 1985 and then not until July through October of 1986. The

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[5] The study samples perhaps included too few observations in which parastatals oriented to cash crops are coded as the main source. Thus the hypothesized relationship probably cannot be proved or disproved.

absence of contact does not completely coincide with the November through April rainy season, but it does match the December through June season for growing maize. The percentage of noncontact farmers communicating with contact farmers in the branches and months for which visits were reported range from 3 percent to 13 percent. The system apparently does not have enough contact farmers to cover the population, and farmers may have personal constraints on their time, particularly during the maize growing season.

Some noncontact farmers received advice from contact farmers on the use of fertilizer, preparation of land, harvesting of crops, and use of hybrid seed. A few households received advice more than once between November 1985 and October 1986, but only on the subject of fertilizer use. There were no statistically significant differences among branches in the amount of advice received from contact farmers, for any of the four subjects.

The likelihood that a noncontact farmer would receive extension advice on specific operations, regardless of source, during the survey period was also very small for most branches and subject areas. Hardly any advice was received on animal husbandry, and the advice received on any subject rarely involved more than a few contacts during the year.

Logit analysis reveals that the probability that a household will be advised on specific operations, regardless of source, is significantly affected by the gender of the head of household (see Table 15.7). Other statistically significant factors, including the age of the head of household, the size of the household, and the length of time T&V has been operational in the district, may capture other branch-specific influences, but the variable of gender is robust. Simulating the elimination of sex bias in agricultural extension it is found that the likelihood of being advised increases from 8 percent with bias to 19 percent without bias for a typical Kasendeka household.[6] The statistically significant, general logit equation, the basis of simulation parameters, correctly predicts 81 percent of the 253 sample observations.

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[6] In Kasendeka none of the surveyed households received specific advice between November 1985 and November 1986. All 13 survey months were used for the logit analysis in order to increase the number of observations not valued at zero. Although 40 percent reported having a main source of information prior to the survey in May and June 1986, during the time of the 13-month survey, they did not receive advice on specific operations.

Table 15.7—Statistically significant regression results for the probability that a noncontact farmer will receive specific advice on agricultural operations, by source

Logit equation: $P = 1/(1+e^{-BX})$.

Variable	All Sources	Radio	Extension Worker	Cooperative	Friends and Neighbors
FEMALEHH	-1.044**	-0.700	-2.086**	4.086	-0.596
AGEHHYRS	0.035*	0.015	0.025*	0.081	0.036**
EDUCTN	-0.081	-0.001	0.060	0.414	-0.023
FAMILYSZ	0.173*	0.144	-0.464	0.336	0.083
AVILLDAY	0.015	0.021	0.001	0.193	0.023
PATRILOC	0.1[illegible]	1.701	-1.083	7.796	4.130*
YRSUNDER	-2.431*	-4.157*	-1.554*	-17.724*	-5.671*
RDTOADHQ	0.020	0.045	0.049*	-0.041	-0.018
RDTOCHIP	-0.005	-0.009	-0.013*	-0.046	0.007
OWNBIKE	0.276	0.741	-0.169	3.843	-0.240
OWNRADIO	0.212	-0.062	0.247	-1.404	0.176
CULTSIZE	-0.074	-0.032	-0.115	0.121	-0.032
PERPERHA	-0.005	-0.073	0.011	0.542*	0.292
OXANDHOE	-0.191	2.153*	-0.474	2.198	0.789
HYBRDFRT	0.931	0.749	0.025	10.817*	1.184
FERTONLY	0.309	1.473**	-0.408	-10.064	-0.546

(continued)

Log-likelihood	-100.450	-51.890	-50.872	-11.199	-51.412
Chi-squared	85.274	40.959	38.137	26.742	46.669
Level of significance	0.000	0.000	0.000	0.031	0.000
Prediction accuracy	81	93	92	98	93
Sample size	253	253	253	253	253

Note: The variables are defined as follows: FEMALEHH, farmer's sex (1 = female, 0 = male); AGEHHYRS, farmer's age (years); EDUCTN, farmer's education (years); FAMILYSZ, the number of persons in the family; AVILLDAY, number of sick days per household member from November through April; PATRILOC, branch culture (1 = patrilocal, 0 = matrilocal); YRSUNDER, the number of years T&V has been in the district; RDTOADHQ, access to the branch's district headquarters by road (kilometers); RDTOCHIP, access to the branch's provincial headquarters by road (kilometers); OWNBIKE, family ownership of a bicycle (1 = yes, 0 = no); OWNRADIO, family ownership of a radio (1 = yes, 0 = no); CULTSIZE, farm's cultivated area (hectares); PERPERHA, farm's population density (persons per hectare); OXANDHOE, cultivation technology (1 = ox and hoe, 0 = hoe); HYBRDFRT, the adoption both of hybrids and fertilizer (1 = yes, 0 = no); and FERTONLY, the adoption of fertilizer alone (1 = yes, 0 = no).

* The t-value of the coefficient is significant at the 0.05 level.

** Statistically significant at the level of 0.05 in general and branch explicit equations.

Significant results are not obtained using logit analysis to examine the probability that a noncontact farmer will receive specific advice from contact farmers, demonstrations, or parastatals. Logit analysis does reveal, however, that noncontact farmers who apply fertilizer, but do not plant hybrid maize, are more likely to receive some advice over the radio than are farmers who use neither (see Table 15.8). The statistically significant logit equation accurately predicts 93 percent of the observations, but two additional variables, the use of oxen (positive) and the number of years T&V has been in the district (negative), which are statistically significant in the more general formulation, cease to be significant when branch dummies are included. Simulating a change in the consistently significant variable of fertilizer use suggests that a typical Kasendeka farmer who uses fertilizer but not hybrid maize has a 13 percent likelihood of listening to extension advice on the radio, while a typical farmer who uses neither hybrid maize nor fertilizer has only a 3 percent probability. As more households adopt fertilizer technology, the demand for radio-transmitted extension advice will probably increase. Other extension systems, such as T&V, could endeavor to supply the demanded information as well. Radio has both an advantage and a disadvantage: the cost of providing extension does not increase as the number of listeners increases, but radio listeners cannot provide simultaneous feedback to the source of extension.

Receiving advice from extension workers from the Ministry of Agriculture and Water Development is influenced by the sex of the head of household (Table 15.7). Also statistically significant are the head of household's age (positive), the number of years T&V has been in the district (negative), and the distance by road to the district and provincial headquarters (positive and negative, respectively), but these may capture other branch-specific influences. The tendency of females to participate less than males is small in Kasendeka—a probability of 1 percent for males and 0 percent for females. Of greater concern is the low rate of female participation in agricultural extension regardless of source. The low probability that noncontact farmers will receive advice directly from extension workers is not in itself a concern, since designated contact farmers and other farmers who may be as effective as "official" contact farmers (Benor and Baxter 1984, 49) replace extension workers at the bottom of the T&V structure.

Older heads of household are more likely to rely upon friends and neighbors for advice (Table 15.7). A 40-year-old farmer from Kasendeka is almost twice as likely to receive information from other

Table 15.3—Regression results for the probability that a noncontact farmer will receive specific advice on agricultural operations

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Coefficient	t-ratio
Farmer's sex (1 = female, 0 = male)	-0.936	-1.906*
Farmer's age (years)	0.039	2.926*
Farmer's education (years)	-0.050	-0.702
Number of persons in the family	0.198	2.207
Number of sick days per household member from November through April	0.016	1.046
Branch culture (1 = patrilocal, 0 = matrilocal)	0.272	0.444
Number of years T&V has been in the district	-2.846	-4.889
Access of the branch to the district headquarters by road (kilometers)	0.028	1.494
Access of the branch to the provincial headquarters by road (kilometers)	-0.007	-1.718
Family ownership of a bicycle (1 = yes, 0 = no)	0.193	0.437
Family ownership of a radio (1 = yes, 0 = no)	-0.094	-0.186
Farm's cultivated area (hectares)	-0.115	-1.009
Farm's population density (persons per hectare)	-0.007	-0.152
Cultivation technology (1 = ox and hoe, 0 = hoe)	0.408	0.716
Adoption of both hybrids and fertilizer (1 = yes, 0 = no)	1.146	1.773*
Adoption of fertilizer alone (1 = yes, 0 = no)	0.367	0.569
Main source of information is		
Contact farmer (1 = yes, 0 = no)	0.701	0.712
Friends and neighbors (1 = yes, 0 = no)	0.066	0.129
Demonstration plot (1 = yes, 0 = no)	2.683	1.901
Extension worker (1 = yes, 0 = no)	1.673	2.088*
Parastatal worker (1 = yes, 0 = no)	0.655	0.616
Radio (1 = yes, 0 = no)	1.682	2.796*

(continued)

Table 15.8—Continued

Prediction accuracy (percent)	82
Sample size (number)	253
Log-likelihood	-92.816
Restricted log-likelihood (slopes = 0)	-143.090
Chi-squared (10)	100.550
Level of significance	0.000

* Statistically significant at the 0.05 level in general and branch explicit equations.

farmers as a farmer half her age—5 and 3 percent, respectively.[7] Also, farmers are more likely to receive advice from other farmers if the community is patrilocal rather than matrilocal and less likely if the district has been under T&V for a longer rather than a shorter period of time. More research must be done, however, since the finding on length of time does not hold up when branch influences are included. The finding on patrilocal bias also becomes statistically insignificant when branch dummies are included, whereas the sex of the head of household becomes a significant explanatory factor. A male/female dynamic probably exists that could be examined better using an anthropological approach.

Cooperatives also provide specific advice to a few households, but findings from the statistically significant logit regression do not hold up when branch dummies are introduced. The t-values for the years T&V has been operating and for the use of hybrid maize with fertilizer remain statistically significant (negative and positive, respectively), but the chi-squared statistic is no longer significant at the 0.05 level. Even the t-value for number of family members per hectare (which is positive) ceases to be significant. The findings suggest that research using a single, large nonclustered sample or a large nonstratified sample of clusters should be used for follow-up studies.

Taking another look at the probability that a household will receive specific extension advice, logit analysis in which main sources are predetermined variables reveals that farmers who rely mainly on radios

[7] Although none of the Kasendeka respondents received specific advice from friends and neighbors between November 1985 and November 1986, 30 percent had other farmers as their main source of information before the survey in May and June 1986.

or extension workers for their information are more likely to receive advice on specific operations than those who rely on other sources (Table 15.8). The influence of sex and age are reconfirmed, and farmers who have adopted a technology package of hybrid maize with fertilizer are more likely to receive advice than those who have not. Family size, years under T&V, and distance by road to provincial headquarters are significant, but difficult to separate from other branch-specific factors. The use of demonstration plots as a main source of information has a positive and significant impact in the more general model, but is replaced by the use of parastatal workers as a significant factor in the regressions that include branch dummy variables.

Extension workers and radio broadcasts are equally effective media for insuring that specific advice is received. By relying on either system, a typical Kasendeka farmer has a 24 percent probability of being advised on specific operations. Also, a typical Kasendeka farmer who has not adopted the use of hybrid maize with fertilizer has a 2 percent probability of receiving advice rather than a 6 percent probability. The regression estimated equation on which simulation parameters are based has an 82 percent rate of prediction accuracy.

When asked to identify the best source of additional advice on improved agricultural practices, noncontact farmers overwhelmingly choose extension workers. The exceptions are in Chaweya and Makangila, where over half the respondents think someone other than the ministry's extension workers, village leaders, contact farmers, or other noncontact farmers are best.

Noncontact farmers desiring more advice on chemicals (applying pesticides, weed killers, and fungicides) are more likely to think that the ministry's extension workers, not contact farmers, are the best source of additional advice (see Table 15.9). Logit analysis shows that the probability that noncontact farmers will identify other noncontact farmers or village leaders as the best source is not statistically significant; however, the desire for more information on chemicals negatively affects the view that a source other than extension workers, contact farmers, noncontact farmers, or village leaders is best (see Table 15.10). The desire for more advice on fertilizers also reduces the probability that a noncontact farmer will perceive other sources as best. Other statistically significant factors do not remain significant when branch differences are explicitly included.

Table 15.9—Regression results for the probability that a noncontact farmer will consider an extension worker or contact farmer to be the best source of additional information on improved agricultural practices

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Extension Worker Coefficient	Contact Farmer Coefficient
Main source of information is		
Contact farmer (1 = yes, 0 = no)	-0.144	4.602*
Radio (1 = yes, 0 = no)	0.866	-17.515
Extension worker (1 = yes, 0 = no)	0.532	0.911
Parastatal worker (1 = yes, 0 = no)	-0.356	-19.248
Friends and neighbors (1 = yes, 0 = no)	-0.841*	-2.045*
Demonstration plot (1 = yes, 0 = no)	-1.994	-15.387
Cooperative membership (1 = yes, 0 = no)	0.843	-0.800
T&V helpful to contact farmer (1 = yes, 0 = not helpful or undecided)	-1.139*	-0.088
T&V not helpful to contact farmer (1 = not helpful, 0 = helpful or undecided)	-0.161	-1.810
Want more advice about		
Fertilizer (1 = yes, 0 = no)	0.765*	-1.303*
Planting time (1 = yes, 0 = no)	-0.363	-0.542
Plant spacing (1 = yes, 0 = no)	0.755*	-1.479*
Chemicals (1 = yes, 0 = no)	1.495**	-3.878**
Weeding time (1 = yes, 0 = no)	0.499	-19.210
Prediction accuracy (percent)	77	97
Sample size (number)	239	239
Log-likelihood	-115.000	-29.691
Restricted log-likelihood (slopes = 0)	-137.850	-41.527
Chi-squared (13)	45.698	23.671
Level of significance	0.000	0.034

* Statistically significant at the 0.05 level only in the general equation.
** Statistically significant at the 0.05 level in the general and branch explicit equations.

Table 15.10—Regression results for the probability that a noncontact farmer will consider a source other than an extension worker, contact farmer, noncontact farmer, or village leader to be the best source of additional information on improved agricultural practices

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Coefficient	t-ratio
Main source of information is		
Contact farmer (1 = yes, 0 = no)	-17.073	-0.008
Radio (1 = yes, 0 = no)	-0.521	-0.824
Extension worker (1 = yes, 0 = no)	-1.677	-1.484
Parastatal worker (1 = yes, 0 = no)	0.472	0.552
Friends and neighbors (1 = yes, 0 = no)	0.588	1.437
Demonstration plot (1 = yes, 0 = no)	2.518	1.586
Cooperative membership (1 = yes, 0 = no)	-1.134	-1.669
T&V helpful to contact farmer (1 = helpful, 0 = not helpful or undecided)	0.934	1.504
T&V not helpful to contact farmer (1 = not helpful, 0 = helpful or undecided)	0.489	0.876
Want more advice about		
Fertilizer (1 = yes, 0 = no)	-1.220	-3.023*
Planting time (1 = yes, 0 = no)	0.229	0.531
Plant spacing (1 = yes, 0 = no)	-0.891	-2.209
Chemical advice (1 = yes, 0 = no)	-1.821	-4.208*
Weeding time (1 = yes, 0 = no)	-0.257	-0.502
Prediction accuracy (percent)	84	
Sample size (number)	239	
Log-likelihood	-87.833	
Restricted log-likelihood (slopes = 0)	-109.540	
Chi-squared (13)	43.416	
Level of significance	0.000	

* Statistically significant at the 0.05 level in general and branch explicit equations.

Simulations indicate that if the typical farmer in Kasendeka does not want more chemical advice, the probability that she thinks the best source of additional advice is a contact farmer rises from 0 to 3 percent and that she thinks an extension worker is best drops from 93 to 76 percent. The probability that she thinks other sources are best climbs to 13 percent if she does not want more chemical advice and to 34 percent if she does not want additional advice on chemicals and fertilizers (the probability is 7 percent if she only wants more advice on chemicals). The extension worker seems to be the preferred source of additional advice on chemicals and, perhaps, on fertilizers.

Almost all the contact farmers surveyed in May and June of 1986 think that their one-to-four-hour group meetings with extension workers are useful—the differences among branches are not significant. Yet, two-thirds of the contact workers in Mphata and almost half in Mtenthela describe the recommendations as irrelevant to their type of farming—this finding is alarming since T&V is supposed to be a fast and effective remedy to the perceived irrelevance of some traditional types of extension (Cernea, Coulter, and Russell 1983, 6-9). Statistically significant logit results show that older contact farmers are less likely to find the recommendations relevant to them than younger ones (see Table 15.11). Also, the longer an agricultural district has been under T&V, the greater is the likelihood that a contact farmer will think the recommendations are relevant. These factors are not, however, statistically significant when branch effects are considered. A larger survey of contact farmers would probably confirm that recommendations become increasingly relevant as a district gains experience with the training and visit system.

At least some contact farmers in each branch report being sought for advice by noncontact farmers. Logit analysis does not indicate that their characteristics, including the method by which they were selected to be contact farmers, statistically influence noncontact farmers to seek them for advice (see Table 15.12).

Logit analysis does, however, reveal that better educated contact farmers are more likely to brief noncontact farmers about agricultural practices discussed during their group meetings (see Table 15.13). An increase in education from four to nine years increases the simulated likelihood from 21 to 45 percent that a typical contact farmer in Kasendeka will brief a noncontact farmer.

Noncontact farmers were asked in May and June of 1986 to evaluate the change in extension system. Only in Chipili, Mphata, Chaweya, and Nkhoka are a majority even aware that a change had taken place. Mphata, Chaweya, and Nkhoka approve of the change, but

81 percent of the Chipili noncontact farmers think the new system is worse than the one it replaced. The differences in evaluation are statistically significant by branch.

Table 15.11—Regression results for the probability that a contact farmer will consider the recommendations of the last contact farmer meeting attended to be relevant to his or her type of farming

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Coefficient	t-ratio
Farm size (hectares)	-0.003	-0.025
Uses credit (1 = yes, 0 = no)	1.272	1.067
Contact farmer's age (years)	-0.090	-2.447
Contact farmer's education (years)	-0.090	-0.668
Contact farmer's sex (1 = female, 0 = male)	15.607	0.006
Contact farmer's membership length (years)	1.270	1.060
Number of years T&V has been in the district	2.440	3.234
Farm plot meeting (1 = yes, 0 = village or other)	-30.692	-0.008
Other site meeting (1 = yes, 0 = plot or village)	16.706	0.005
Log-likelihood	-16.383	
Restricted log-likelihood (slopes = 0)	-32.526	
Chi-squared (8)	32.287	
Level of significance	0.000	
Prediction accuracy (percent)	91	
Sample size (number)	65	

Note: No variables are statistically significant at the 0.05 level in branch explicit equations.

Table 15.12—Regression results for the probability that a contact farmer will be asked for advice by a noncontact farmer

Logit equation: $P = 1/(1+e^{-BX})$

Description of the Variable	Coefficient	t ratio
Farm size (hectares)	0.082	0.842
Contact farmer's age (years)	-0.007	-0.363
Contact farmer's education (years)	0.041	0.513
Contact farmer's sex (1 = female, 0 = male)	1.359	1.279
Branch culture (1 = patrilocal, 0 = matrilocal)	0.787	1.094
Number of years T&V has been in the district	0.496	0.586
Access of the branch to the district headquarters by road (kilometers)	-0.044	-0.464
Access of the branch to the provincial headquarters by road (kilometers)	-0.011	-1.204
Selection method		
Village head (1 = yes, 0 = no)	1.528	1.231
Village election (1 = yes, 0 = no)	0.143	0.206
Other (1 = yes, 0 = no)	-0.018	-0.011
Contact farmer's length of membership (years)	0.802	0.943
Prediction accuracy (percent)	68	
Sample size (number)	75	
Log-likelihood	-41.905	
Restricted log-likelihood (slopes = 0)	-50.043	
Chi-squared (11)	16.275	
Level of significance	0.131	

Note: Contact farmers not selected by the village head, village election, or another method were selected by an extension worker.

Table 15.13—Regression results for the probability that a contact farmer will brief noncontact farmers about recommendations discussed at the last contact farmer meeting attended

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Coefficient	t-ratio
Farm size (hectares)	0.068	0.479
Contact farmer's age (years)	-0.040	-1.228
Contact farmer's education (years)	0.221	2.122*
Contact farmer's sex (1 = female, 0 = male)	2.366	1.454
Branch culture (1 = patrilocal, 0 = matrilocal)	0.813	0.737
Number of years T&V has been in the district	1.597	1.238
Access of the branch to the district headquarters by road (kilometers)	-0.191	-1.357
Access of the branch to the provincial headquarters by road (kilometers)	-0.013	-1.071
Selection method		
Village head (1 = yes, 0 = no)	1.717	1.047
Village election (1 = yes, 0 = no)	0.791	0.839
Other (1 = yes, 0 = no)	-15.513	-0.005
Contact farmer's length of membership (years)	0.011	0.010
Contact group's meeting length (hours)	0.854	1.452
Farm plot meeting (1 = yes, 0 = village or other)	14.338	0.005
Other meeting site (1 = yes, 0 = plot or village)	0.099	0.041
Prediction accuracy (percent)	80	
Sample size (number)	65	
Log-likelihood	-26.819	
Restricted log-likelihood (slopes = 0)	-40.896	
Chi-squared (14)	28.153	
Level of significance	0.014	

Note: Contact farmers not selected by the village head, village election, or another method were selected by an extension worker.

* Statistically significant at the 0.05 level in the general and branch explicit equations.

Noncontact farmers who are aware of the change to T&V and have an opinion are more likely to approve of the change if they are more highly educated (see Table 15.14). Approximately half of the noncontact farmers in Kasendeka who have an opinion approve of the change, but if the typical noncontact farmer has nine instead of three years of education, the likelihood of approval rises to 85 percent.

Higher levels of education not only increase the satisfaction of noncontact farmers with T&V, but also more highly educated contact farmers will more likely discuss recommendations with noncontact farmers. Both a long-term goal of increasing education and a short-term goal of recruiting more educated contact farmers would be beneficial and advisable; there already seems to be a slight bias toward recruiting better educated farmers.

Among noncontact farmers, females are less likely than males to have contact with any source of extension information, and only 5 percent of contact farmers in Eastern Province are women (Phiri 1986, 49). Female-headed households would probably be better served by T&V if more women were recruited to be contact farmers.

Extension in Eastern Province is supervised from provincial and agricultural district headquarters for both T&V and parastatal cash-crop extension (Nkole 1986, 46). Logit analysis indicates that noncontact farmers who are farther by road from the district headquarters are less satisfied with the amount of advice received than those who are closer. Improving the access of supervisors to field staff would probably help meet the needs of farmers for information on improved agricultural practices.

Farmers who have already adopted the hybrid maize and fertilizer technology package are more likely to receive advice on improved agricultural practices than those who have not.[8] Farmers who have only adopted fertilizer are more likely to receive information through radio broadcasts than are those who have not adopted. Since early adopters have an advantage in acquiring knowledge about additional improvements, in the interest of equitable growth more emphasis should perhaps be placed on encouraging and helping farmers to adopt hybrid maize and fertilizer. Radio broadcasts should perhaps emphasize the adoption of hybrid maize.

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[8] Although causality may go in both directions, the time priority established by the survey questions and the fact that farmers who adopt technology are not less likely to receive additional advice suggest that adoption at least encourages farmers to have a continued interest in improvements.

Table 15.14—Regression results for the probability that a noncontact farmer with an opinion will consider a switch to training and visit to be an improvement

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Coefficient	t-ratio
Noncontact farmer's sex (1 = female, 0 = male)	-0.026	-0.032
Noncontact farmer's age (years)	-0.014	-0.492
Noncontact farmer's education (years)	0.286	2.027*
Household size (number of persons)	0.250	1.283
Number of sick days per household member from November through April	0.183	2.937
Branch culture (1 = patrilocal, 0 = matrilocal)	0.414	0.393
Number of years T&V has been in the district	-1.890	-2.276
Access of the branch to the district headquarters by road (kilometers)	-0.031	-0.608
Access of the branch to the provincial headquarters by road (kilometers)	0.013	1.426
Household ownership of a bicycle (1 = yes, 0 = no)	0.044	0.049
Household ownership of a radio (1 = yes, 0 = no)	-0.547	-0.617
Farm's cultivated area (hectares)	0.114	0.358
Farm's population density (persons per hectare)	-0.145	-1.693
Cultivation technology (1 = ox and hoe, 0 = hoe)	0.975	0.782
Uses both hybrids and fertilizer (1 = both, 0 = no)	-3.923	-2.863
Only uses fertilizer (1 = yes, 0 = no)	-2.742	-2.342
Uses institutional credit (1 = yes, 0 = no)	0.174	0.178
Only uses informal credit (1 = yes, 0 = no)	1.855	1.548
Percent of the farm's area affected by problems	-0.008	-0.850
Contact farmer group enhances output of contact farmers (1 = yes, 0 = no)	1.033	0.995

(continued)

Table 15.14—Continued

Prediction accuracy (percent)	84
Sample size (number)	101
Log-likelihood	-30.338
Restricted log-likelihood (slopes = 0)	-66.355
Chi-squared (19)	72.033
Level of significance	0.000

* Statistically significant at the 0.05 level in general and branch explicit equations.

Extension coverage in Eastern Province could probably be improved by recruiting more educated farmers into groups of contact farmers and by encouraging more females to participate. Improving roads, acquiring vehicles, and decentralizing the administration of T&V within agricultural districts might improve the supervision of extension efforts and should thus be considered. In the absence of such changes, the quantity and quality of extension in Eastern Province is likely to remain poor.

THE EFFECTS OF EXTENSION

Although noncontact farmers feel that T&V has provided relatively little extension, contact farmers have adopted at least some of the recommendations discussed at the group meetings. As was the case in examining whether recommendations are relevant to contact farmers, the longer an agricultural district has experienced T&V, the more likely contact farmers in the district are to adopt

recommendations (see Table 15.15).[9] Again, it is difficult to separate out branch-specific influences. Although less than half of the contact farmers surveyed in Mphata branch adopted some of the recommendations, 87 to 100 percent did so in the six other branches.

Table 15.15—Regression results for the probability that a contact farmer will adopt any recommendation discussed at a contact farmer meeting

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Coefficient	t-ratio
Farm size (hectares)	2.015	1.496
Contact farmer's age (years)	-0.306	-1.573
Contact farmer's education (years)	-0.060	-0.127
Contact farmer's sex (1 = female, 0 = male)	-1.082	-0.376
Contact farmer's length of membership (years)	-0.191	-0.041
Number of years T&V has been in the district	8.072	1.709
Prediction accuracy (percent)	95	
Sample size (number)	65	
Log-likelihood	-6.337	
Restricted log-likelihood (slopes = 0)	-24.246	
Chi-squared (5)	35.817	
Level of significance	0.000	

Note: No variables are statistically significant at the 0.05 level in either the general or the branch explicit equations.

[9] In addition to the length of time T&V has been operating, personal aspirations, abilities, and other characteristics affect the adoption of improved practices. However, the reasonable assumption that "a person's ability and inclination to innovate, accept new ideas, or desire an improvement in standard of living is likely to be related to his level of education" (Lever 1970, 18) is not demonstrated in the logit results, where education is statistically insignificant and negative. This supports the idea that marginal increases in education have little effect at low levels of education. (Stevens and Jabara 1988, 318). As in Botswana (Lever 1970, 79-81), farm size is not a significant factor.

It would be useful to know if adopting any of the recommended practices improves yields. To obtain meaningful regression results for the effect of practices on yields, a larger sample of contact farmers with valid data on yields and areas affected by problems that depress yield would be needed. Also, farmers might have to gain more experience with the new practices before yields would measurably increase.

This survey did include enough observations of noncontact farmers to observe the effects, if any, of extension on problems that depress yield. Ordinary-least-squares regression results indicate that the farmer's main source of extension has no statistically significant effect on the percentage of a farm's cultivated area that is adversely affected by problems such as insufficient or excessive rain, monkeys, birds, insects, other animals, excessive weeds, fungi and diseases, poor soil, and lack of fertilizer, either collectively or separately. The mean percentage of cultivated area suffering from depressed yields ranges from a low of 11 percent in Chiwizi to a high of 76 percent in Sinda.

Where obtaining accurate and complete data on yield is difficult, thought should be given to using the farmers' perceptions of the extent of problems that depress yield. Even when good data are available, listening to the opinions of farmers can guide researchers and extensionists seeking to determine the nature of yield-depressing problems.[10]

The opinion that noncontact farmers hold about whether membership in a group of contact farmers enhances the quantity or quality of crops produced provides a subjective measure of the potential impact of T&V and of their confidence in the T&V approach. Noncontact farmers who know contact farmers in Chaweya, Mtenthela, Makangila, and Sinda well enough to have an opinion say that membership enhances crop production, although the vote is sometimes close. In Mphata, Kasendeka, and Chipili noncontact farmers believe that membership does not improve the quantity or quality of a farmer's yield. No one questioned in Nkhoka, Chiwize, and Kamwala reports knowing any contact farmers.

As agricultural districts gain experience with T&V, contact farmers should become better advised so that production is enhanced quantitatively and qualitatively. Closer supervision, as measured by the

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[10] In Botswana, researchers have used farmers' identification of their main problems with arable farming to help determine the priorities for on-farm research (Baker 1988, 24-27, 57).

distance by road to district and provincial headquarters, should have a similar impact. Increased experience and easier communications should also make noncontact farmers more aware of any enhancement of production through membership in a group of contact farmers. Although the logit estimated coefficients have the expected signs, the t-values and the chi-squared statistic are not statistically significant (see Table 15.16).

As of 1985/86, the introduction of the training and visit system of extension has helped contact farmers to a limited extent, and in some areas of Eastern Province noncontact farmers are becoming aware of the benefits. In other countries, crop yields are reported to be higher for farmers who receive extension advice, regardless of the source, and higher still if T&V is the main source (Feder, Slade, and Sundaram 1985, iii). Crop production in some parts of Eastern Province is perceived to be enhanced by membership in contact farmer groups. In Eastern Province, however, neither T&V nor any other form of extension seems to have adequately addressed environmental and supply problems that depress crop yields. Dramatic progress is not expected within the first few years of T&V implementation, and 10 to 15 years may be needed to establish a T&V system fully (Cernea, Coulter, and Russell 1983, 11). Still, at least some progress should be evident in the first few years (Moore 1984, 314). In Eastern Province evidence of the progress includes some contact farmers adopting some of the recommendations of extension and some noncontact farmers perceiving that T&V helps contact farmers improve their production of crops.

POLICY SUGGESTIONS

Improving the effectiveness of agricultural extension should, by definition, contribute to improving the efficiency of public expenditure through administrative means. Not all approaches, however, are compatible with the other goal of the government's new economic recovery program: balancing the budget by freezing government employment at current levels.

Decentralizing the administrative functions of T&V from provincial to district headquarters might, in some cases, double the likelihood that households will be aware of T&V initiatives. Doing so would, however, obviously entail increasing the number of supervisory personnel. The trade-off between a gain in efficiency and an added labor cost would have to be estimated, which is not an easy task.

Table 15.16—Regression results for the probability that a noncontact farmer with an opinion will think membership in a contact farmer group enhances the quantity or quality of crop production

Logit equation: $P = 1/(1+e^{-BX})$.

Description of the Variable	Coefficient	t-ratio
Number of years T&V has been in the district	0.481	1.016
Access of the branch to the district headquarters by road (kilometers)	-0.044	-0.686
Access of the branch to the provincial headquarters by road (kilometers)	-0.004	-1.297
Prediction accuracy (percent)	54	
Sample size (number)	83	
Log-likelihood	-55.492	
Restricted log-likelihood (slopes = 0)	-56.509	
Chi-squared (2)	2.035	
Level of significance	0.361	

Note: No variables are statistically significant at the 0.05 level in either the general or the branch explicit equations.

To increase their importance as a source of information, the number of extensionists from the Ministry of Agriculture and Water Development would have to be increased to obtain adequate coverage of farmers. This variation of the T&V approach would probably increase the likelihood that farmers would receive specific advice.

Also, reliance on radio increases a farmer's likelihood of receiving specific advice. Using the radio to communicate extension advice would require fewer employees than T&V. At the very least, T&V should examine elements from the Zambian experience with extension by radio, in order to merge the benefits of face-to-face contact with the savings of radio broadcasts.

If the government decides, for budgetary reasons, to switch from

T&V to a more radio-dominated approach,[11] providing households with radios would probably speed the transition since households with radios are less likely to rely on contact farmers than those without them. All things being equal, if households continue acquiring radios on their own, less reliance on contact farmers may be inevitable.

To strengthen the reliance on contact farmers, the government could encourage the ownership of bicycles. Households with bicycles are more mobile than those without them, and in a sparsely populated region like Eastern Province mobility improves the communication with contact farmers.

Noncontact farmers who use fertilizer, even without adopting hybrid maize, are more likely than farmers who do not use it to receive information through radio broadcasts. Therefore, extension using radios will probably be strengthened without making additional net investments in radio as other extension services promote the use of fertilizer. Adoption of the entire package of hybrid maize and fertilizer is associated with continued interest in adopting improved agricultural practices, recommended at meetings of groups of contact farmers, which indicates that the recommendations of T&V extension are compatible with hybrid maize farming. Training and visit extension will probably become more effective as more farmers adopt hybrid maize, and radios will become a more important component of extension even sooner as farmers first adopt fertilizer technology.

One way to increase the effectiveness of extension in Eastern Province without increasing manpower and to create greater equality would be to promote the participation of females. The current system of extension has a bias that reduces the likelihood that female heads of household will receive extension information.

In the long term, investment in education could help extension efforts. Households headed by more educated individuals are more likely to receive specific advice than those headed by less educated ones. In some cases the likelihood that T&V contact farmers will brief noncontact farmers about the agricultural practices discussed at group meetings could double if the level of education of contact farmers was raised from four to nine years. In the short run, the policy could simply

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[11] In Malawi, across the border from Eastern Province, the cost of providing extension by radio is considerably less than the cost of extension by agent: 5.33 percent of the total annual cost, 5.00 percent of the cost per farm, and 0.03 percent of the cost per hour of contact (Perraton, Jamison, and Orivel 1983, 180-182).

be changed to recruit more highly educated farmers, which would not increase the cost to the government. Farmers with more education are more satisfied with the change to T&V than farmers with less. The agricultural practices being taught should perhaps be simplified to make the system more inclusive, but not less effective (Belloncle 1989, 38-39).

A reasonable course of action for the Zambian government to consider in light of the constraints of its new economic recovery program would include the following:

(1) Emphasize broadcasting extension by radio with face-to-face follow-up provided by the current number of extension workers,
(2) Promote the ownership of radios (for example, encourage donors to provide transistor radios and batteries to rural enterprises, which would sell them at cost),
(3) Promote the use of hybrid maize and fertilizer, and
(4) Promote the inclusion of females in extension efforts (for example, employ women as broadcasters and radio sales clerks).

If T&V is to remain the principal method of extension, the following less costly measures could be used to strengthen it:

(1) Abstract relevant elements from the experience of radio extension,
(2) Promote the ownership of bicycles (for example, encourage private voluntary organizations to help develop a small-scale bicycle factory in each district),
(3) Use secondary sources of extension to supplement the promotion of hybrid maize through training and visit,
(4) Promote the participation of females (for example, recruit more women to be contact farmers and field-level extension workers),
(5) Recruit more highly educated farmers for contact farmer groups,
(6) Recommend effective practices that can be understood by less educated farmers, and
(7) Encourage contact farmers to be active during maize cropping season (for example, reward contact farmers who meet with noncontact farmers during maize cropping season with bags of maize).

The goals of the national economic recovery program and the seriousness of the budgetary situation stimulating the adjustment effort place severe constraints on policies designed to improve agricultural extension in Eastern Province. Faced with a large budget deficit, the

government's choice of methods to promote agricultural improvements is severely constrained by finances. Since costly programs with minimal returns should be avoided, and many conceivable approaches to improving T&V would be costly, less costly remedial actions should be taken. Given its desire to balance the budget by freezing public employment and improving administrative efficiency, the government will have to persuade international donors to bear the most costly improvements or adopt a less expensive system of agricultural extension.

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Part IV
Conclusions

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16
Conclusions and Policy Recommendations

Rafael Celis, John T. Milimo, and Sudhir Wanmali

The analyses contained in the previous chapters highlight several implications for policy in the areas of agricultural production, income generation, food and nonfood consumption, nutrition and health, infrastructure, and equity. This chapter looks at some of those implications in light of the household characteristics on which the sampling was based. Households are distinguished as users or nonusers of hybrids, users or nonusers of oxen, contact or noncontact farmers, and headed by a male or a female. Also, conditions influencing the availability of improved agricultural technology and the infrastructure of rural services are relevant and as such are included in the household-level analyses.

ISSUES OF GROWTH

All these characteristics influence issues of growth in Zambian agriculture. The cultivation of hybrid maize, the use of oxen, being a contact farmer, and having a male-headed household are critical elements for analyzing issues of food and nonfood consumption and agricultural research and extension. They are significant in the rural economic life of Zambia's Eastern Province and influence issues of equity in Zambian agriculture. Finally, the issues of growth and equity have an impact on Zambia's policies of national economic development. Although drawn from one province of Zambia, the results of these microlevel studies illustrate what agricultural development could achieve if an appropriate environment were created in which it could take place.

The Cultivation of Hybrid Maize

The cultivation of hybrid maize is a major force driving the transformation of agriculture in Eastern Province. In association with the application of fertilizers, the cultivation of hybrid maize substantially improves the marketed surplus of households. Zambia should encourage farmers to diversify by planting crops such as cotton, sunflower, soybeans, groundnuts, and rice and thus reduce the risk inherent in single-crop agriculture. Since the cultivation of hybrid maize

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is dependent on oxen and fertilizer and these technological inputs are not universally accessible, the income disparities that exist among the regions of Eastern Province are likely to widen as their use spreads.

Several factors of production are significantly associated with the production of hybrid maize in Eastern Province. For example, the application of fertilizer increases as the amount of land cultivated with hybrid maize grows. Moreover, the cultivation of hybrid maize requires a large amount of labor, particularly female labor. Expanding the area cultivated is equally, if not more, attractive to smallholder farmers than increasing yield.

The Use of Oxen

Household incomes are greatly influenced by increases in the marketed surplus of hybrid maize. The use of oxen for cultivation, however, leads not only to higher sales of marketed surplus, but also to higher income. In this respect, the promotion of oxen for cultivation should be given a high priority in policies to promote the growth of agriculture since it contributes the most to increasing productivity. Moreover, the rental of oxen is responsible for increasing the size of area cultivated by the household.

Food and Nonfood Consumption

In the area of food and nonfood consumption, several observations about health, nutrition, and rural demand linkages have important implications for policy. More food consumption and less diverse diets are associated with hybrid maize. Households in the valley consume fewer calories, but have more diverse diets than households in the plateau. Although more diverse overall, the diets of households in the valley have little seasonal diversity. The cultivation of hybrid maize is associated with higher quality water for drinking and sanitation and with better nourished preschool children, but not with better nourished older children.

In the area of nonfood consumption, the demand linkages of rural households are weak, but could be strengthened through improved access (to goods and services). Farming households in the plateau, which grow predominantly hybrid maize, use oxen, and apply fertilizers, direct more of their current and incremental expenditures to both food and nonfood goods and services than do farmers in the valley. Farming households in the plateau that have larger holdings would be more responsive to changes in the access to goods and

services than farming households in the valley that have smaller ones. Households in the valley have, however, a greater need to develop infrastructure and improve the access to it than households in the plateau.

Agricultural Research and Extension

In the area of agricultural research and extension, growth in the ownership of radios would probably reduce the reliance of households on contact farmers in the training and visit system, but bicycle ownership would strengthen it. Households adopting the agricultural extension package of hybrid maize and fertilizer would probably increase their adoption of other agricultural practices. Further, increasing the level of education of smallholder farmers would increase their reception of specific agricultural extension advice, and increasing the level of education of contact farmers would increase the scope of extension to include more noncontact farmers. To be more effective, the training and visit contact briefings should be increased during the season for cropping hybrid maize, and the access of households to better education, credit, and rural infrastructure should be improved. Although extension services have made only a small contribution to the adoption and diffusion of new agricultural technology, they have made a clear contribution to specialized commodities such as tobacco, cotton, sunflower, and soybeans.

Eastern Province needs a system of agricultural research and extension that is geared to its two agroecological zones: the valley and the plateau. The valley, in particular, needs to explore agricultural technologies that save labor and augment yields. In this connection, controlling the infestations of tsetse flies would enlarge the area in which oxen can be used for cultivation, which would, in turn, increase the income of rural households.

ISSUES OF EQUITY

Government policies aim not only to stimulate economic growth and development, but also to promote equity. Household differences, such as the adoption of hybrid maize, use of oxen, membership in a contact farmer group, and gender of the head of household can lead to problems of equity. Although policies related to growth might exacerbate problems of equity, other policies help reduce them.

The Cultivation of Hybrid Maize

The obvious approach to reducing the inequalities between farmers who grow hybrid maize and those who do not is to encourage greater adoption. This would require more research on the adoption process, but expanding the access of farmers to credit, road transportation, input distribution, markets, and oxen technology would be an important part of any package. By growing hybrid maize, poor households could improve their income and level of consumption. The welfare of females and children in households that grow hybrid maize is at a disadvantage, and remedial policies are needed in this area.

The Use of Oxen

Using oxen for traction allows farmers to cultivate larger areas and thus reduces land-based inequalities. As with hybrid maize, the adoption of oxen traction should be encouraged. This, however, becomes somewhat difficult in Eastern Province because of the infestations of tsetse flies, and a major preventive intervention is necessary for the adoption of oxen traction to become more feasible and widespread. Where oxen traction is not practiced, further research on nontillage and irrigation technology would help reduce the current inequalities in agricultural productivity and income.

Agricultural Research and Extension

With the introduction of the training and visit system of agricultural extension, a few farmers improved their access to information about agricultural extension. Improving the link between contact farmers and noncontact farmers could help mitigate the lack of access that constrains the majority of farmers in the study region. Inequality could also be reduced by increasing the access of farmers to mass media sources of extension such as radio broadcasts.

Promoting more equality between male- and female-headed households could be achieved through enlightened extension policies. Additional research on the dynamics of rural households in Eastern Province could shed important light on the subject of gender-based inequality. Agricultural research needs to direct itself toward technologies that save labor and augment yield in the valley and toward diversified cropping patterns in the entire province. This would help reduce the inequalities in crop incomes and expenditure patterns that exist between regions and among households.

Rural Service Infrastructure

Rich households on the plateau are more responsive to changes in their access to rural service infrastructure than poor households in the valley. The differences in their responses reflect, in part, regional differences in the supply of services. These regional differences could be reduced by appropriate planning. Research on the supply of rural service infrastructure is lacking, however, and must be undertaken before the spatial and temporal provision of services can be planned and regional inequalities reduced.

THE ISSUE OF DISCRIMINATION AGAINST THE AGRICULTURAL SECTOR

Agricultural development in Eastern Province cannot be separated from major global economic events such as the oil crisis and the sharp decline in the price of copper and agricultural commodities. Furthermore, the impact of these exogenous shocks was exacerbated by Zambia's macroeconomic policies during the period of study. Despite the government's pledge to support agricultural development, its policies discriminate against the agricultural sector and favor urban-based nonagricultural industries.

Within the agricultural sector, policies discriminate among activities. Although smallholder agriculture produces two-thirds of Zambia's agricultural output, input subsidies and credit allocation mostly favor commercial farms. Historically, credit has tended to be distributed to a limited number of producers: even as the amount of money approved for credit disbursal has increased, the number of applicants awarded credit has decreased. Credit has also been increasingly allocated to seasonal activities, and the disbursal of medium- and long-term credit, which could be used to fund farm improvements, has been seriously neglected. A primary factor underlying this skewed distribution of credit, as well as the bias favoring short-term credit, is the traditional system of land tenure, which does not grant title to persons who work the land and consequently disqualifies them from participating in national credit programs. Moreover, the traditional inheritance practices of this system heavily discriminate against women.

Agricultural research plays a role in the discrimination within the agricultural sector by giving more attention to the problems of commercial farmers and the general problem of agriculture than to

smallholder farmers and the specific problems of regions, such as the valley. In particular, the government should design agricultural research programs aimed at developing minor crops that can be grown during the dry season. This would enhance the use of land and labor and generate income for farmers in the dry season.

Policies also discriminate against small businesses and favor medium- and large-scale enterprises in urban areas. The result is a lack of robust small business and service sectors in the rural areas of Eastern Province. Almost half of all businesses and service institutions are located in Chipata, the provincial capital. This favoritism has unquestionably deprived the rural sector of a badly needed mechanism for supporting technological change in agriculture and transmitting the dynamism generated by that change throughout the region.

Eastern Province is the most densely populated rural area of Zambia; within the province, however, large differences exist between the plateau, with its relatively dense population, and the valley, with its relatively sparse population. The valley has a very low labor to land ratio that is further reduced by the impact that diseases have on the availability of labor. Hence, Eastern Province needs labor-saving practices and technologies that increase labor productivity, which, in turn, increase the income of farmers and enlarge employment multipliers, particularly in the nonfarm economy.

AREAS OF POLICY INTERVENTION

Government policies have an important role to play in stimulating agricultural growth, transmitting that growth to other sectors of the economy through consumption and employment effects, and ensuring that the benefits arising from it are equitably distributed.

The findings of this study suggest several areas of public sector intervention that should be given high priority because they have the potential to create large multiplier effects in the farm and nonfarm economy of Eastern Province. Infrastructural development is one such area, particularly roads and irrigation, which play a crucial role in integrating the market, lengthening the cropping season, and diversifying the agricultural economy.

Another area of policy intervention is the use of oxen for cultivation. Government policies should seek to create credit schemes that improve the access of smallholders to oxen and implements for animal traction. Animal disease control programs should also be supported to expand the ecological environment in which the use of

oxen is feasible.

A major reason for the weak government expenditure on agriculture, employment, and farm and nonfarm linkages in Eastern Province is that businesses and service institutions that provide goods and services to rural areas have been developed only recently. The development of roads, which would help establish a system for distributing goods and services, would support these businesses and service institutions. The government should seriously consider encouraging the private sector to participate in these activities.

Finally, policy intervention is also needed in the area of educational development since education plays such a critical role in the adoption and diffusion of new agricultural technology.

CONCLUSION

Households in Eastern Province are using new agricultural technology in a manner that is, perhaps, above average for the country as a whole. Nevertheless the tremendous potential for its adoption remains untapped. The studies presented in this volume overwhelmingly demonstrate which factors significantly influence the adoption of new agricultural technology, increase agricultural productivity, and strengthen demand linkages in rural households. The results also underline the interplay, and simultaneous nature, of state policy, on the one hand, and agricultural research and extension, road transportation, irrigation, rural service infrastructure, and education, on the other. All of these are needed to establish a firm basis for developing the smallholder agricultural sector of Eastern Province, Zambia.

.397

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410